SITE SENSITIVITY VERIFICATION REPORT (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020)

PROPOSED DEVELOPMENT OF THE NGXWABANGU WIND ENERGY FACILITY AND ASSOCIATED GRID CONNECTION NEAR COFIMVABA, INTSIKA YETHU LOCAL MUNICIPALITY (CHRIS HANI DISTRICT MUNICIPALITY), EASTERN CAPE PROVINCE.

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January 2023

EXECUTIVE SUMMARY

Ngxwabangu Wind Power (Pty) Ltd is planning to develop, construct and operate a 260 MW Wind Energy Facility (WEF) and associated Grid Connection (up to 22km long) on a site approximately 15 km north of the small town of Cofimvaba in the Chris Hani District Municipality of the Eastern Cape Province.

Large portions of the Kgxwabangu WEF and Grid Connection project areas are underlain by potentially fossiliferous continental sediments of the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) of Early Triassic age as well as by unfossiliferous Karoo dolerite. However, the Burgersdorp Formation bedrocks here are generally highly-weathered near-surface, their fossil content has been compromised by thermal and chemical alteration due to nearby dolerite intrusion, while bedrock exposure levels are very low indeed. No fossil sites at all were recorded within the project areas during a recent two-day palaeontological site visit, neither within the Triassic bedrocks nor associated with the overlying mantle of Late Caenozoic superficial sediments (*e.g.* Pleistocene to Recent Masotcheni Formation slope deposits, lateritic and other soils). Good exposures of Burgersdorp beds observed locally along the banks of the Tsomo River would be spanned by the proposed transmission line. The provisional Very High Palaeosensitivity of much of the project areas is according *contested*. **The entire combined WEF and Grid Connection project area is rated here as being of Very Low Palaeosensitivity in practice.**

Anticipated impacts on local palaeontological heritage during the construction phase of the WEF and Grid Connection are accordingly Very Low to Negligible. This assessment applies to all the infrastructure components listed in the project descriptions. Provided that the Chance Fossil Finds Protocol tabulated in Appendix 2 is incorporated into the EMPrs and fully implemented during the construction phase of the WEF and Grid Connection developments, no further specialist palaeontological studies, monitoring or mitigation are recommended for these projects. The professional palaeontologist involved in any construction phase mitigation work would need to apply beforehand for a Fossil Collection Permit from the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za).

The proposed renewable energy and electrical infrastructure developments are not fatally flawed, and there are no objections on palaeontological heritage grounds to their authorisation.

1. INTRODUCTION & PROJECT DESCRIPTION

Ngxwabangu Wind Power (Pty) Ltd., a subsidiary of EDF Renewables South Africa (Pty) Ltd., plans to develop, construct and operate a 260 MW Wind Energy Facility (WEF) and associated Grid Connection (OHL) on a site approximately 15 km north of the small town of Cofimvaba in the Eastern Cape Province (Figures 1A & 1B). The project site is situated in the Intsika Yethu Local Municipality (LM) which forms part of the Chris Hani District Municipality (DM). The WEF will be connected *via* 132 kV powerline up to 22 km in length to the existing Eskom Qolweni Substation situated *c*. 25 km NE of Cofimvaba. The proposed Ngxwabangu WEF is situated within the Stormberg Renewable Energy Development Zone (REDZ4) which was promulgated in GN R. 840 for large scale wind and solar photovoltaic energy facilities.

- **Ngxwabangu WEF**

The proposed Ngxwabangu WEF will consist of up to 36 turbines, with a total facility output of up to 260MW. The WEF will also include up to four (4) 33kV medium voltage internal collector substations (SS), two (2) 33kV medium voltage underground powerlines of up to 6km and 9km in length (two alternatives), a 33 kV medium voltage Overhead Line (OHL) of approximately 12km to connect the northern section to the southern section of the site, an IPP SS (two alternatives) which will include a 33kV/132kV Switching Station area in order to connect the WEF to the existing Eskom Substation *via* a 132kV OHL. The WEF will also include a Battery Energy Storage System (BESS) (two alternatives), temporary and permanent laydown areas, a Concrete Tower Manufacturing Facility (CTMF), a Construction Compound (CC) and access roads. The construction footprint of the proposed WEF will be up to 208.574 ha (inclusive of roads), rehabilitated to an operational footprint of up to 117.534 ha (inclusive of roads). Please see Figures 1A and 1B for the proposed layout.

In summary, the proposed Ngxwabangu WEF will include:

- Up to 36 turbines with a maximum nominal power output of up to 260MW.
- The proposed WEF will include turbines with a hub height of up to 130m, a rotor diameter of up to 170m, blade length of up to 85m, and a maximum tip height of up to 215m and a lower tip height of 30m.
- Permanent laydown areas adjacent to each wind turbine (up to 4 000 m^2).
- Temporary laydown areas adjacent to each wind turbine (up to 3 150 m^2).
- Foundations (up to 900 m^2) for each wind turbine.
- An IPP Substation (SS) of up to 4ha (inclusive of a 33/132kV Eskom SS, offices and parking and a permanent SS laydown area). Two alternatives are proposed:
    - IPP Substation Alternative 1: situated in southern area. This is the preferred alternative.
    - IPP Substation Alternative 2: situated in the northern area.
- Four (4) Collector Substations (SS) of up 3ha each (33kV). Two (2) of the Collector SSs are situated within the western cluster of turbines (turbines 1-39 and two (2) of the Collector SSs are situated within the eastern cluster of turbines.
- Temporary Laydown Area, Temporary Buffer Yard, Temporary Batching Plant, Temporary CTMF and Temporary Site Camp (Construction Compound) of up to 9ha.
- BESS of up to 3ha (temporary laydown area, CTMF and CC area will be converted to the BESS facility post-construction phase). Two alternatives are proposed:
    - BESS Alternative 1: Situated adjacent to the southern IPP Substation (IPP SS Alternative 1). This is the preferred alternative.
    - BESS Alternative 2: Situated adjacent to the northern IPP Substation (IPP SS Alternative 2).
- Two (2) medium voltage underground powerlines (up to 33kV) between the Collector SS and the IPP Substation of up to 6km and 9km in length. Two alternatives are proposed:
    - 33kV Powerline Alternative 1: Connecting the Northern and Eastern Collector SSs to the southern IPP Substation (IPP SS Alternative 1). This is the preferred alternative.
    - 33kV Powerline Alternative 2: Connecting the Northern and Eastern Collector SSs to the northern IPP Substation (IPP SS Alternative 2).

- A 33kV medium voltage Overhead Line (OHL) of approximately 12km to connect the northern section to the southern section of the site.
- Medium voltage cabling (up to 33kV) between turbines and the collector substations, to be laid underground and along roads, where technically feasible.
- Internal access roads of up 103km constructed at up to 15m wide (construction phase), rehabilitated to 8m wide (operational phase). Existing roads will be used as far as possible. However, where required, internal access roads will be constructed between the turbines.

The proposed Ngxwabangu WEF will require Grid Infrastructure in order to connect to the existing Eskom Grid network. This is proposed via a 132kV overhead line (OHL) from the proposed onsite IPP Substation (SS) (33/132kV) to the existing Qolweni SS. The proposed OHL will be strung with a single circuit tern conductor, up to 22km in length.

Four (4) alternatives for the 132kV OHL are being considered.

- Alternative 1 is proposed from the southern IPP Substation (IPP SS Alternative 1 in the WEF BA). This OHL is 132kV and is up to 19km in length. This is the preferred alternative.
- Alternative 2 is proposed from the southern IPP Substation (IPP SS Alternative 1 in the WEF BA). This OHL is 132kV and is up to 19km in length.
- Alternative 3 is proposed from the northern IPP Substation (IPP SS Alternative 2 in the WEF BA). This OHL is 132kV and is up to 21km in length.
- Alternative 4 is proposed from the northern IPP Substation (IPP SS Alternative 2 in the WEF BA). This OHL is 132kV and is up to 22km in length.

Two (2) alternatives for the IPP Substation (SS) are being considered. The IPP SS will be up to 4ha in extent (inclusive of a 33/132kV SS, offices and parking and a permanent SS laydown area).

- IPP Substation Alternative 1: situated in southern area. This is the preferred alternative.
- IPP Substation Alternative 2: situated in the northern area;

CES has been appointed by Ngxwabangu Wind Power as the Environmental Assessment Practitioner (EAP) to conduct the necessary Basic Assessment (BA) Process for the project in terms of the National Environmental Management Act (NEMA, Act No. 107 of 1998 and subsequent amendments) EIA Regulations (2014 and subsequent 2017 amendments).

Table 1: Summary project description for proposed the Ngxwabangu WEF

NGXWABANGU WEF DESIGN SPECIFICATIONS	
Number of turbines	Up to 36 turbines
Power output per turbine	Unspecified
Facility output	Up to 260 MW
Turbine hub height	Up to 130 m
Turbine rotor diameter	Up to 170 m
Turbine blade length	Up to 85 m
Turbine upper tip height	Up to 215 m
Turbine lower tip height	30m
IPP Substations (SS)	33kV
Collector Substations (SS)	33kV
Eskom Substation (SS)	33/132kV
Cabling	33kV (underground where technically feasible, otherwise overhead)
Internal Access Roads	15m (construction phase), to be rehabilitated to 8m (operational phase)
BESS Technology	Solid State (Li-Ion) or REDOX-Flow (High level risk assessment for both) – 3ha

Table 2: Breakdown of the footprint of the proposed Ngxwabangu WEF

FACILITY COMPONENT	CONSTRUCTION FOOTPRINT (PRE-MITIGATION)	OPERATIONAL FOOTPRINT (POST-MITIGATION)
Permanent Turbine Laydown Area	TOTAL 4 000 m^2 x 36 turbines = 144 000 m^2 which equates to **14.400 ha**	TOTAL 4 000 m^2 x 36 turbines = 144 000 m^2 which equates to **14.400 ha**
Permanent Turbine Foundation Area	TOTAL Up to 900m^2 x 36 turbines = 32 400 m^2 which equates to **3.240 ha**	TOTAL Up to 900m^2 x 36 turbines = 32 400 m^2 which equates to **3.240 ha**
Permanent Turbine Transformer Area	TOTAL Up to 25m^2 x 36 turbines = 900 m^2 which equates to **0.090 ha**	TOTAL Up to 25m^2 x 36 turbines = 900 m^2 which equates to **0.090 ha**
Permanent BESS Area	TOTAL Up to 30 000m^2 which equates to **3.000 ha**	TOTAL Up to 30 000m^2 which equates to **3.000 ha**
Permanent IPP Substation (including a 33/132kV Switching Station)	TOTAL Up to 40 000m^2 = 40 000 m^2 which equates to **4.000 ha**	TOTAL Up to 40 000m^2 = 40 000 m^2 which equates to **4.000 ha**
Permanent Collector Substations (33kV)	TOTAL Up to 30 000m^2 x 4 = 120 000 m^2 which equates to **12.000 ha**	TOTAL Up to 30 000m^2 x 4 = 120 000 m^2 which equates to **12.000 ha**
Permanent WEF Gatehouse	TOTAL Up to 40m^2 which equates to **0.004 ha**	TOTAL Up to 40m^2 which equates to **0.004 ha**
Temporary Turbine Laydown Area	TOTAL 3 150 m^2 x 36 turbines = 113 400 m^2 which equates to **11.340 ha**	TOTAL 0 m^2 x 36 turbines = 0m^2 which equates to **0.000 ha**
Temporary WEF Site Camp **Temporary WEF Laydown Area**	TOTAL Up to 90 000m^2 which equates to **9.000 ha**	TOTAL Up to 0m^2 which equates to **0.000 ha**

FACILITY COMPONENT	CONSTRUCTION FOOTPRINT (PRE-MITIGATION)	OPERATIONAL FOOTPRINT (POST-MITIGATION)
Temporary WEF CTMF Area		
Temporary Buffer Yard		
Temporary WEF Batching Plant		
New Internal Access Roads (15 m construction, rehabilitated to 8 m during operation)	TOTAL Up to 57 000 m x 15m = 855 000 m^2 which equates to **85.500 ha**	TOTAL Up to 57 000 m x 8m = 456 000 m^2 which equates to **45.600 ha**
Upgraded Existing Internal Access Roads (15 m construction, rehabilitated to 8 m during operation)	TOTAL Up to 44 000 m x 15m = 660 000 m^2 which equates to **66.000 ha**	TOTAL Up to 44 000 m x 8m = 352 000 m^2 which equates to **35.200 ha**
TOTAL FOOTPRINT:	**Up to 57.074 ha** ***of clearing needed for the construction phase of the development of the proposed WEF (excluding roads)*** **Up to 208.574 ha** ***of clearing needed for the construction phase of the development of the proposed WEF (including roads)***	**Up to 36.734 ha** ***of clearing remaining during the post-construction operational phase (after rehabilitation) of the proposed WEF (excluding roads)*** **Up to 117.534 ha** ***of clearing remaining during the post-construction operational phase (after rehabilitation) of the proposed WEF (including roads)***

Table 3: Land parcels concerned with the proposed Ngxwabangu WEF project

NGXWABANGU WIND ENERGY FACILITY			
FARM NAME	**SG DIGIT NUMBER**	**FARM NUMBER/PORTION**	**AREA (HA)**
Farm 123	**2317/2011**	Portion 0 of 123	885.056
Mcambalala	**2048/2011**	Portion 0 of 101	3 047.617
Nququ Plantation	**6134/2001**	Portion 0 of 66	1 389.899
Farm 98	**1308/2011**	Portion 0 of 98	2 588.953
Lower Nququ	**4739/1948**	Portion 0 of 95	4 605.394
Ngxwabangu	**1211/2013**	Portion 0 of 170	3 109.851
Upper Ncuncuzo	**84/2014**	Portion 0 of 184	2 283.640
Ncuncuzo	**83/2014**	Portion 0 of 183	5 674.083
Mtshanyana	**1192/2013**	Portion 0 of 188	3 723.084
TOTAL			**27 307.577**

- **Ngxwabangu WEF Grid Connection**

The proposed Ngxwabangu WEF will require Grid Infrastructure in order to connect to the existing Eskom Grid network. This is proposed via a 132kV overhead line (OHL) from the proposed onsite IPP Substation (SS)

(33/132kV), which have also been applied for in the Ngxwabangu WEF application, to the existing Qolweni SS. The proposed OHL will be strung with a single circuit tern conductor, up to 22km in length.

Four (4) alternatives for the 132kV OHL are being considered (Figure 1B):

- Alternative 1 is proposed from the southern IPP Substation (IPP SS Alternative 1 in the WEF BA). This OHL is 132kV and is up to 19km in length. This is the preferred alternative.
- Alternative 2 is proposed from the southern IPP Substation (IPP SS Alternative 1 in the WEF BA). This OHL is 132kV and is up to 19km in length.
- Alternative 3 is proposed from the northern IPP Substation (IPP SS Alternative 2 in the WEF BA). This OHL is 132kV and is up to 21km in length.
- Alternative 4 is proposed from the northern IPP Substation (IPP SS Alternative 2 in the WEF BA). This OHL is 132kV and is up to 22km in length.

Two (2) alternatives for the IPP Substation (SS) are being considered. The IPP SS will be up to 4ha in extent (inclusive of a 33/132kV SS, offices and parking and a permanent SS laydown area).

- IPP Substation Alternative 1: situated in southern area. This is the preferred alternative.
- IPP Substation Alternative 2: situated in the northern area;

OVERHEAD LINE DESIGN SPECIFICATIONS	
OHL Capacity	Up to 132kV
Length of line	Up to 22km
Conductor type	Tern Conductor
Tower type	Monopole & Lattice structures
Communication infrastructure	48-core Optic Ground Wire (OPGW)
Service road width	Up to 3m wide (jeep track)

Table 4: Summary project description for proposed the Ngxwabangu WEF Grid Connection

FACILITY COMPONENT	OPERATIONAL FOOTPRINT (POST-MITIGATION)
Permanent IPP Substation Area, inclusive of a 33/132kV Switching Station	TOTAL Up to 40 000m² = 40 000 m² which equates to **4.000 ha**
132kV Overhead line	40m x 22 000m *(note that this is this is the servitude width and not the footprint)* The footprint area will be based on the siting of the pylons which will be up to 22 ha.
TOTAL FOOTPRINT:	260 000m² = 26ha

Table 5: Breakdown of the footprint of the proposed Ngxwabangu WEF Grid Connection

NGXWABANGU WIND ENERGY FACILITY Grid Connection			
FARM NAME	SG DIGIT NUMBER	FARM NUMBER/PORTION	AREA (HA)
Ngxwabangu	**1211/2013**	Portion 0 of 170	3 109.851

Ncuncuzo	**83/2014**	Portion 0 of 183	5 674.083
Mtshanyana	**1192/2013**	Portion 0 of 188	3 723.084
Ngcagca	**T473/2015**	Portion 0 of 181	1 449.698
TOTAL			**13 956.716**

Table 6: Land parcels concerned with the proposed Ngxwabangu WEF Grid Connection project near Cofimvaba

According to the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental Screening Tool (hereafter referred to as the "screening tool"), large portions of the WEF and associated Grid Connection corridor project area are of Very High palaeosensitivity (Figures 28 to 30). In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations of 2014, the present combined field-based and desktop site sensitivity verification report has therefore been undertaken in order to confirm or contest the environmental sensitivity of the proposed combined WEF and Grid Connection project area as identified by the Screening Tool.

CES - Environmental and social advisory services, Grahamstown (Contact details: Ms Caroline Evans. CES - Environmental and social advisory services. Grahamstown, Eastern Cape. Tel: +27 (46) 622 2364. Fax: +27 (46) 622 6564. E-mail: c.evans@cesnet.co.za) has been appointed by Ngxwabangu Wind Power as the Environmental Assessment Practitioner (EAP) to conduct the necessary BA Processes for the WEF and Grid Connection project in terms of the National Environmental Management Act (NEMA, Act No. 107 of 1998 and subsequent amendments) EIA Regulations (2014 and subsequent 2017 amendments).

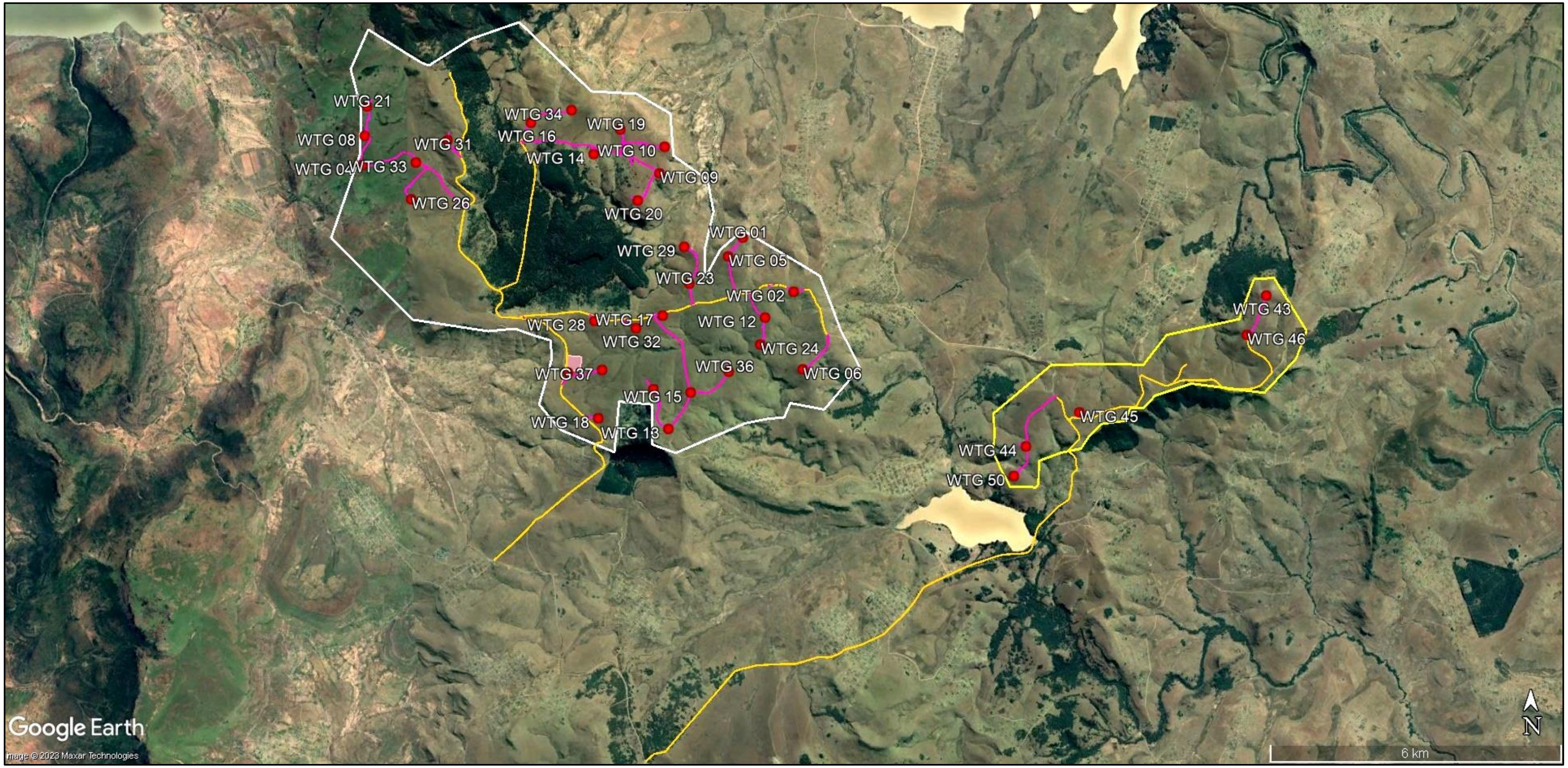

Figure 1A: Google Earth© satellite image showing the dissected upland terrain in the project areas for the proposed Ngxwabangu WEF situated *c*. 15 km to the north of Cofimvaba in the Eastern Cape Province (white and yellow polygons). Cerise and yellow lines = new and existing internal roads respectively. Red numbered circles = turbine positions. Pink rectangle = laydown area. Please see following figure for associated electrical infrastructure.

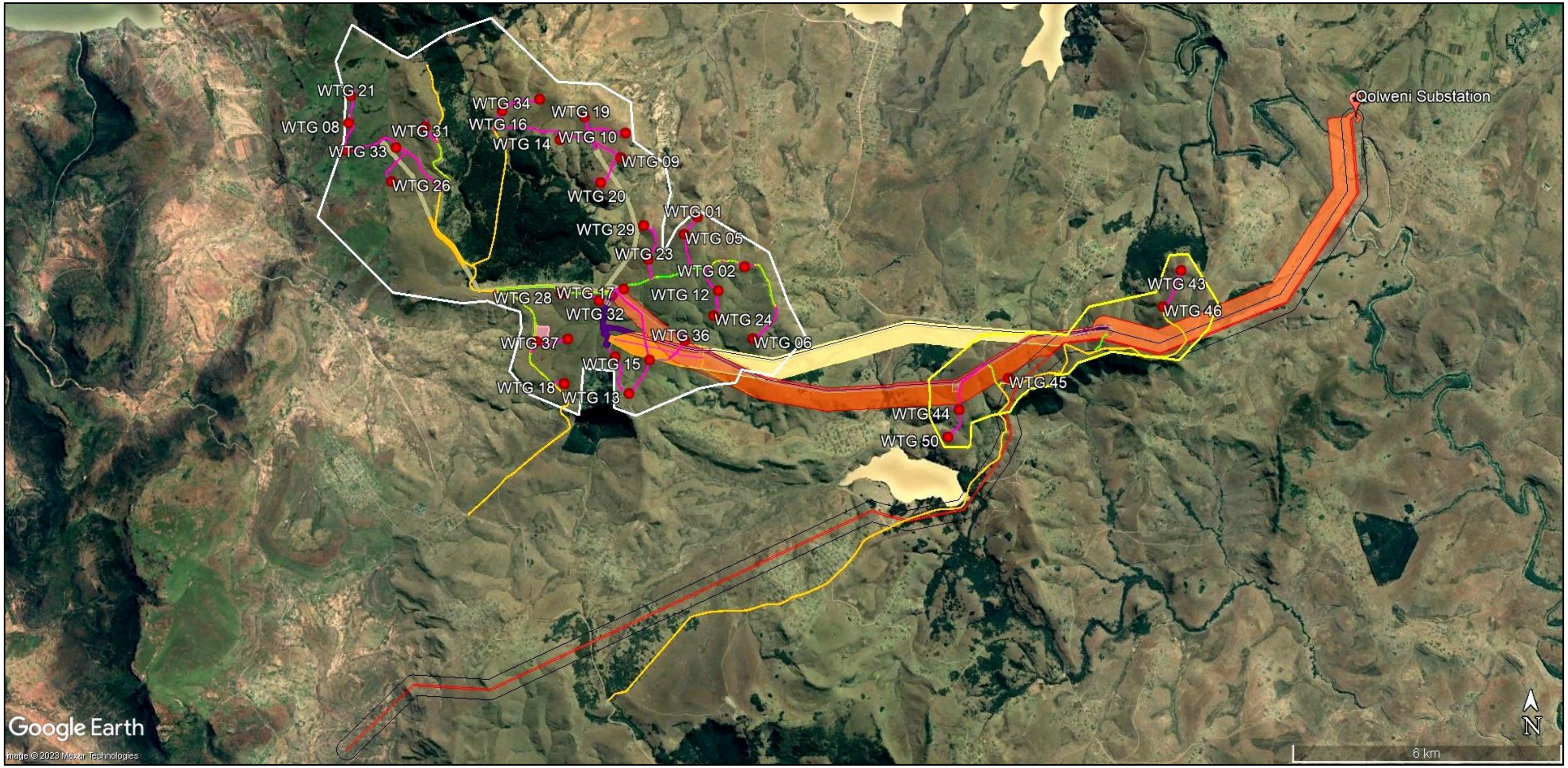

Figure 1B: Google Earth© satellite image of the Ngxwabangu WEF project areas showing route options for the 132 kV OHL grid connection to the existing Qolweni SS (orange and pale yellow corridors within which the four alternatives will run). Internal 33 kV overhead lines are shown in purple and grey.

2. DATA SOURCES

The palaeontological heritage site sensitivity verification report for the combined Ngxwabangu WEF and associated Grid Connection infrastructure project area is based on:

- A short project project description, kmz files, DFFE screening reports and other relevant background documentation provided by the CES.
- A desktop review of (a) 1:50 000 scale topographic maps (3127CD Qamata, 3127DC Ncorha Dam) and the 1:250 000 scale topographic map (3126 Queenstown), (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1:250 000 geological maps (sheet 3126 Queenstown) and relevant sheet explanation (Johnson 1984), as well as (d) several previous desktop and field-based fossil heritage (PIA) assessments in the wider Cofimvaba region by the author (*cf* Almond 2018, 2021, 2022b).
- A two day field survey of representative rock exposures within the WEF and associated infrastructure project study area by the author and an experienced field assistant on 9 and 10 May 2022. The season of the site visit had no bearing on the observations made and conclusions reached in this palaeontological heritage report.

3. GEOLOGICAL CONTEXT

The small town of Cofimvaba is located on the west bank of the Cofimvaba River, a small tributary of the Great Kei, in highly dissected, hilly terrain to the south of the Drakensberg Range. The uplands here lie between the Wit Kei and Great Kei Rivers. Several ranges of steeply-sloped mountains to the west, east and north of town are often capped with dolerite. The rolling upland plateau area to the north where the WEF will be situated reaches elevations of 1670 m amsl (Ndulutsolo in the NW) and is drained by numerous streams, several of which end up flowing into the Ncorha Dam and the Tsomo River towards the northeast and east. The hill slopes in this portion of the previous Transkei region are mantled in colluvium and soil as well as grassy vegetation, with local forest patches in valleys and upland plantations, while thick alluvial deposits are encountered on the valley floors. In general levels of bedrock exposure in the area are therefore very poor, aside from occasional road cuttings, quarries, stream and erosion gullies and borrow pits.

The geology of the Ngxwabangu WEF and Grid Connection project study area to the north of Cofimvaba is shown on the southern portion of map 3126 Queenstown (Council for Geoscience, Pretoria) (Figure 2). A short geological explanation for the Queenstown sheet has been published by Johnson (1984). The study area is underlain at depth by Early Triassic (*c*. 250 Ma = million years old) sediments of the Upper Beaufort Group (**Tarkastad Subgroup**, **Karoo Supergroup**). According to the geological map these are assigned to the mudrock-dominated **Burgersdorp Formation** (TRb) which builds the higher-lying, hilly to mountainous terrain towards the north of Cofimvaba. The recessive-weathering overbank mudrocks within the Burgersdorp succession are rarely well-exposed; most hill slope and stream or river bed exposures and road cuttings belong to the more resistant -weathering, litho-feldspathic channel sandstone packages. Mountain slopes built of Burgersdorp Formation bedrocks often show a distinctive stepped appearance due to the packages of prominent-weathering, tabular to lenticular channel sandstones. Hilly upland terrain underlain by the mudrock-dominated Burgersdorp Formation is characterised by gentle, largely uninterrupted slopes with a few prominent channel sandstones (Figure 3). Although good natural hill slope exposures are generally rare (and often highly weathered), both sandstone and mudrock facies of the Burgersdorp Formation are exposed in occasional road cuttings, borrow pits and river banks on the outskirts of Cofimvaba (*cf* Almond 2014a, 2022b) as well as further afield towards Tsomo and Ngcobo (*cf* Almond 2018, 2021, 2022b).

The Upper Beaufort Group sediments in the Cofimvaba region are extensively intruded by sills and dykes referred to the **Karoo Dolerite Suite** of Early Jurassic age (*c*. 182 Ma; Duncan & Marsh 2006). Normally, extensive areas of Beaufort Group outcrop to either side of the larger dolerite intrusions are mantled in rubbly doleritic colluvium (scree deposits), in situ weathered doleritic saprolite with corestones (*sabunga*) and reddish-brown lateritic soils that also show up well on satellite images.

Various types of **superficial deposits** of Late Caenozoic (Miocene / Pliocene to Recent) age occur widely throughout the Cofimvaba study region. They include pedocretes (*e.g*. calcretes, ferricretes), slope deposits (scree, hillwash *etc*), river alluvium, diverse soils and surface gravels as well as spring and pan sediments (*cf* Partridge *et al*. 2006). As a result of these deposits as well as pervasive grassy vegetation cover and local woodland plantations, surface exposure of fresh Karoo Supergroup rocks within the region is usually very poor, apart from occasional stream banks and beds, erosional gullies or *dongas* and steeper hill slopes as well as artificial exposures in road and railway cuttings, farm dams and borrow pits or quarries. The hill slopes are typically mantled with a thin to thick layer of semi-consolidated, partialy calcretised **colluvium** or slope deposits (*e.g.* sandstone and dolerite scree, finer-grained hill wash) and soil. Widespread prisms of semi-consolidated gravels and sands on lower hillslopes are generally assigned to the Pleistocene to Holocene **Masotcheni Formation** and typically show high levels of erosional gullying. Thick accumulations of silty, sandy, gravelly and bouldery **alluvium** of Late Caenozoic age (< 5 Ma), including pediment gravels, are found in streams and river valleys. These colluvial and alluvial deposits may be extensively calcretised (*i.e.* cemented with soil limestone or calcrete), especially in the neighbourhood of dolerite intrusions.

Typical scenery as well as epresentative exposures of the various rock units seen within or on the margins of the WEF and Grid Connection project areas are illustrated below in Figures 3 to 24, together with explanatory figure legends.

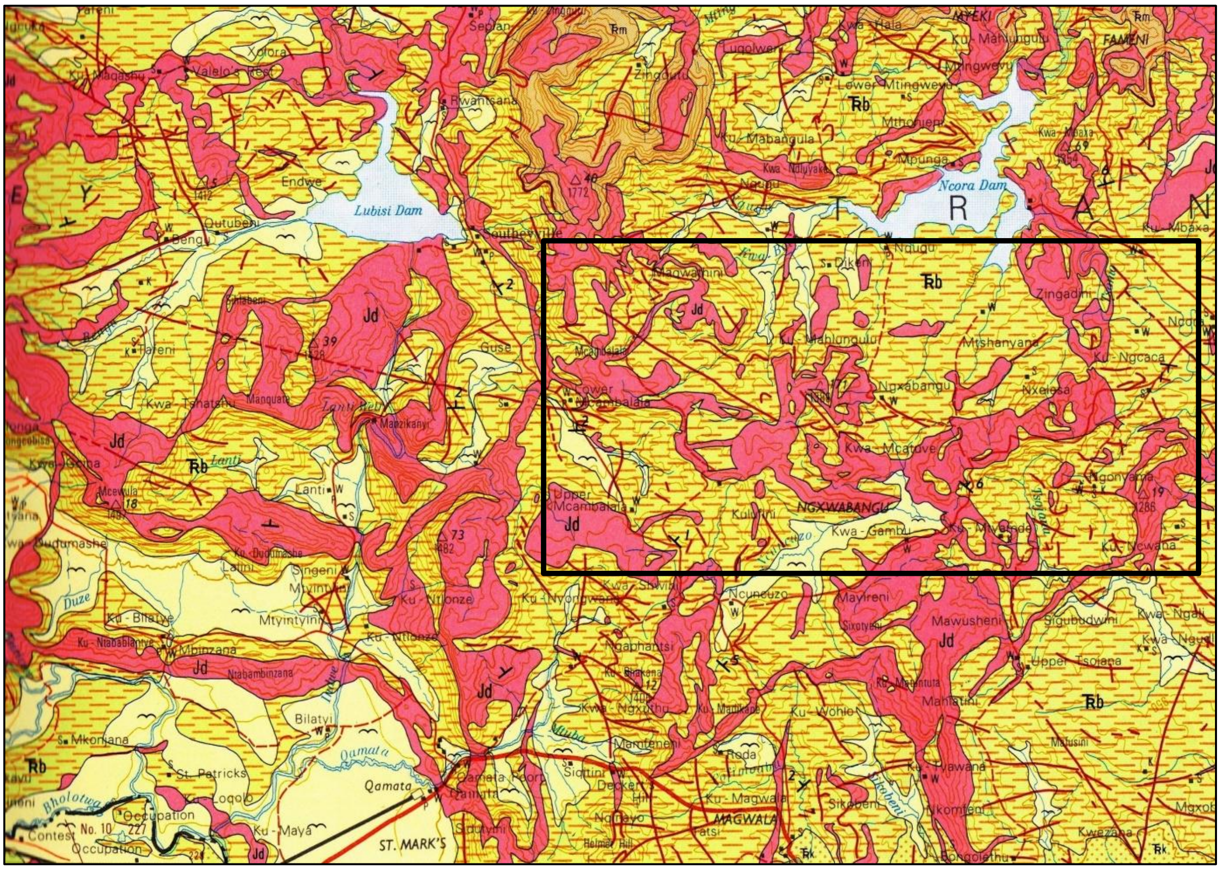

Figure 2: Extract from 1: 250 000 geological map 3126 Queenstown (Council for Geoscience, Pretoria) showing the geology of the Ngxwabangu WEF and Grid Connection project area (within black rectangle) to the north of Cofimvaba, Eastern Cape Province. The main geological units represented here include: Early Triassic Burgersdorp Formation (Upper Beaufort Group/ Tarkastad Subgroup) (TRb, dark yellow with red dashes); intrusive sills and dykes of the Early Jurassic Karoo Dolerite Suite (Jd, red); Late Caenozoic alluvium (Qa, pale yellow with flying bird symbol) (*N.B.* Pleistocene to Holocene colluvial deposits of the Masotcheni Formation mantling many lower hillslopes are not mapped at this scale).

Figure 3: View along the southwestern escarpment edge in the western sector of the WEF project area (Farm RE/101) showing gentle, stepped slopes reflecting occasional prominent-weathering Burgersdorp Formation channel sandstone bodies with a rugged, rocky dolerite outcrop in the middle ground.

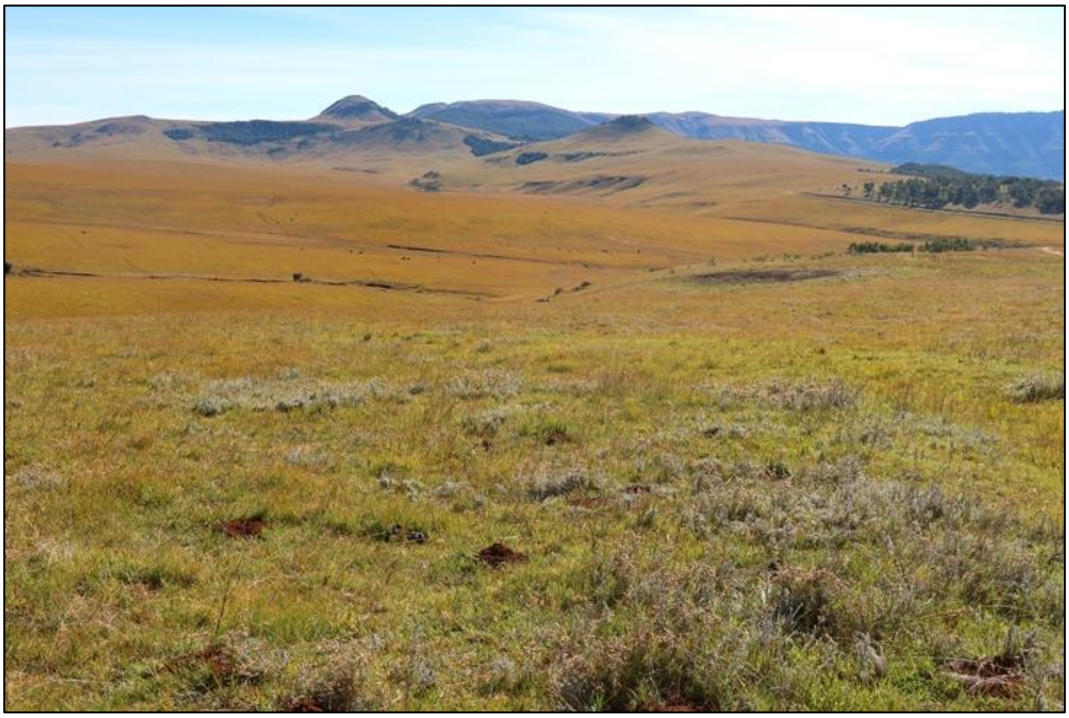

Figure 4: View across the grassy upland plateau on Farm 123 towards the mountains on the north-western edge of the WEF project area. Note the absence of exposures of potentially fossiliferous sedimentary bedrock here.

Figure 5: View south-westwards along a shallow stream valley on Farm 170 showing gently, grassy valley slopes and incision of thick, pale alluvial / colluvial deposits along the valley floor.

Figure 6: View northwards across rolling grassy terrain within the WEF and Grid Connection project area on Farm RE/93/

Figure 7: Hilly, locally forested terrain along the southern edge of the Grid Connection project area on Farm 518.

Figure 8: Cut face within a large roadside quarry on Farm RE/93 showing a tabular package of low angle cross-bedded, secondarily ferruginised channel wackes of the Burgersdorp Formation sharply overlying massive, weathered, grey-green overbank mudrocks.

Figure 9: Shallow incised, SE-flowing stream traversing the upland grassy plateau on Farm 170 with brownish-weathering Burgersdorp Formation channel wackes exposed in the stream bed. Thin mudflake channel breccias occur in this area.

Figure 10: Close-up of the superficially massive channel wackes seen in the previous illustration with dispersed, prominent-weathering, sphaeroidal siliceous concretions which are probably a consequence of nearby dolerite intrusion (hammer = 30 cm).

Figure 11: Brownish-weathering, tabular-bedded channel wackes of the Burgersdorp Formation exposed in a road cutting in Ngxabangu Village on Farm 170 (hammer = 30 cm).

Figure 12: Deeply-weathered, mottled Burgersdorp Formation channel wackes (above) and grey-green to khaki overbank mudrocks (below) exposed in a road cutting towards the SW edge of the WEF project area on Farm RE/101 (hammer = 30 cm).

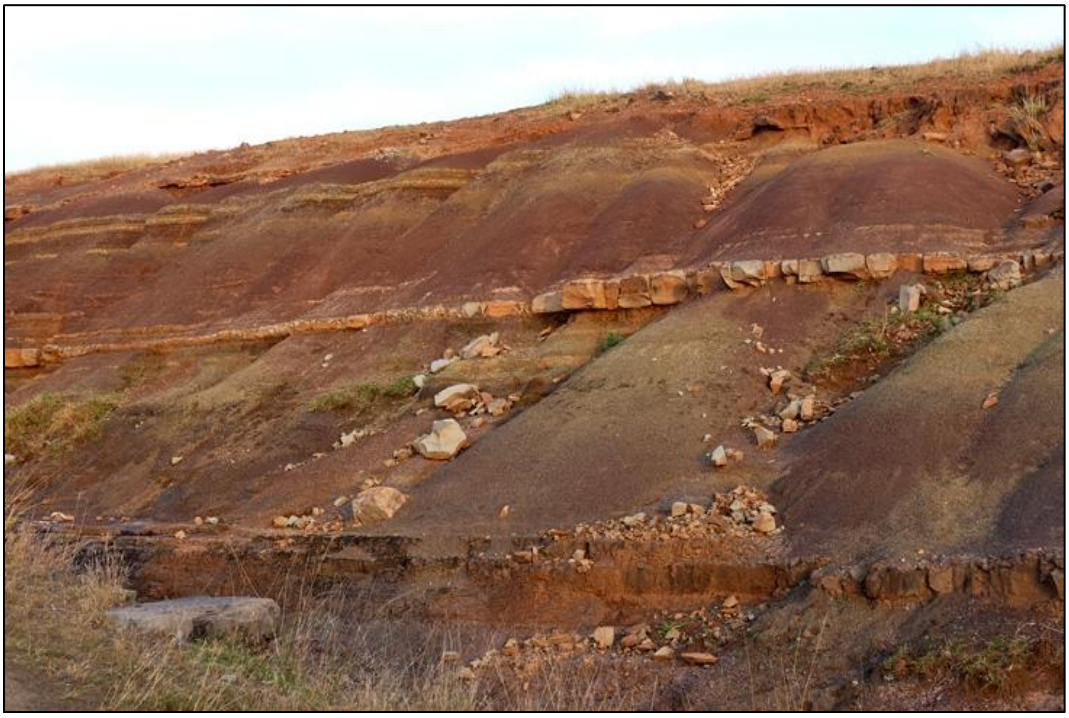

Figure 13: Excellent exposures of purple-brown overbank mudrocks and thin buff sandstones of the Burgersdorp Formation seen along the banks of the Tsomo River near KwaMzola Village, c. 1.8 km SSE of Qolweni Substation. Any such riverbank exposures would be spanned by the transmission line.

Figure 14: Roadside quarry close to the escarpment edge on Farm RE/101 in the SW sector of the WEF project area exposing weathered, dark grey-green, tabular bedded mudrocks of the Burgersdorp Formation.

Figure 15: Road cutting section though thinly interbedded, purple-grey mudrocks and paler sandstones – possibly a lacustrine or distal floodplain facies of the Burgersdorp Formation on Farm 101 (hammer = 30 cm).

Figure 16: Brown modern loamy soils overlying deep orange-hued lateritic subsoils and soft, slightly pinkish, saprolitic bedrocks of the Burgersdorp Formation on Farm 170.

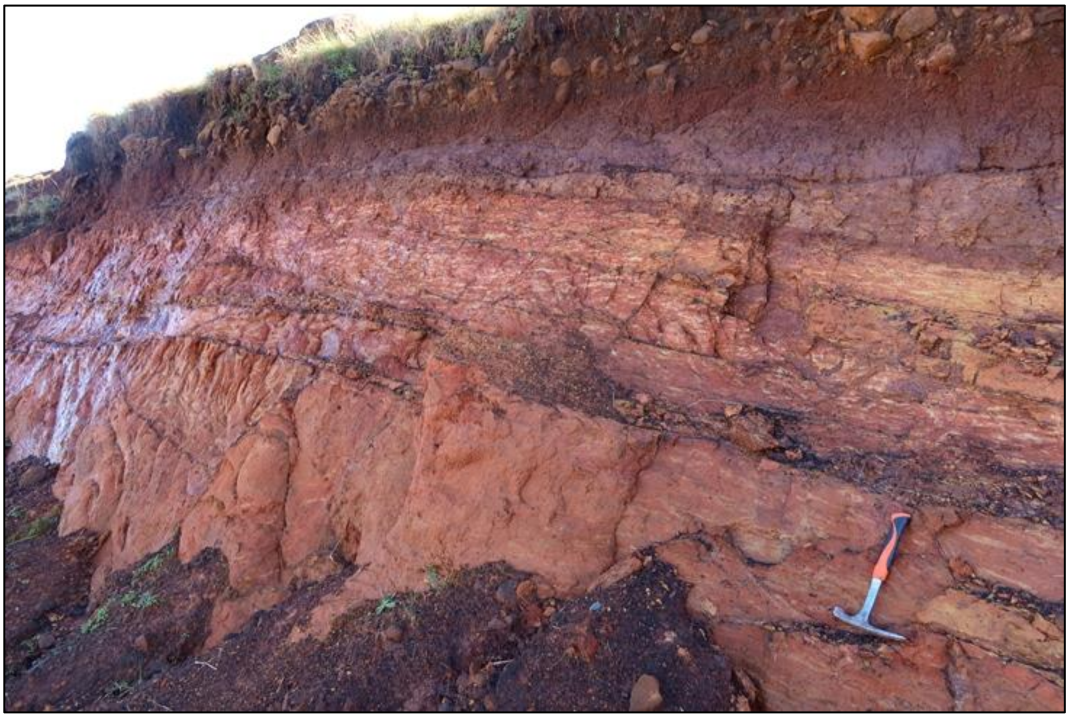

Figure 17: Deeply-weathered, secondarily reddened saprolite of the Burgersdorp Formation capped by reddish-brown lateritic soils and eluvial gravels exposed in a road cutting on Farm RE/101 (hammer = 30 cm).

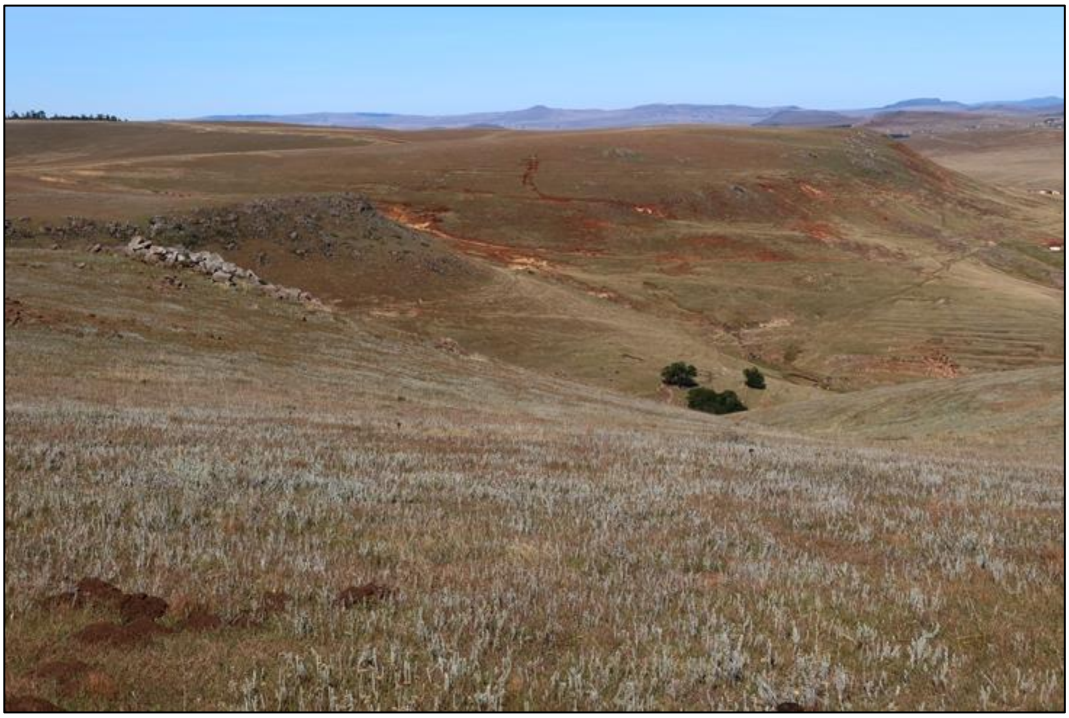

Figure 18: View southwards along the escarpment edge near KuPungutya Village, Farm RE/101, showing dolerite capping associated with occasional rocky exposures as well as extensive development of deep orange, lateritic soils.

Figure 19: Rocky exposure of well-jointed, pitted and lichen-patinated dolerite within the Grid Connection project area on Farm RE/188. Widened joints and surface pitting suggest possible karstic weathering processes here.

Figure 20: Thick mantle of saprolitic, lateritic dolerite (*sabunga*) with suspended rounded corestones, capped in turn by eluvial gravels and brown modern soils, road cutting on Farm 170 (hammer = 30 cm).

Figure 21: Escarpment edge quarry area on Farm RE/101 exposing weathered, dark grey Burgersdorp Formation mudrocks overlain by a *possible* colluvial channel infill with suspended, rounded dolerite corestones (hammer = 30 cm).

Figure 22: Steep, very thick *donga* (erosion gulley) section through downslope-dipping, well-bedded, semi-consolidated sands and gravels of the Masotcheni Formation with weathered bedrock exposed on the gulley floor , Farm 170.

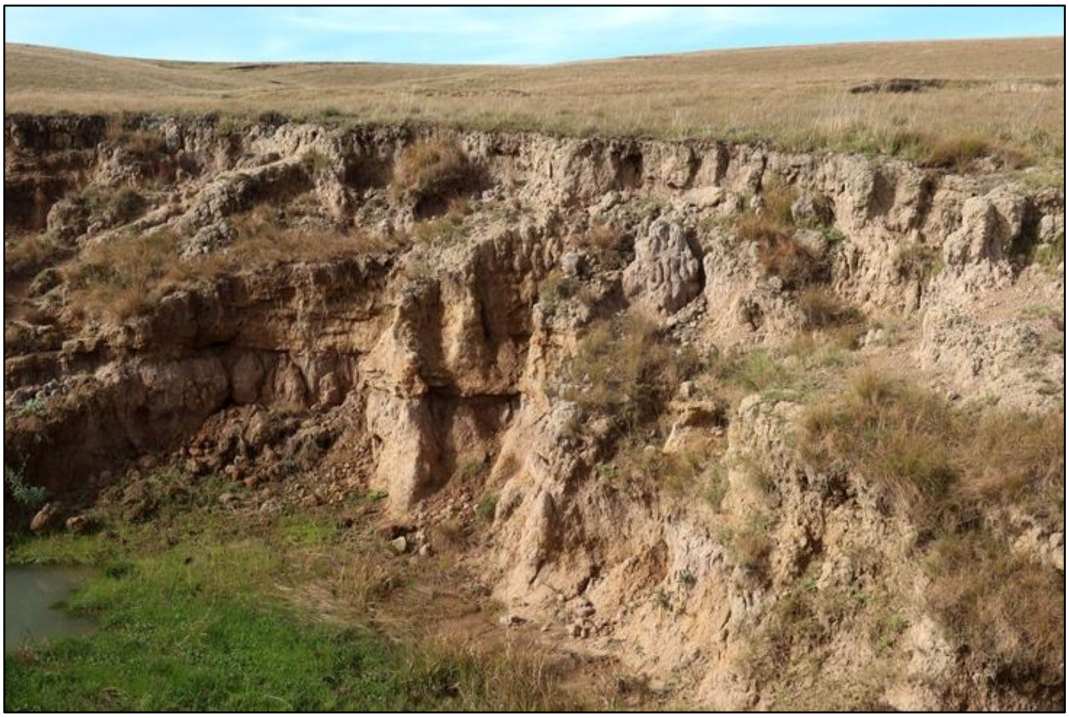

Figure 23: Superimposed packages of pale, semi-consolidated Masotcheni Formation slope deposits exposed by donga erosion into the upland plateau on Farm 170. Incipient ferricrete and calcrete pedocretes often occur within such deposits while gravelly horizons and lenses are best developed towards the base of the section.

Figure 24: Pale brown modern soils overlying orange lateritic soils and eluvial gravels exposed in an area of extensive *donga* erosion on Farm 170.

5. PALAEONTOLOGICAL HERITAGE

The overall palaeontological sensitivity of the Beaufort Group sediments in the Main Karoo Basin of South Africa is high (Rubidge 1995, Rubidge 2005, Almond *et al*. 2008). These continental sediments have yielded one of the richest fossil records of land-dwelling plants and animals of Permo-Triassic age anywhere in the world. A chronological series of mappable fossil biozones or assemblage zones (AZ), defined mainly on their characteristic tetrapod faunas, has been established for the Main Karoo Basin of South Africa (Rubidge 1995, 2005). Maps showing the distribution of the Beaufort assemblage zones within the Main Karoo Basin have been provided by Kitching (1977), Keyser and Smith (1977-78) and Rubidge (1995). The 1: 250 000 geological maps as well as a recently updated Karoo biozone map based on a comprehensive GIS fossil database (Van der Walt *et al.* 2010) suggests that two Early Triassic vertebrate-based biozones are represented within the wider Cofimvaba study region between Queenstown and Umtata, *viz.* the *Lystrosaurus* Assemblage Zone (now termed the *Lystrosaurus declivis* Assemblage Zone) within the Katberg Formation at lower elevations and the *Cynognathus* Assemblage Zone for the higher hill slopes of Burgersdorp Formation rocks (See previous palaeontological assessment studies by Almond (2011a, 2011b, 2014a, 2014b, 2014c) and Prevec (2011) for an outline of Katberg and Burgersdorp Formation fossil biotas in the broader Queenstown – Cofimvaba region of the Eastern Cape. Of these, only the *Cynognathus* AZ biotas may be present within the present Ngxwabangu WEF and Grid Connection project area.

As a consequence of their proximity to large dolerite intrusions, the Beaufort Group sediments in parts of the study area been thermally metamorphosed or "baked" (*i.e*. recrystallised, impregnated with secondary minerals). Embedded fossil material of phosphatic composition, such as bones and teeth, is frequently altered by baking – bones may become blackened, for example - and can be very difficult to extract from the hard matrix by mechanical preparation (Smith & Keyser *in* Rubidge 1995). Thermal metamorphism by dolerite intrusions therefore tends to reduce the palaeontological heritage potential of Beaufort Group sediments.

A recent compilation map of known fossil vertebrate sites from the Beaufort Group of the Main Karoo Basin (Nicolas 2007) emphasises the lack of records from the former Transkei region between Queenstown and Umtata that includes the present study area (Figure 25). Rather than simply a lack of fossils here, the main reasons are probably low levels of surface exposure (soil, colluvial, alluvial and vegetation cover), high levels of subsurface humid climate weathering, thermal and chemical alteration of sedimentary bedrocks as a consequence of dolerite intrusion as well as the paucity of palaeontological field studies in the region.

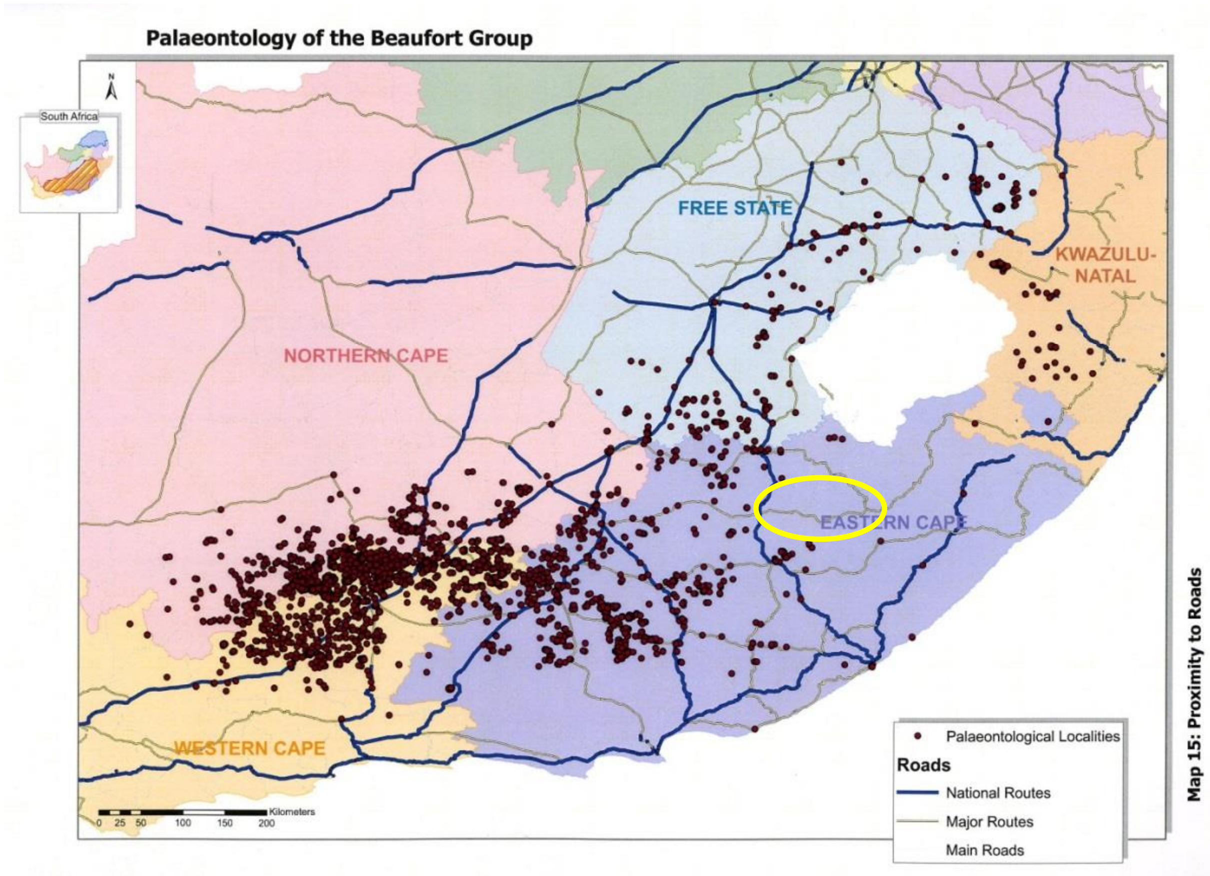

Figure 25: Distribution of recorded fossil vertebrate localities within the Beaufort Group (Main Karoo Basin) showing the lack of sites in the palaeontologically poorly-studied region of the former Transkei region between Queenstown and Umtata, including the Cofimvaba area (yellow ellipse) (Map abstracted from Nicolas 2007).

5.1. Fossils within the Burgersdorp Formation

The Burgersdorp Formation is characterized by a diverse continental fossil biota of Early to Middle Triassic (Olenekian to Anisian) age, some 249 to 237 milllion years old (Kitching 1995, Rubidge 2005, Neveling *et al.* 2005, Hancox *et al.* 2020). The Burgersdorp fauna is dominated by a wide variety of tetrapod taxa, notably a range of amphibians, reptiles and therapsids ("mammal-like reptiles") (Figures 26 & 27). This distinctive biota is referred to the *Cynognathus* Assemblage Zone (= *Kannemeyeria* – *Diademodon* Assemblage Zone of earlier authors; see Keyser & Smith 1977-78, Kitching 1995). Comparable Triassic faunas have been described from various parts of the ancient supercontinent Pangaea, including Russia, China, India, Argentina, Australia and Antarctica.

Useful accounts of the palaeontological heritage of this stratigraphic unit – which has recently being recognised as one of the richest Early-Mid Triassic biotas worldwide – are given by Kitching (1977, 1995), Keyser and Smith (1977-78), MacRae (1999), Hancox (2000; see also many references therein), Cole *et al.* (2004), Rubidge (2005) and Smith *et al.* (2012) with a recent review by Hancox *et al.* (2020). The Burgersdorp biotas include a rich freshwater vertebrate fauna, with a range of fish groups (*e.g.* sharks, lungfish, coelacanths, ray-finned bony fish such as palaeoniscoids) as well as large capitosaurid and trematosuchid amphibians. The latter are of considerable important for long-range biostratigraphic correlation. The interesting reptile fauna includes lizard-like sphenodontids, beaked rhynchosaurs, and various primitive archosaurs (distant relatives of the dinosaurs) such as the crocodile-like erythrosuchids, some of which reached body lengths of 5 m, as well as the more gracile *Euparkeria* (Figure 26). The therapsid fauna contains large herbivorous dicynodonts like *Kannemeyeria* (Figure 27), which may have lived in herds, *plus* several small to medium-sized carnivorous or herbivorous therocephalians (*e.g. Bauria*) and advanced cynodonts. The most famous cynodont here is probably the powerful-jawed genus *Cynognathus* (Figure 27), but remains of the omnivorous *Diademodon* are much commoner. Tetrapods are also represented by several fossil trackways while large *Cruziana*–like burrow systems with coarsely scratched ventral walls are attributed to burrowing tetrapods (*cf* Shone 1978, Bordy *et al.* 2019). Locally abundant vertebrate burrows have been attributed to small procolophonid reptiles (Groenewald *et al.* 2001). Important new studies on lacustrine biotas in the northern Burgersdorp outcrop area have yielded rich microvertebrate faunas as well as vertebrate coprolites; sites such as Driefontein in the Free State are now among the best-documented non-marine occurrences of Early Triassic age anywhere in the world (Bender & Hancox 2003, 2004, Hancox *et al.* 2010, Ortiz *et al.* 2010 and refs. therein).

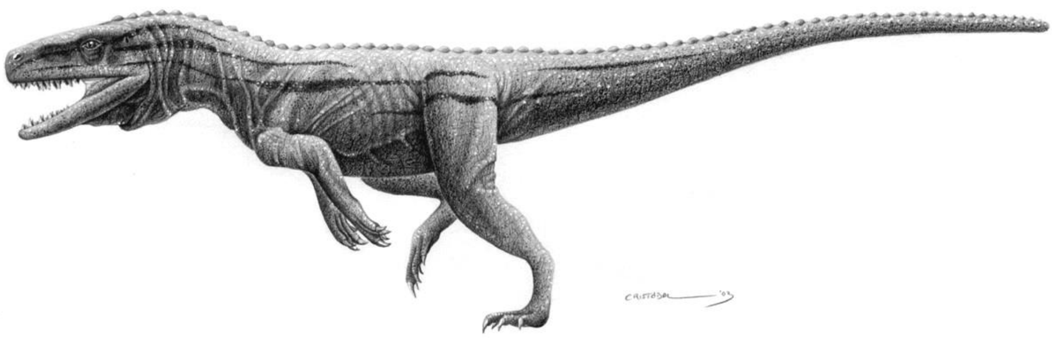

Figure 26. Reconstruction of the small (*c.* 0.5m long) bipedal reptile *Euparkeria*, a primitive member of the archosaur group from which dinosaurs evolved later in the Triassic Period.

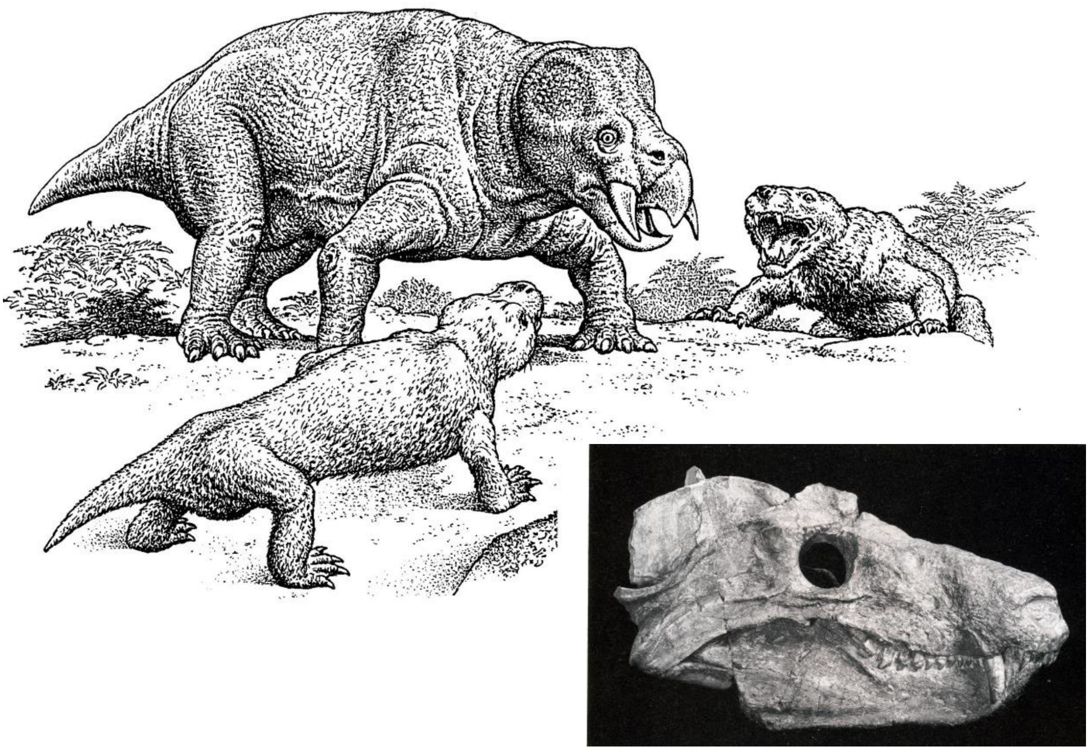

Figure 27: Reconstruction of typical therapsids of the Early Triassic *Cynognathus* Assemblage Zone - the large tusked herbivorous dicynodont *Kannemeyeria* and the predatory, bear-sized cynodont *Cynognathus*. The inset shows the heavily-built skull of *Cynognathus* (*c.* 30 cm long) in lateral view.

Contemporary invertebrate faunas are still very poorly known. Freshwater unionoid molluscs are rare, while the chitinous exoskeletons of the once-abundant terrestrial arthropods do not preserve well in the highly oxidising arid-climate sediments found here; arthropod trace fossils are known but so far no fossil insects. Likewise fossil plants of the characteristic Triassic *Dicroidium* Flora are poorly represented and low in diversity. They include lycophytes (club mosses), ferns (including horsetails such as *Schizoneura*), "seed ferns" (*e.g. Dicroidium*) and several gymnospermous groups (conifers, ginkgos, cycads *etc*) (Anderson & Anderson, 1985, Bamford 2004). A small range of silicified gymnospermous fossil woods are also present including *Agathoxylon, Podocarpoxylon* and *Mesembrioxylon* (Bamford 1999, 2004).

According to Kitching (1963, 1995) isolated, dispersed fossil bones, as well as some well-articulated skeletons, are associated with "thin localised lenses of silty sandstone" within the Burgersdorp Formation. Pedogenic, brown-weathering calcrete concretions occasionally contain complete fossil skeletons, while transported "rolled" bone is associated with intraformational conglomeratic facies at the base of channel sandstones. Fossil diversity decreases upwards through the succession. Complete tetrapod specimens are commoner lower down and amphibian remains higher up (Kitching 1995).

Burgersdorp Formation fossils from the Queenstown – Cofimvaba area have been briefly treated by Johnson (1984) as well as Almond (2011b, 2015, 2021, 2022b). No body fossil remains of any sort were recorded from the Burgersdorp Formation during the present field assessment. These rocks are generally very poorly exposed and are baked in the vicinity of major dolerite intrusions, compromising their palaeontological heritage. Where exposed, the mudrock as well as sandstone facies are usually highly weathered near-surface

5.2. Fossils within Late Caenozoic superficial deposits

The central Karoo superficial deposits of Late Caenozoic age have been comparatively neglected in palaeontological terms. However, they may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises. Good examples are the Pleistocene mammal faunas at Florisbad, Cornelia and Erfkroon in the Free State and elsewhere (Wells & Cooke 1942, Cooke 1974, Skead 1980, Klein 1984, Brink, J.S. 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al*. 1995, MacRae 1999, Meadows & Watkeys 1999, Churchill *et al*. 2000, Partridge & Scott 2000, Brink & Rossouw 2000, Rossouw 2006). Other late Caenozoic fossil biotas from these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, tortoise remains, trace fossils (*e.g.* calcretised termitaria, coprolites, invertebrate burrows), and plant material such as peats or palynomorphs (pollens) in organic-rich alluvial horizons (Scott 2000) and diatoms in pan sediments. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest (*e.g.* Smith 1999 and refs. therein). Ancient solution hollows within extensive calcrete hardpans may have acted as animal traps in the past. As with coastal and interior limestones, they might occasionally contain mammalian bones and teeth (perhaps associated with hyaena dens) or invertebrate remains such as snail shells.

No fossils at all were recorded from the various Late Caenozoic superficial deposits – including the well-developed Masotcheni Formation slope deposits - within the present project area during the site visit.

6. SITE SENSITIVITY VERIFICATION

Provisional site sensitivity mapping for palaeontological heritage prepared by CES using the DFFE National Web-Based Environmental Screening Tool suggests that large portions of the Ngxwabangu WEF and Grid Connection project areas are of Very High palaeosensitivity due to the presence here of potentially fossiliferous sediments of the Burgersdorp Formation (Upper Beaufort Group / Tarkastad Subgroup, Karoo Supergroup) of Early Triassic age, while substantial scattered areas of zero or negligible sensitivity here reflect widespread intrusions of unfossiliferous Karoo dolerite (Figures 28 to 30).

Based on several previous desktop and field-based PIA studies by the author in the broader Cofimvaba region (listed in References) as well as the recent 2-day palaeontological site, it is concluded that the entire WEF and grid connection project areas are in fact of **Low to Very Low palaeosensitivity overall**. This is because the Burgersdorp Formation bedrocks here are generally very poorly exposed and are baked in the vicinity of major dolerite intrusions, compromising their palaeontological heritage. Where exposed, both the mudrock as well as sandstone facies are usually highly weathered near-surface. All these factors undermine the potential for well-preserved fossils of scientific and / or conservation value occurring in the region. The provisional DFFE Screening Tool-based palaeosensitivity mapping is accordingly *contested* here.

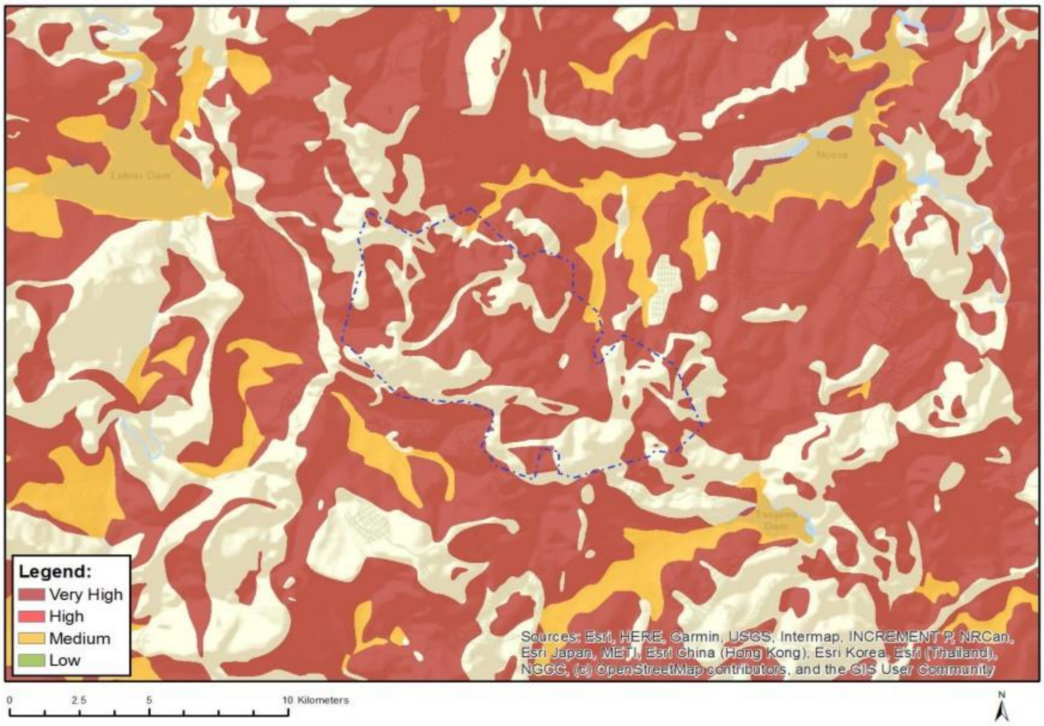

Figure 28: Provisional palaeosensitivity mapping of the western sector of the WEF project area using the DFFE Screening Tool (image provided by CES). The Very High palaeosensitivity of much of the project area (dark red) is *contested* here. Insensitive areas are underlain by Karoo dolerite.

Figure 29: Provisional palaeosensitivity mapping of the eastern sector of the WEF project area using the DFFE Screening Tool (image provided by CES). The Very High palaeosensitivity of small parts of the project area is *contested* here. The extensive insensitive areas are underlain by Karoo dolerite.

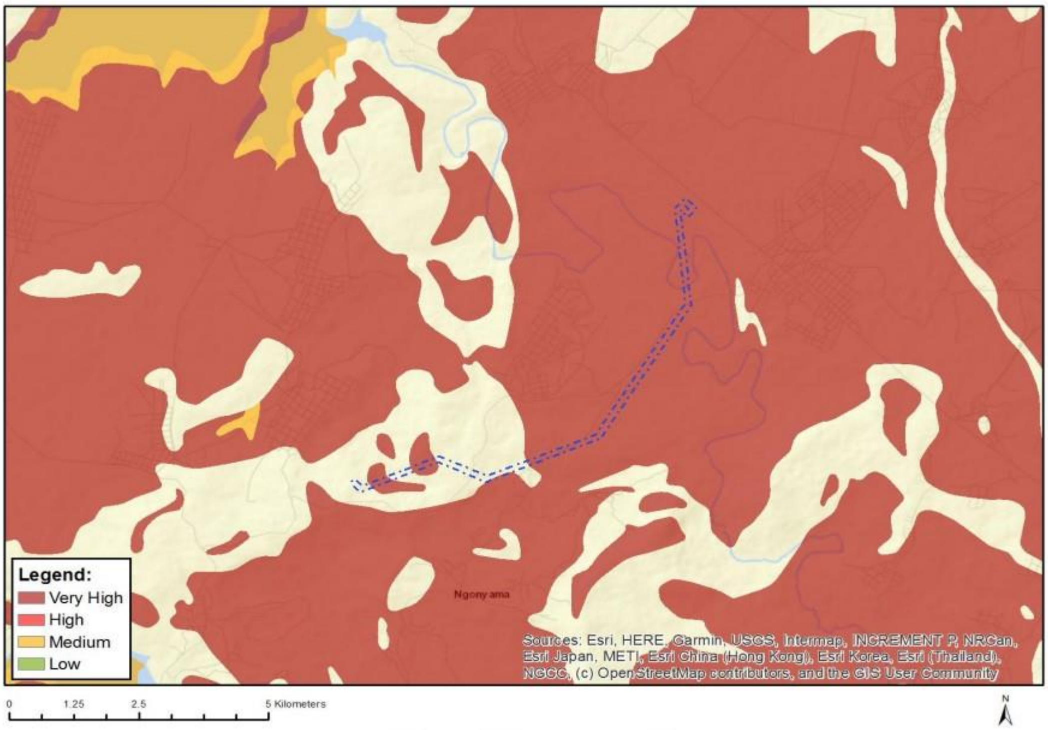

Figure 30: Provisional palaeosensitivity mapping of the Grid Connection project area using the DFFE Screening Tool (image provided by CES). The Very High palaeosensitivity of much of the project area (dark red) is *contested* here. Insensitive areas are underlain by Karoo dolerite.

7. CONCLUSIONS

Large portions of the Kgxwabangu WEF and Grid Connection project areas are underlain by potentially fossiliferous continental sediments of the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) of Early Triassic age as well as by unfossiliferous Karoo dolerite. However, the Burgersdorp Formation bedrocks here are generally highly-weathered near-surface, their fossil content has been compromised by thermal and chemical alteration due to nearby dolerite intrusion, while bedrock exposure levels are very low indeed. No fossil sites at all were recorded within the project areas during a recent two-day palaeontological site visit, neither within the Triassic bedrocks nor associated with the overlying mantle of Late Caenozoic superficial sediments (*e.g.* Pleistocene to Recent Masotcheni Formation slope deposits, lateritic and other soils). Good exposures of Burgersdorp beds observed locally along the banks of the Tsomo River would be spanned by the proposed transmission line. The provisional Very High Palaeosensitivity of much of the project areas is according *contested*. **The entire combined WEF and Grid Connection project area is rated here as being of Very Low Palaeosensitivity in practice.**

Anticipated impacts on local palaeontological heritage during the construction phase of the WEF and Grid Connection are accordingly Very Low to Negligible. **This assessment applies to all the infrastructure components and layout options listed in the project descriptions**. Provided that the Chance Fossil Finds Protocol tabulated in Appendix 2 is incorporated into the EMPrs and fully implemented during the construction phase of the WEF and Grid Connection developments, no further specialist palaeontological studies, monitoring or mitigation are recommended for these projects. The professional palaeontologist involved in any construction phase mitigation work would need to apply beforehand for a Fossil Collection Permit from the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za).

The proposed renewable energy and electrical infrastructure developments are not fatally flawed, and there are no objections on palaeontological heritage grounds to their authorisation.

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8. ACKNOWLEDGEMENTS

Ms Caroline Evans of CES - Environmental and social advisory services, Grahamstown, is thanked for commissioning this PIA study and for providing the necessary background information. Ms Madelon Tusenius of *Natura Viva* cc is thanked, as always, for logistical support, companionship and palaeontological assistance in the field.

APPENDIX 1: JOHN ALMOND SHORT CV

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and the University of Tübingen in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa and Madagascar. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out numerous palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mpumalanga, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

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

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

<table>
<tr><td colspan="3">APPENDIX 2: NGXWABANGU WIND ENERGY FACILITY AND ASSOCIATED GRID CONNECTION INFRASTRUCTURE NEAR COFIMVABA</td></tr>
<tr><td>Province & region:</td><td colspan="2">Eastern Cape: Chris Hani District Municipality (Intsika Yethu Local Municipality)</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za).</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Early Triassic Burgersdorp Formation (Upper Beaufort Group), Pleistocene-Holocene Masotcheni Formation, alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Tetrapod bones, teeth, burrows, invertebrate trace fossils, petrified wood and plant fossils within Upper Beaufort Group.
Mammalian bones, teeth, horncores, calcretised trace fossils, non-marine molluscs within Quaternary deposits.</td></tr>
<tr><td rowspan="5">Environmental Control Officer (ECO / ESO) protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>