MULILO NEWCASTLE WIND POWER 1

FOR EOH COASTAL ENVIRONMENTAL SERVICES

DATE: 4 MARCH 2022

REVISION 1 30 MARCH 2022

REVISION 2 11 MAY 2022

REVISION 3: 16 JANUARY 2023

By Gavin Anderson

Umlando: Archaeological Surveys and Heritage Management

PO Box 10153, Meerensee, 3901

Phone:035-7531785 Cell: 0836585362

umlando@gmail.com

TABLE OF CONTENT

TABLE OF FIGURES

Abbreviations

HP	Historical Period
IIA	Indeterminate Iron Age
LIA	Late Iron Age
EIA	Early Iron Age
ISA	Indeterminate Stone Age
ESA	Early Stone Age
MSA	Middle Stone Age
LSA	Late Stone Age
HIA	Heritage Impact Assessment
PIA	Palaeontological Impact Assessment

INTRODUCTION

Mulilo Renewable Project Developments (Pty) Ltd (Mulilo) is developing the Newcastle Wind Energy Facility (WEF) Complex near Newcastle in the Newcastle Local Municipality, in KwaZulu-Natal Province, comprising:

- Mulilo Newcastle Wind Power WEF (up to 200 MW and up to 45 turbines) (Scoping and Environmental Impact Assessment process);
- Mulilo Newcastle Wind Power 2 WEF (up to 200 MW and up to 35 turbines) (Scoping and Environmental Impact Assessment process);
- Mulilo Newcastle Wind Power grid connection infrastructure and associated powerlines (Basic Assessment process); and
- Mulilo Newcastle Wind Power 2 grid connection infrastructure and associated powerlines (Basic Assessment process).

A total of four (4) applications will be submitted to DFFE for Environmental Authorization (EA) for the Mulilo Newcastle WEF Complex. This draft Environmental Impact Assessment report is for:

- **Mulilo Newcastle Wind Power (Pty) Ltd (up to 200 MW and up to 45 turbines WEF).**

The Mulilo Newcastle Wind Power (MNWP) WEF will be located near Newcastle, KwaZulu-Natal. The applicant is Mulilo Newcastle Wind Power (Pty) Ltd, which intends to develop, construct and operate an up to 200 MW WEF as part of the Newcastle WEF Complex, approximately 15 kilometres northwest of the town of Newcastle in the Kwazulu-Natal Province. The study area is situated in the Newcastle Local Municipality, which forms part of the Amajuba District Municipality (ADM) and will have an anticipated lifespan of 20-25 years.

The MNWP WEF will consist of up to forty-five (45) wind turbine generators with a maximum generating output of up to two hundred (200) mega watts (MW). The proposed turbine footprints and associated facility infrastructure will cover an area of up to 85 ha after rehabilitation, depending on final layout design.

The MNWP WEF infrastructure will be located on six (6) land parcels with a total extent of 2,940 ha, although the actual infrastructure footprint will be substantially less than this.

Table 1: Specific Information Requirements from the Competent Authority (DFFE).

DESCRIPTION OF REQUIRED INFORMATION	DESCRIPTION OR RELEVANT SECTION IN THE REPORT

General site information					
Description of all affected farm portions	**Farm ID**	**Farm Name**	**Farm Number**	**Area (ha)**	
21-digit Surveyor General codes of all affected farm portions	N0HS00000000335000001	Geelhoutboom	1/3350	647	
	N0HS00000000335000000	Geelhoutboom	RE/3350	567	
	N0HS00000000944700000	Bernard	9447	465	
	N0HS00000001630200000	Spitskop	16302	280	
	N0HS00000000944800000	Byron	9448	392	
	N0HS00000000943900000	Cliffdale	9439	587	

The following Tables 4 to 6 summarise the key technical details for the Mulilo Newcastle Wind Power WEF project:

Table 2: Turbine specifications

Component	Specification
WEF Capacity	Up to 200 MW
Number of Turbines	Up to 45
Hub Height	Up to 140 m
Rotor Diameter	Up to 200 m
Blade length	Up to 100 m

Table 3: Facility component descriptions

Facility Component	Description
Crane platform and hardstand area	Crane platform and hardstand laydown for each turbine position.
Turbine Foundations	Reinforced Concrete Foundation. Depth: up to 3.5 m Diameter: up to 25 m per turbine Volume of concrete: up to 800 m^3 per turbine.

Facility Component	Description
IPP Substation	33 kV to 132 kV collector substation to receive, convert and step-up electricity from the WEF to the 132 kV grid suitable supply. The substations maximum height will be Lightning Mast up to 25 m high. The facility will house control rooms and grid control yards for both Eskom and the IPP. Additional infrastructure includes parking, up to 2.8 m high fencing, storm water channels and culverts, ablutions, water storage tanks, septic tank, and borehole.
Construction/office yard	This includes bunded fuel areas, oil storage areas, general stores (containers) and skips.
WTG component laydown area	Temporary laydown area.
On-site concrete batching plant	Temporary on-site concrete batching plant.
Primary Site Access Roads	Site access will, where possible, make use of existing farm roads that will be upgraded and maintained for the life of the WEF. The existing roads to be upgraded will be expanded to a width of up to 9 m. New roads will be constructed (in areas where there are no existing roads) with a width of up to 9 m to the IPP substation and laydown areas. V-drains will run on both sides of the road.
Internal roads	Roads connecting the turbine positions will where possible make use of existing farm roads that will be upgraded and maintained for the life of the plant. The existing roads to be upgraded will be expanded to a width of up to 6 m. New roads will be constructed (in areas where there are no existing roads) with a width of up to 6 m and will connect all turbines. V-drains will run on both sides of the road.
33 kV reticulation	A combination of 33 kV overhead lines and 33 kV underground cable (where technically feasible) will be used, aligned along the road network connecting each WTG position to the IPP substation.
Operations and maintenance (O&M) buildings	Includes other infrastructure such as parking, up to 2.8 m high fencing, storm water channels and culverts, ablutions, water storage tanks, septic tank and borehole.
Met masts	Two met masts (Up to 140 m height).

Table 4: Facility component footprints.

Facility Component	Construction footprint	Final footprint after rehabilitation
Crane platform and hardstand area	Up to 0.8 ha per turbine which equates to up to 36 ha.	Up to 0.8 ha per turbine which equates to up to 36 ha.
Turbine foundations	Up to 0.06 ha per turbine which equates to up to 2.7 ha (included in hardstand area).	Up to 0.06 ha per turbine which equates to up to 2.7 ha (Included in hardstand area).
IPP substation	Up to 1 ha	Up to 1 ha
Construction/office yard	Up to 2 ha	0 ha
WTG component laydown area	Up to 4 ha	0 ha
On-site concrete batching plant	Up to 1 ha	0 ha
Temporary stockpiles	Up to 2 ha	0 ha
Primary site access road and reticulation	Total width of up to 15 m consisting of: • Up to 12 m wide area prepared for road and v-drain • Up to 3 m width for underground 33 kV reticulation. Overhead lines to be used where underground cables are not technically feasible. Total length up to 8 km which equates to 12 ha.	Total width of up to 12 m consisting of: • Up to 9 m wide road • Up to 1.5 m wide v-drain on either side of road Total length up to 8 km, which equates to 9.6 ha. 33 kV underground / overhead line reticulation and stockpile areas to be rehabilitated. Final footprint up to 0.25 ha to account for cable markers and/or overhead line foundations and stays along primary site access roads.

Facility Component	Construction footprint	Final footprint after rehabilitation
Internal roads and reticulation	Total width of up to 12 m consisting of: • Up to 9 m wide area prepared for road and v-drain. • Up to 3 m wide area for underground 33 kV reticulation. Overhead lines to be used where underground cables are not technically feasible. Total length up to 28 km which equates to 33.6 ha.	Total width of up to 9 m consisting of: • Up to 6 m wide road. • Up to 1.5 m wide v-drain on either side of road. Total length up to 28 km, which equates to 25.2 ha. 33 kV underground / overhead line reticulation and stockpile areas to be rehabilitated. Final footprint up to 1 ha to account for cable markers and/or overhead line foundations and stays along internal roads.
Operations and maintenance (O&M) buildings	Up to 0.5 ha	Up to 0.5 ha
Met masts	Up to 0.002 ha per met mast which equates to 0.004 ha.	Up to 0.002 ha per met mast which equates to 0.004 ha.
Total	**Up to approximately 105 ha**	**Up to approximately 85 ha**

Umlando was requested to undertake a HIA of the proposed wind energy farm. A desktop study was undertaken in December 2021, and is repeated in this report. . Figures 1 – 4 show the location of the development.

FIG. 1 GENERAL LOCATION OF THE PROPOSED DEVELOPMENT

FIG. 2: AERIAL OVERVIEW OF PHASE 1

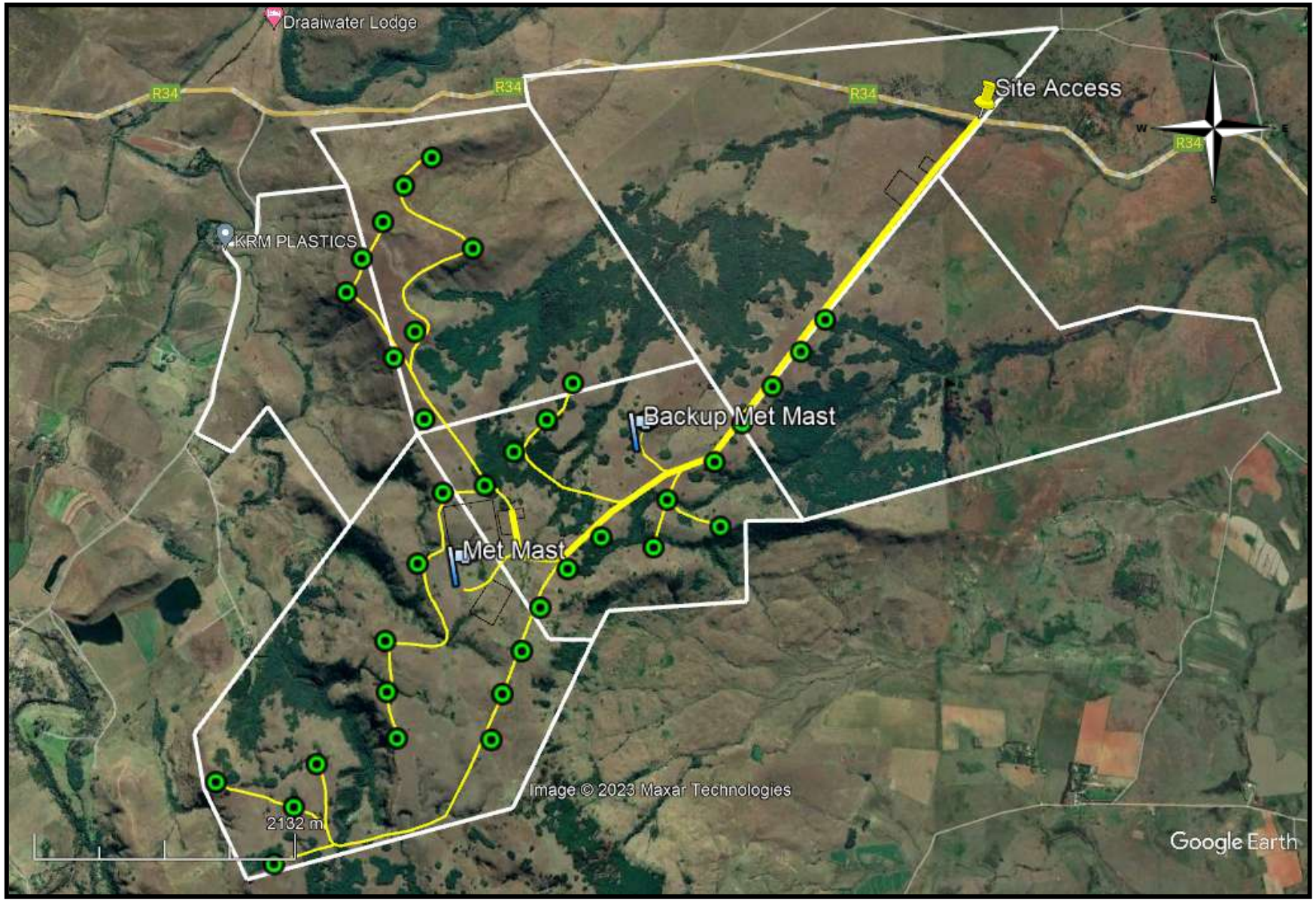


FIG. 3: AERIAL OVERVIEW OF PHASE 2

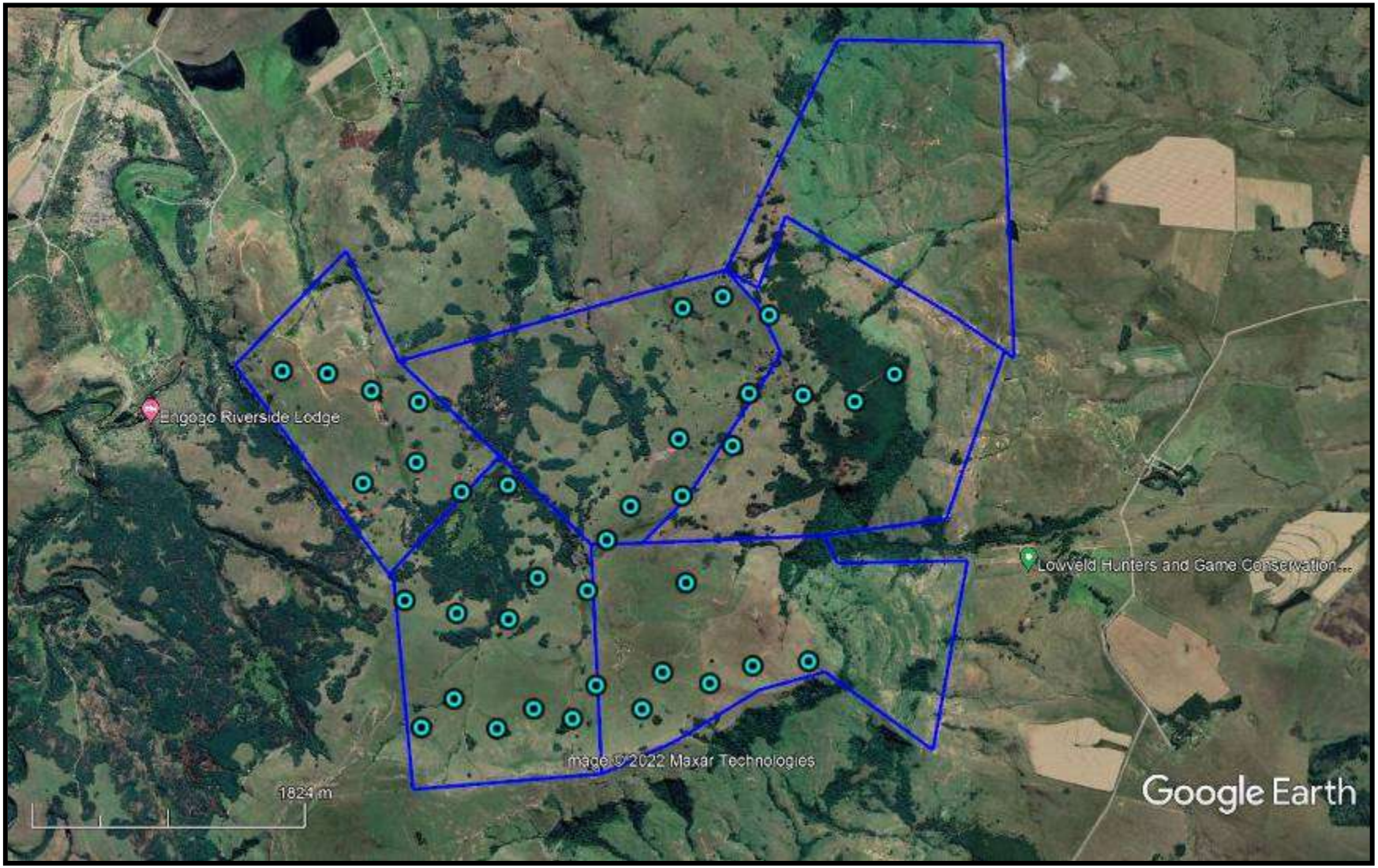
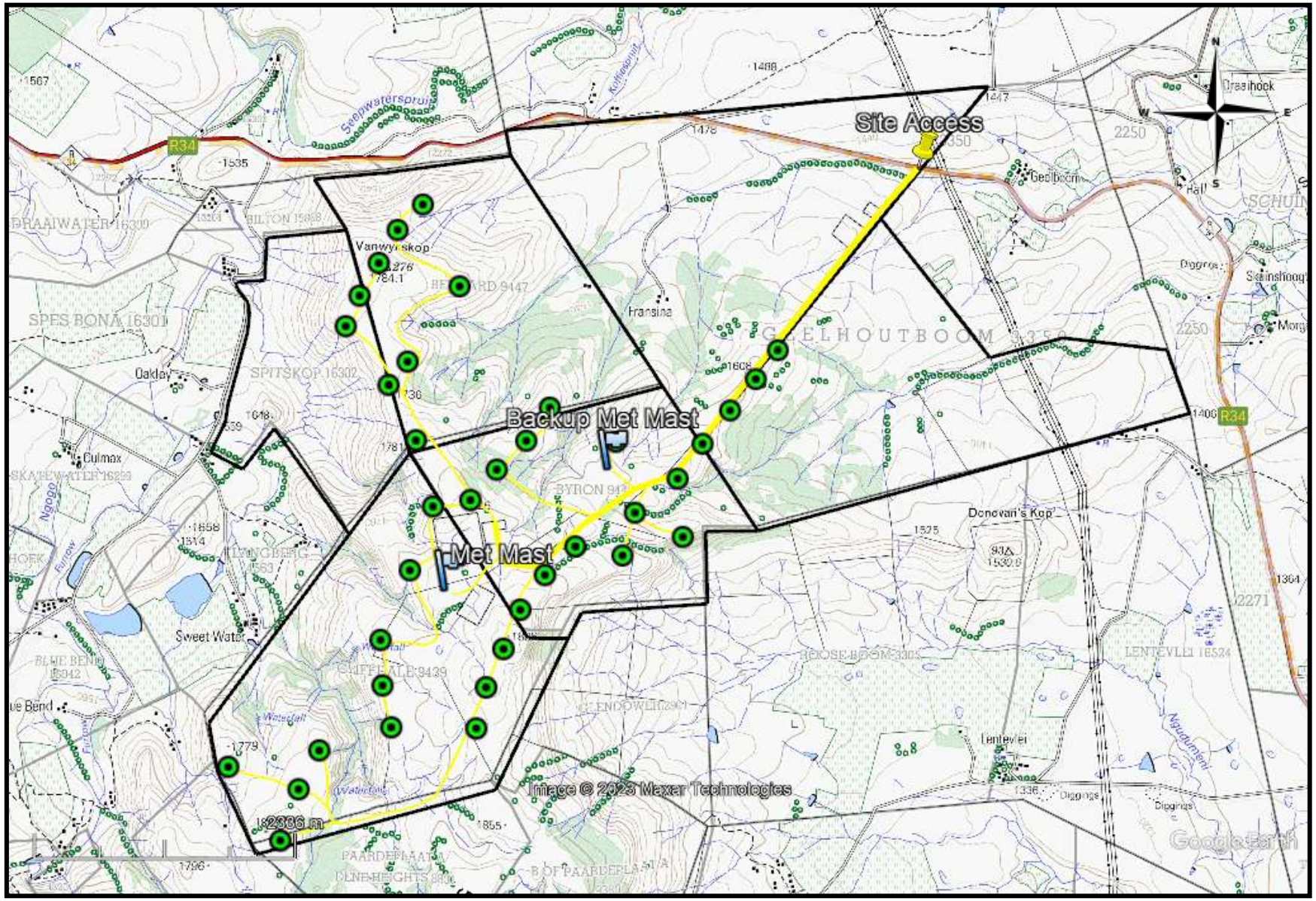


FIG. 4: TOPOGRAPHICAL MAP OF PHASE 1 & 2 (2002)



KWAZULU NATAL AMAFA AND RESEARCH INSTITUTE, ACT 05, 2018

"General protection: Structures.—

- No structure which is, or which may reasonably be expected to be older than 60 years, may be demolished, altered or added to without the prior written approval of the Council having been obtained on written application to the Council.
- Where the Council does not grant approval, the Council must consider special protection in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- The Council may, by notice in the *Gazette*, exempt—
- A defined geographical area; or
- defined categories of sites within a defined geographical area, from the provisions of subsection where the Council is satisfied that heritage resources falling in the defined geographical area or category have been identified and are adequately protected in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- A notice referred to in subsection (2) may, by notice in the *Gazette*, be amended or withdrawn by the Council.

General protection: Graves of victims of conflict.—No person may damage, alter, exhume, or remove from its original position—

- the grave of a victim of conflict;
- a cemetery made up of such graves; or
- any part of a cemetery containing such graves, without the prior written approval of the Council having been obtained on written application to the Council.
- General protection: Traditional burial places.—
- No grave—
- not otherwise protected by this Act; and
- not located in a formal cemetery managed or administered by a local authority, may be damaged, altered, exhumed, removed from its original position, or otherwise disturbed without the prior written approval of the Council having been obtained on written application to the Council.

The Council may only issue written approval once the Council is satisfied that—

- the applicant has made a concerted effort to consult with communities and individuals who by tradition may have an interest in the grave; and
- the applicant and the relevant communities or individuals have reached agreement regarding the grave.

General protection: Battlefield sites, archaeological sites, rock art sites, palaeontological sites, historic fortifications, meteorite or meteorite impact sites.—

- No person may destroy, damage, excavate, alter, write or draw upon, or otherwise disturb any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- Upon discovery of archaeological or palaeontological material or a meteorite by any person, all activity or operations in the general vicinity of such material or meteorite must cease forthwith and a person who made the discovery must submit a written report to the Council without delay.
- The Council may, after consultation with an owner or controlling authority, by way of written notice served on the owner or controlling authority, prohibit any activity considered by the Council to be inappropriate within 50 metres of a rock art site.
- No person may exhume, remove from its original position or otherwise disturb, damage, destroy, own or collect any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- No person may bring any equipment which assists in the detection of metals and archaeological and palaeontological objects and material, or excavation equipment onto any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, or meteorite impact site, or use similar detection or excavation equipment for the recovery of meteorites, without the prior written approval of the Council having been obtained on written application to the Council.

- The ownership of any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site, on discovery, vest in the Provincial Government and the Council is regarded as the custodian on behalf of the Provincial Government."

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. This databases contains archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (http://www.vuvuzela.com/googleearth/monuments.html) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1st and 2nd edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a quick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for

future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

Defining significance

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

1. State of preservation of:

1.1. Organic remains:

1.1.1. Faunal

1.1.2. Botanical

1.2. Rock art

1.3. Walling

1.4. Presence of a cultural deposit

1.5. Features:

1.5.1. Ash Features

1.5.2. Graves

1.5.3. Middens

1.5.4. Cattle byres

1.5.5. Bedding and ash complexes

2. Spatial arrangements:

2.1. Internal housing arrangements

2.2. Intra-site settlement patterns

2.3. Inter-site settlement patterns

3. Features of the site:

3.1. Are there any unusual, unique or rare artefacts or images at the site?

3.2. Is it a type site?

3.3. Does the site have a very good example of a specific time period, feature, or artefact?

4. Research:

4.1. Providing information on current research projects

4.2. Salvaging information for potential future research projects

5. Inter- and intra-site variability

5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?

5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

6. Archaeological Experience:

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

7. Educational:

7.1. Does the site have the potential to be used as an educational instrument?

7.2. Does the site have the potential to become a tourist attraction?

7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

8. Other Heritage Significance:

8.1. Palaeontological sites

8.2. Historical buildings

8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites

8.4. Graves and/or community cemeteries

8.5. Living Heritage Sites

8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts. Table 5 lists the grading system.

TABLE 5: SAHRA GRADINGS FOR HERITAGE SITES

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

RESULTS

DESKTOP STUDY

The desktop study did not differentiate between different phases, but the area in general. The desktop study consisted of analysing various maps for evidence of prior habitation in the study area, as well as for previous archaeological surveys. Many archaeological sites occur in the general area. The archaeological sites tend to be open Stone Age and Iron Age sites of varying significance. Some historical buildings occur in the general area. These sites have been recorded through systematic surveys (fig. 5). No known heritage sites occur within the study area, or nearby to be affected by a visual impact.

The Surveyor General Maps indicate that the farms were first surveyed between 1863 and 1908 (fig.'s 6 - 14). This means the farms were rented before hand and sold thereafter. No buildings are shown on the Surveyor General maps; however, one can assume that buildings would have occurred once the farm was sold. Any buildings and/or ruins on the farms can thus be over 60 years in age and are protected by the heritage legislation. Similarly, any rubbish dumps associated with the older buildings would be protected as well.

The 1954 aerial photographs were only located after the survey (fig. 15). The photographs indicate that most of the settlements (farm houses, kraals, farm labourers' houses, etc.) occur in the northern part of the study area. These features are repeated on the 1968 topographical map.

The 1968 topographical map indicates that there are buildings, ruins and settlements within the study area (fig. 16). Human graves might be associated with some of these features. Table 2 lists these features. These features will be surveyed and assessed.

The Google Earth imagery suggests that overhangs may occur. These overhangs could have rock art and/or archaeological deposits.

FIG. 5: LOCATION OF KNOWN HERITAGE SITES IN THE GENERAL AREA

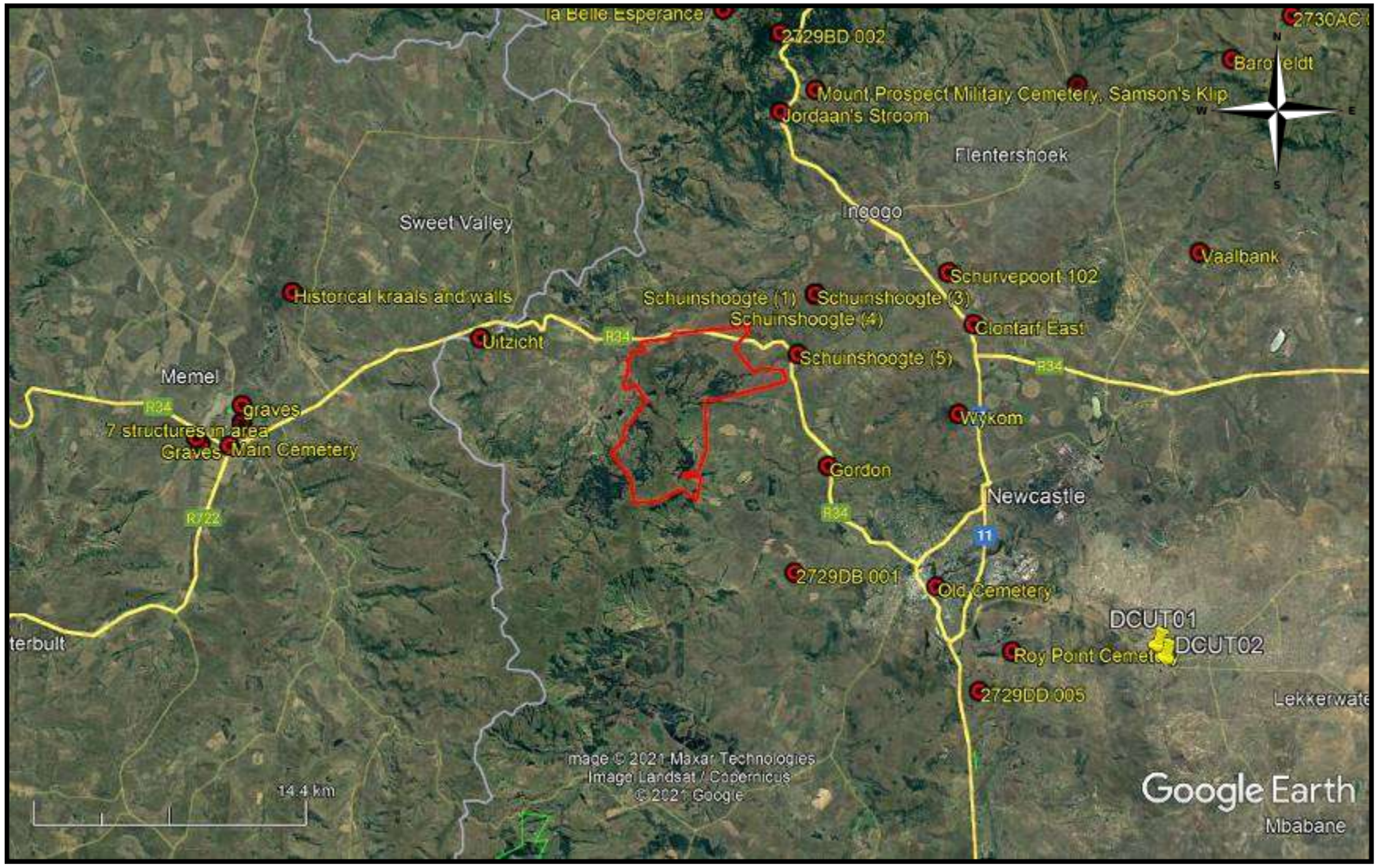
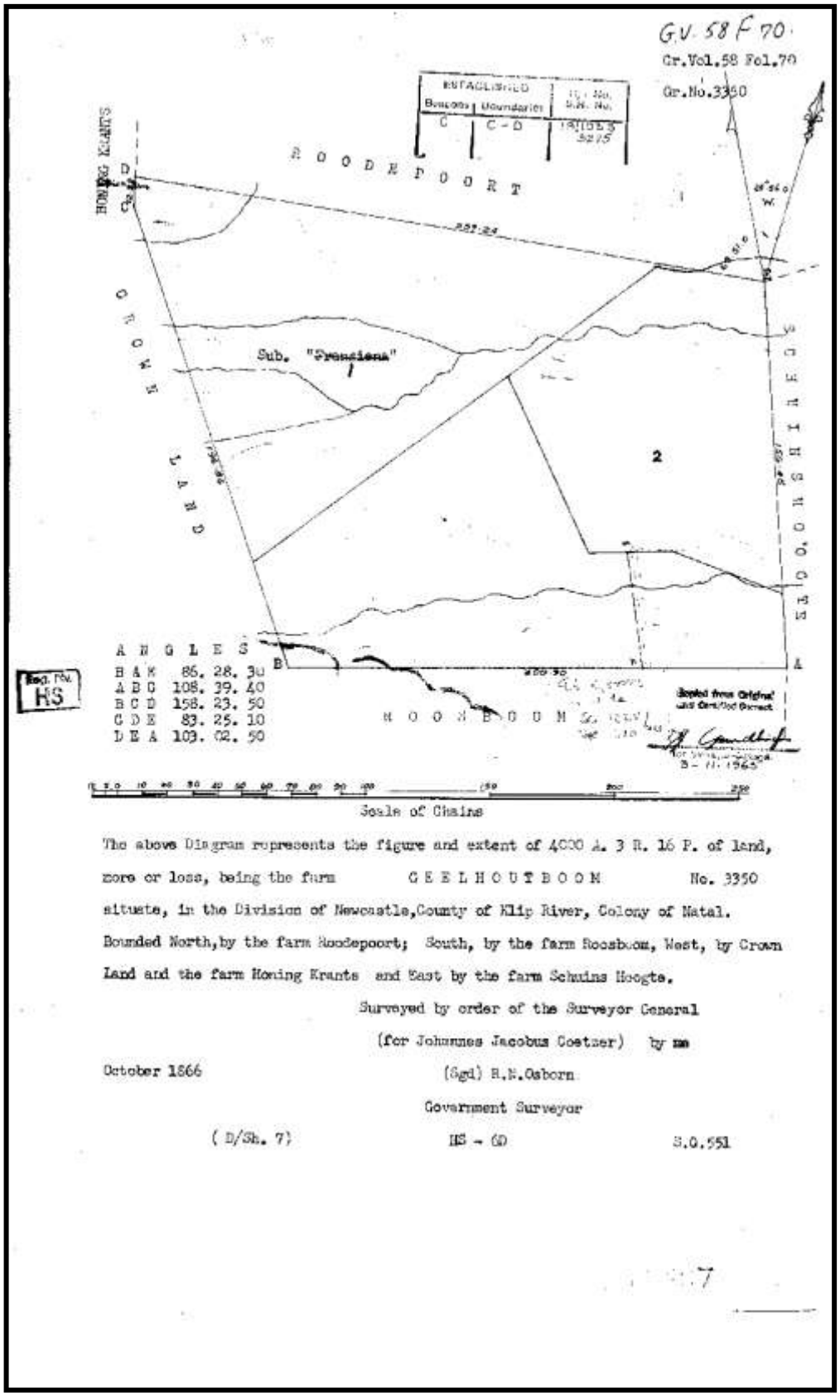


FIG. 6: GEELHOUTBOOM SGD (1866)



The above Diagram represents the figure and extent of 4000 A. 3 R. 16 P. of land, more or less, being the farm GEELHOUTBOOM No. 3350 situate, in the Division of Newcastle, County of Klip River, Colony of Natal. Bounded North, by the farm Roodepoort; South, by the farm Roosboom, West, by Crown Land and the farm Honing Krants and East by the farm Schuins Hoogte.

Surveyed by order of the Surveyor General (for Johannes Jacobus Coetzer) by me

October 1866

(Sgd) H.N.Osborn
Government Surveyor

(D/Sh. 7) HS - 60 S.G.551

FIG. 7: BERNARD 1896

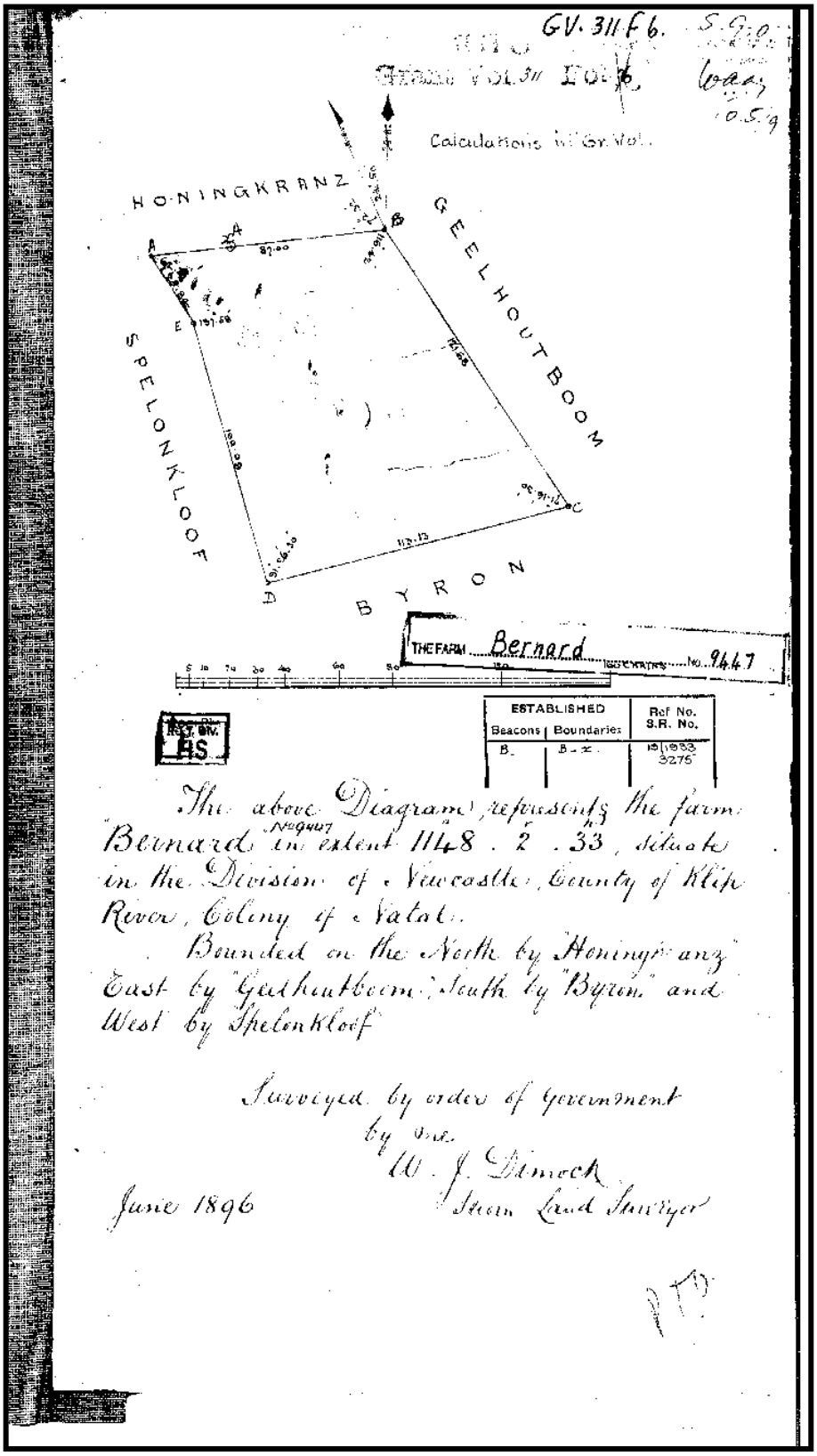


FIG. 8: SPELONKLOOF SOUTH/SPITSKOP (1898)

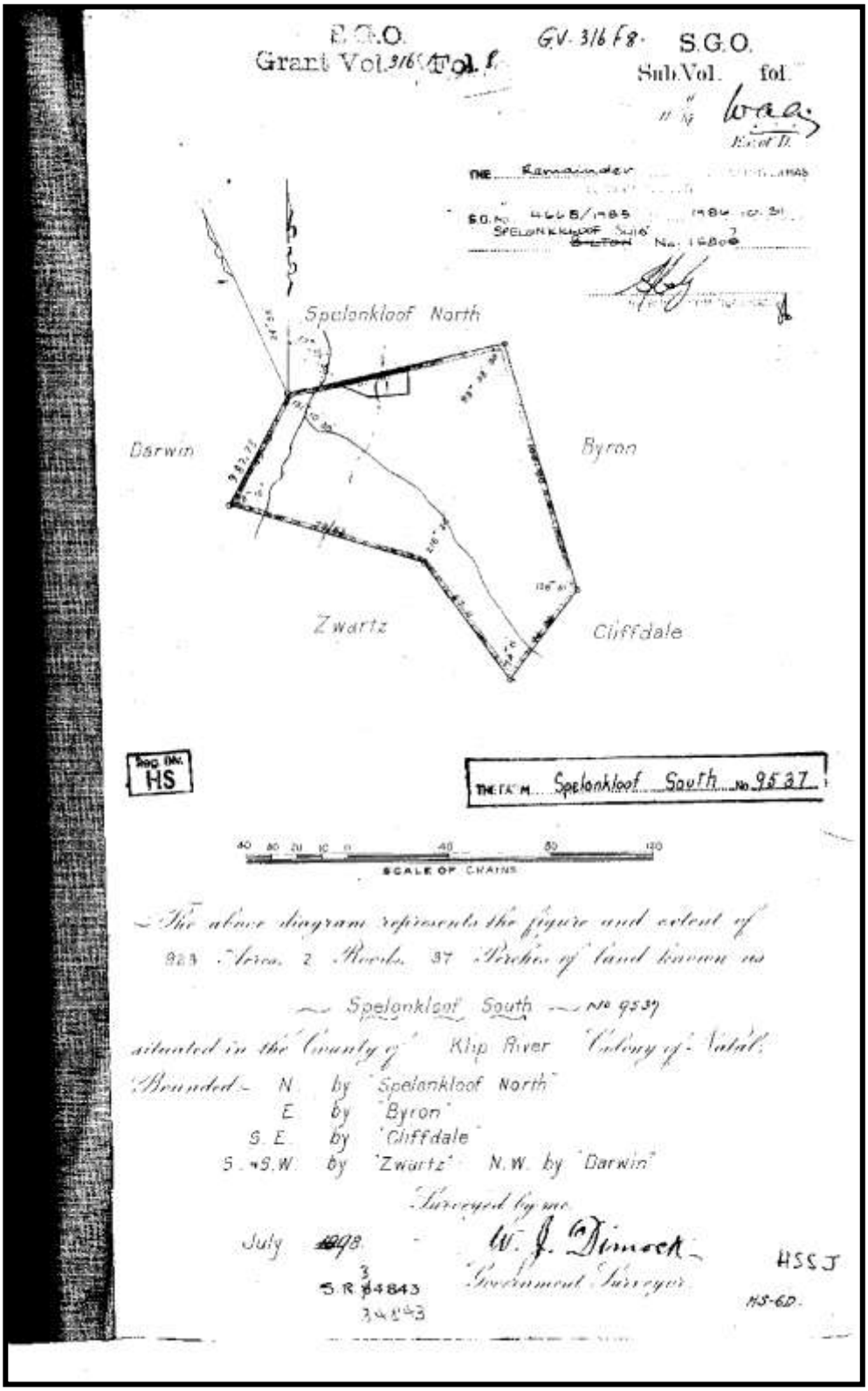


FIG. 9: BYRON 1896

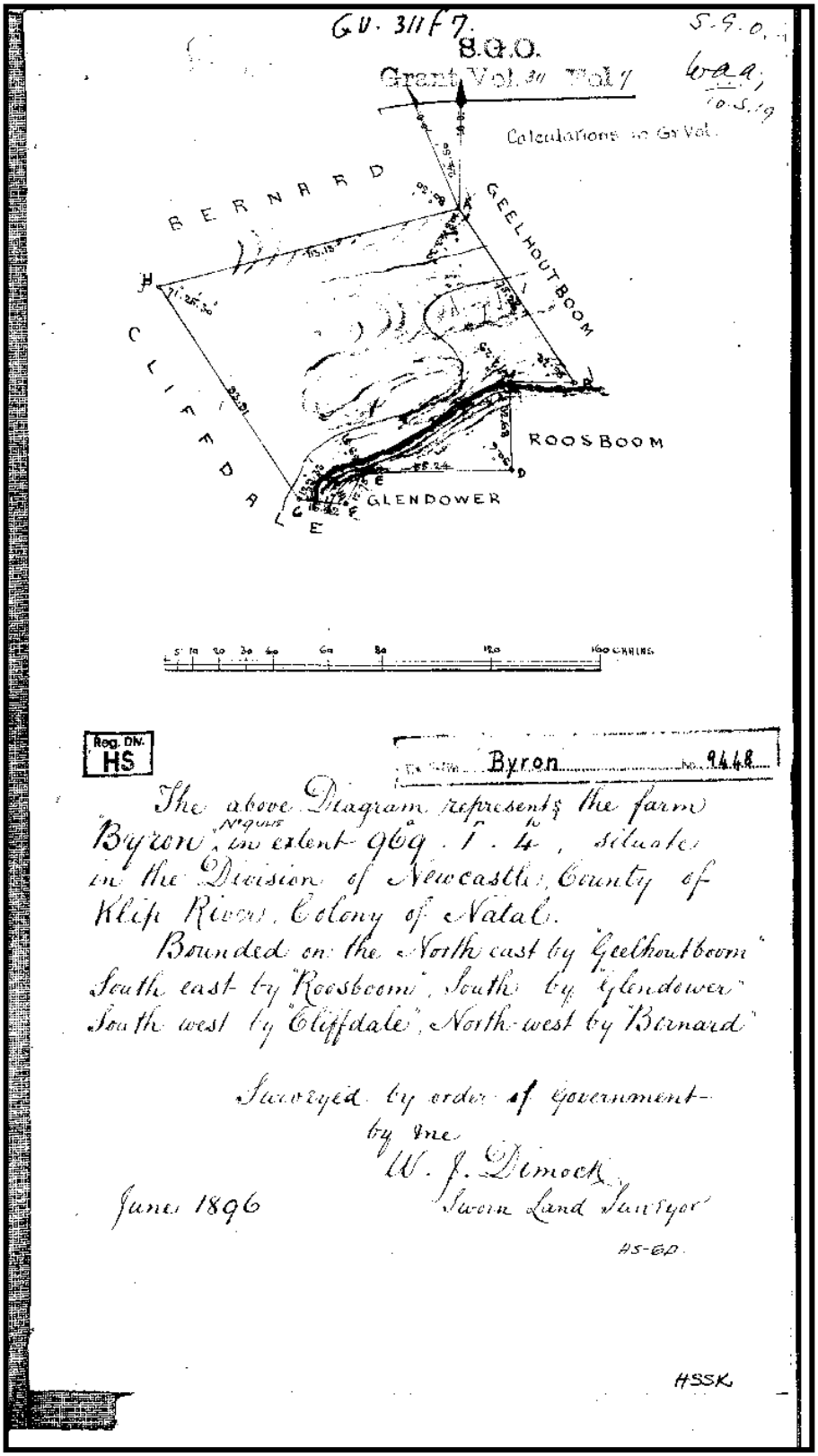


FIG. 10: CLIFFDALE 1896

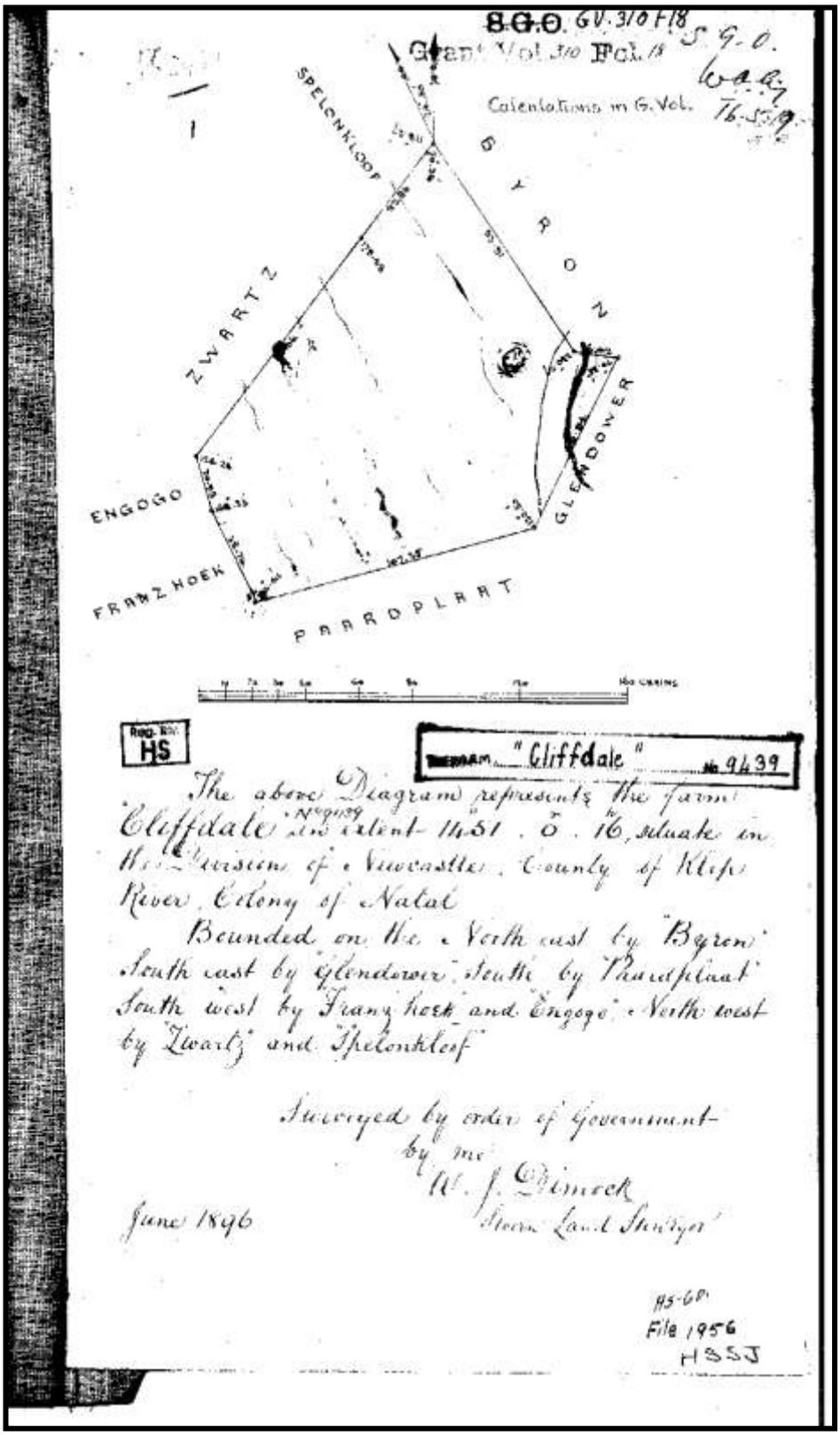
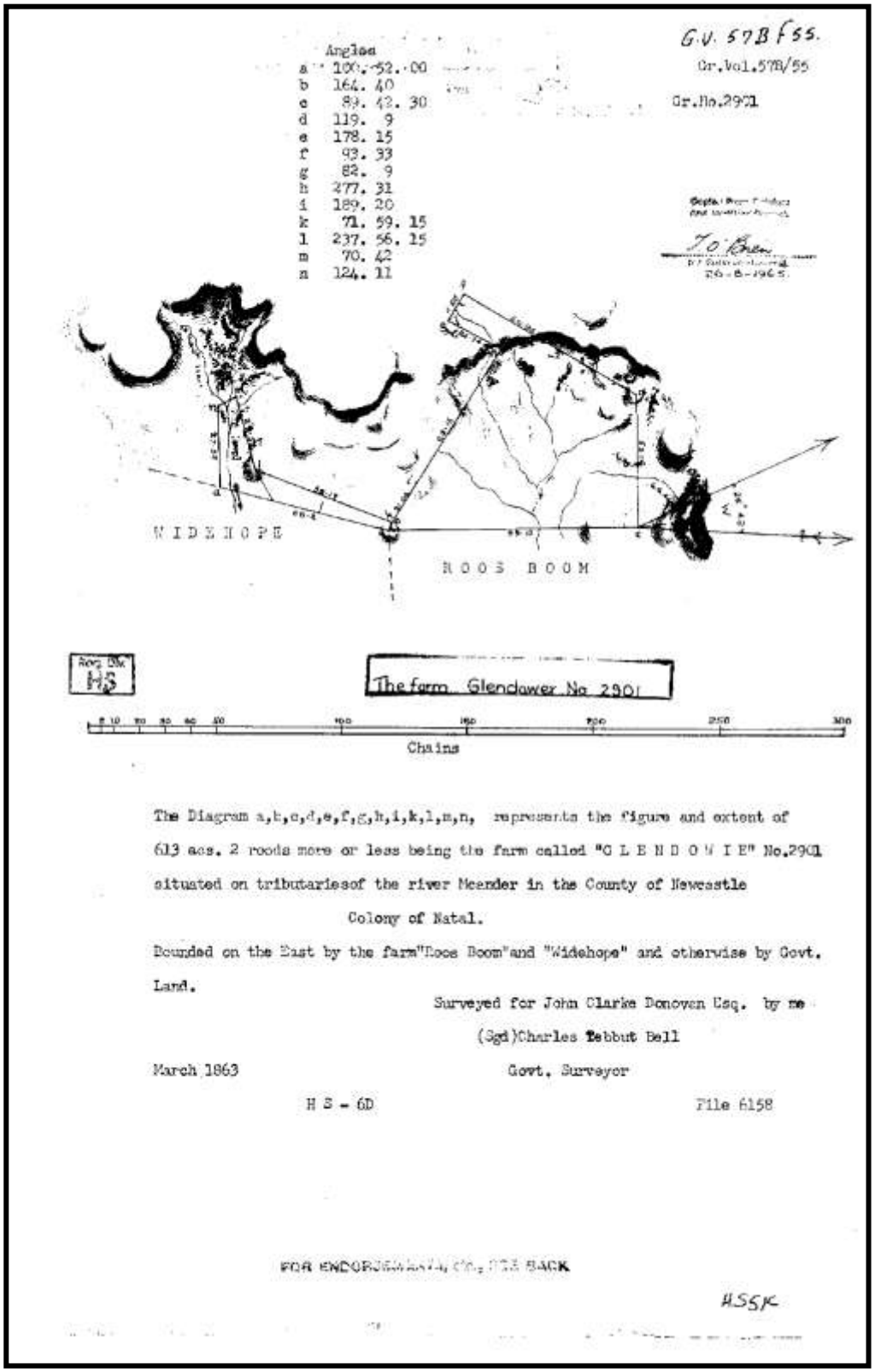


FIG. 11: GLENDOWER 1863



G.V. 57B f 55.

Gr.Vol.57B/55

Gr.No.2901

	Angles
a	100. 52. 00
b	164. 40
c	89. 43. 30
d	119. 9
e	178. 15
f	93. 33
g	82. 9
h	277. 31
i	189. 20
k	71. 59. 15
l	237. 56. 15
m	70. 42
n	124. 11

26-8-1965

WIDEHOPE

ROOS BOOM

Surv. Dpt. HS

The farm Glendower No 2901

Chains

The Diagram a,b,c,d,e,f,g,h,i,k,l,m,n, represents the figure and extent of 613 acs. 2 roods more or less being the farm called "G L E N D O W E R" No.2901 situated on tributaries of the river Meander in the County of Newcastle Colony of Natal.

Bounded on the East by the farm "Roos Boom" and "Widehope" and otherwise by Govt. Land.

Surveyed for John Clarke Donovan Esq. by me

(Sgd) Charles Tebbut Bell

March 1863

Govt. Surveyor

H S - 6D

File 6158

FOR ENDORSEMENTS, SEE BACK

HSSK

FIG. 12: PAARDEPLAAT A /DENE HEIGHTS 1908

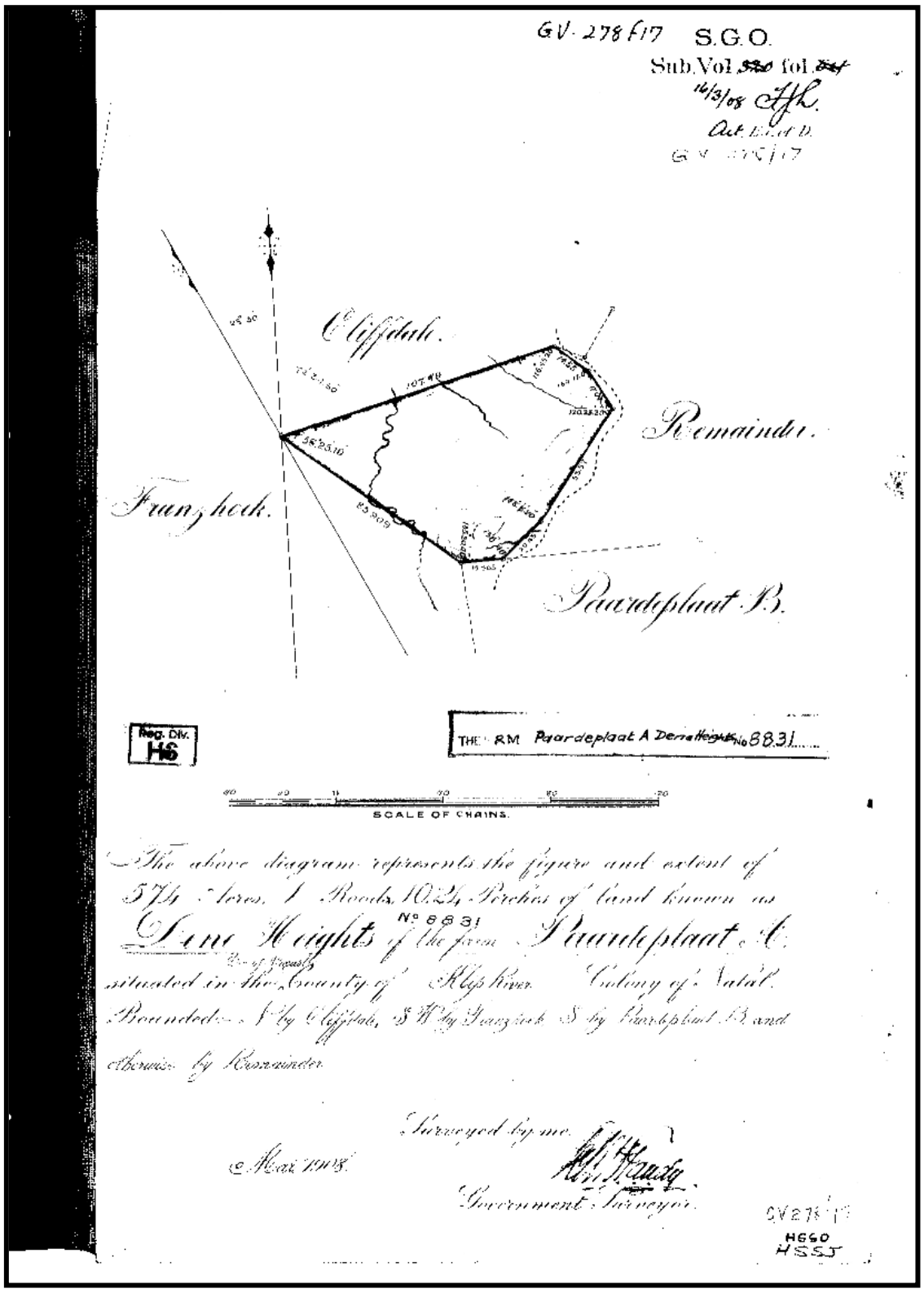


FIG. 13: PAARDEPLAAT B 1908

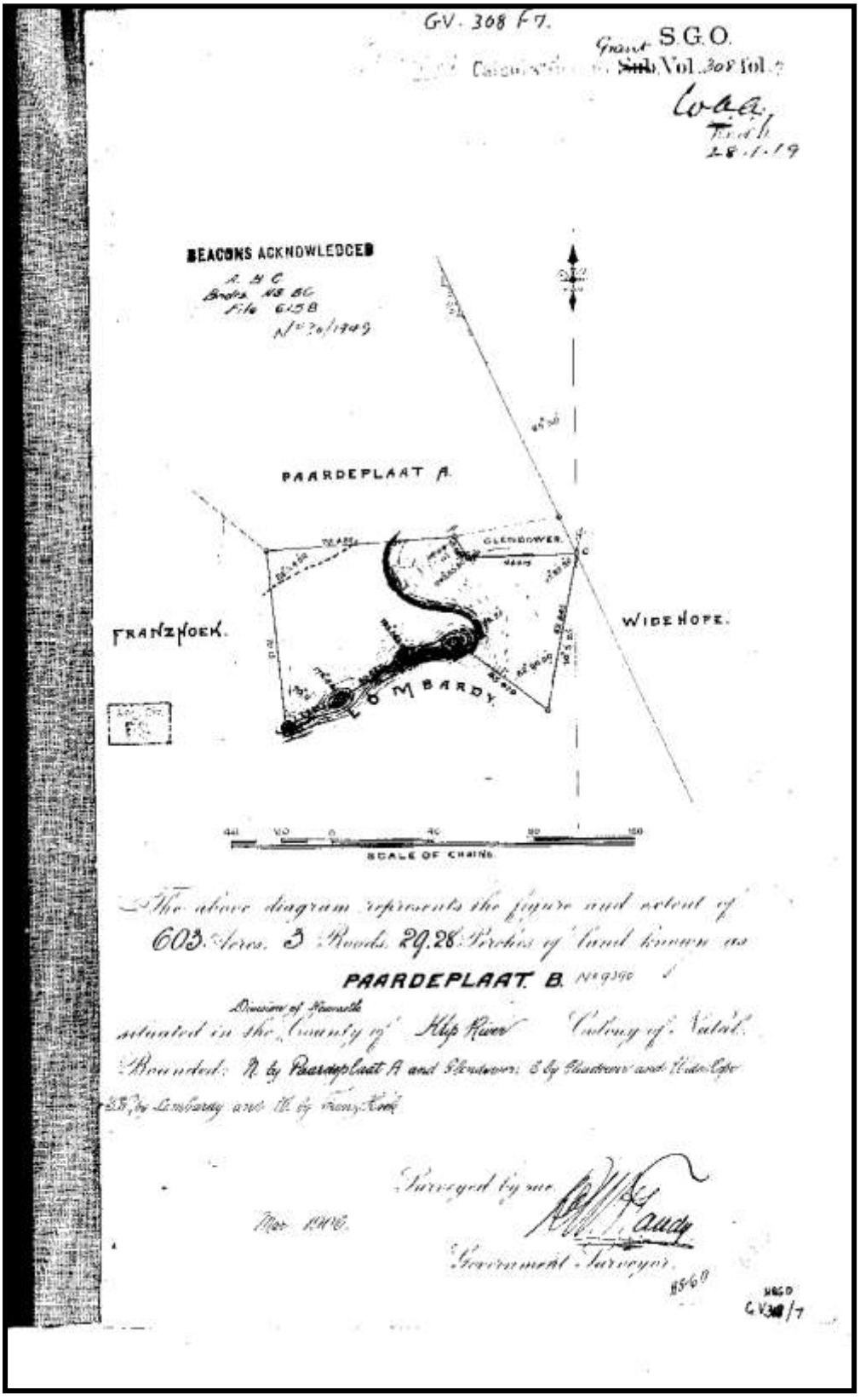


FIG. 14: FRANZHOEK 1895

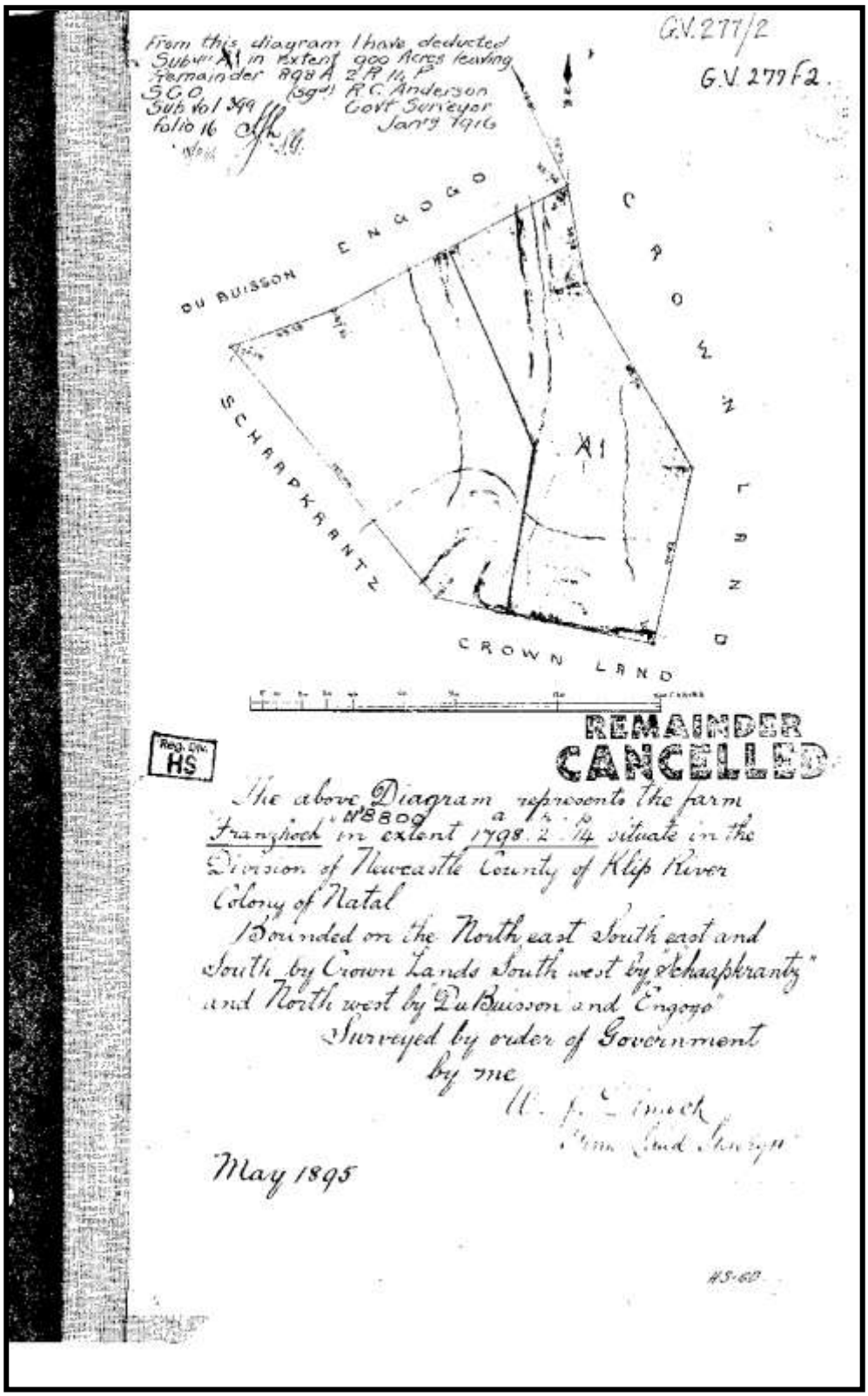


FIG. 15: STUDY AREA IN 1954

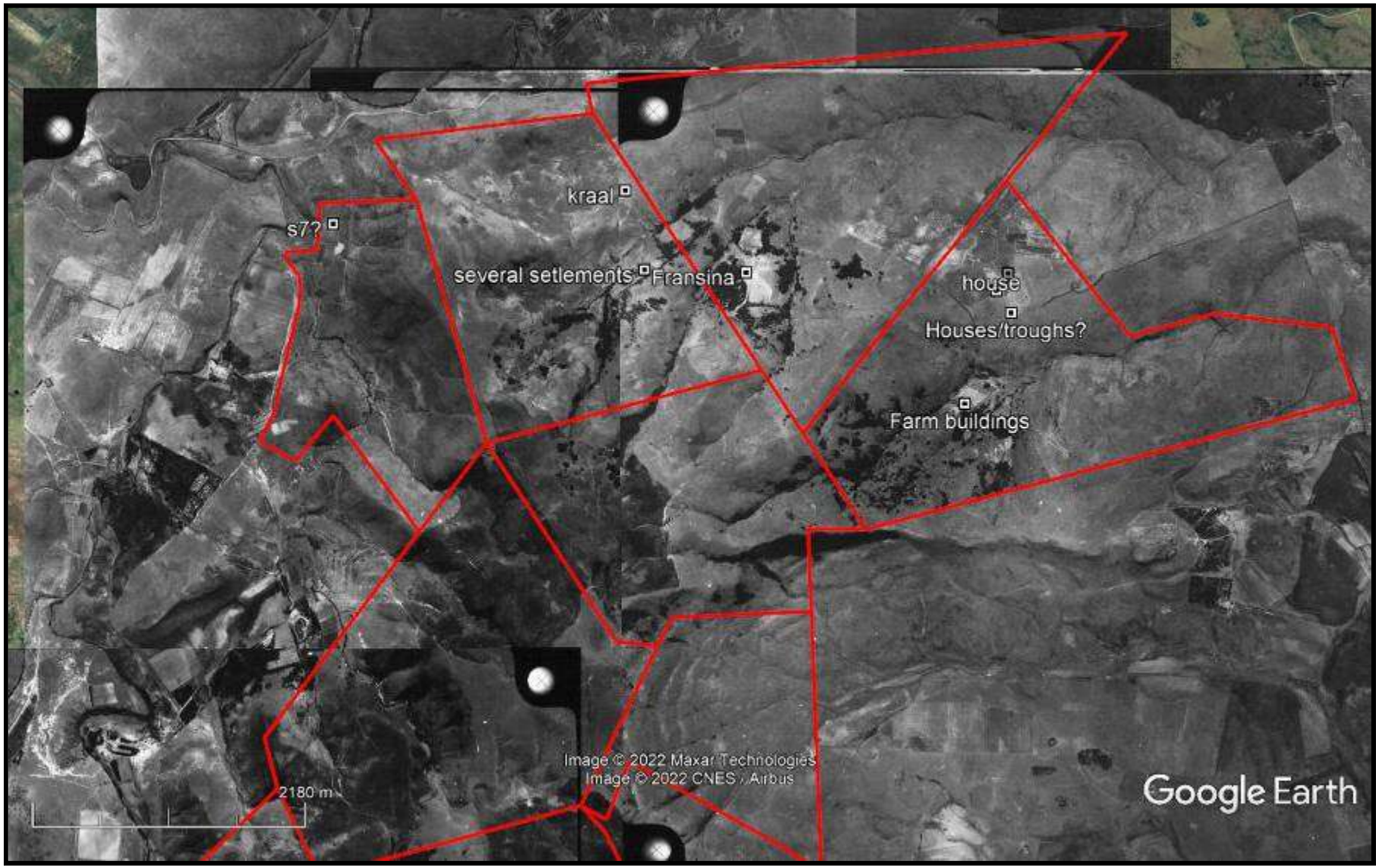


FIG. 16: LOCATION OF THE STUDY ARE AND POSSIBLE FEATURES IN 1968

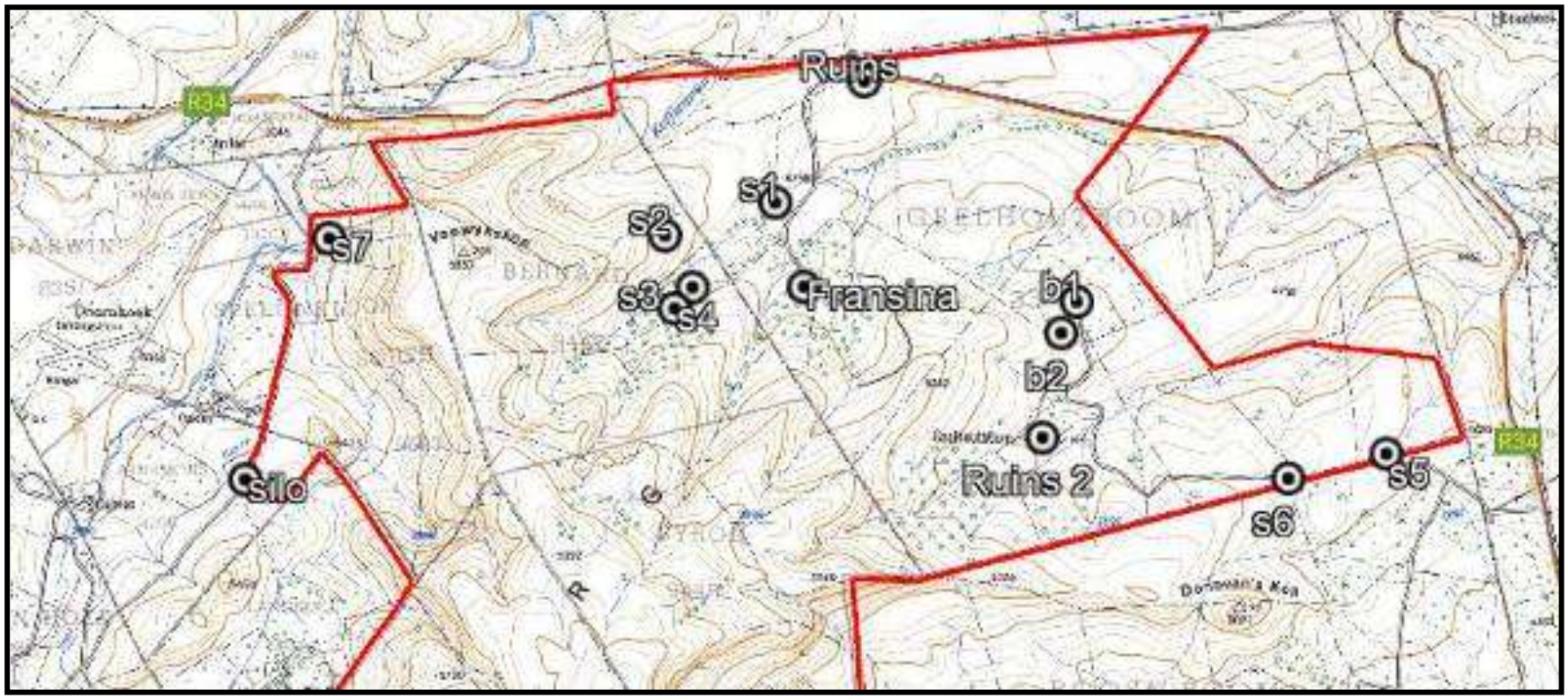


TABLE 2: LOCATION OF FEATURES IN 1953 & 1968

NAME	LATITUDE	LONGITUDE	DESCRIPTION
B1	-27.649829275	29.833382255	Building
B2	-27.651869204	29.832254951	2x Building
B3	-27.648611280	29.806716981	Building
Fransina	-27.649609519	29.813543772	Farm in 1968; ruins by2009
G1	-27.653677951	29.777212072	Foundations (from Google Earth)
G2	-27.661851417	29.776180195	Structure (from Google Earth)
R1	-27.716631432	29.790490664	overhang
R2	-27.713684639	29.799151237	Overhang
R3	-27.711070621	29.811657765	Overhang
R4	-27.706434633	29.803007726	Overhang
R5	-27.700214350	29.806326251	Overhang
Ruins	-27.635659924	29.817913275	Ruins on 1968 map
Ruins 2	-27.658572673	29.830881131	Ruins on 1968 map
S01	-27.643486115	29.811439368	Settlement (+graves?)
S02	-27.645774080	29.803594142	Settlement (+graves?)
S03	-27.649028731	29.805513055	Settlement (+graves?)
S04	-27.650411704	29.804249121	Settlement (+graves?)
S05	-27.660160147	29.855744005	Settlement (+graves?)
S06	-27.661707684	29.848861845	Settlement (+graves?)
S07	-27.645891946	29.779171774	Settlement (+graves?)
S08	-27.685969458	29.816814221	Settlement (+graves?)
S09	-27.693101999	29.784159716	Settlement (+graves?)
S10	-27.701458825	29.775206581	Settlement (+graves?)
S11	-27.676689259	29.778904654	Settlement (+graves?)
Silo	-27.661377774	29.773221457	Silo

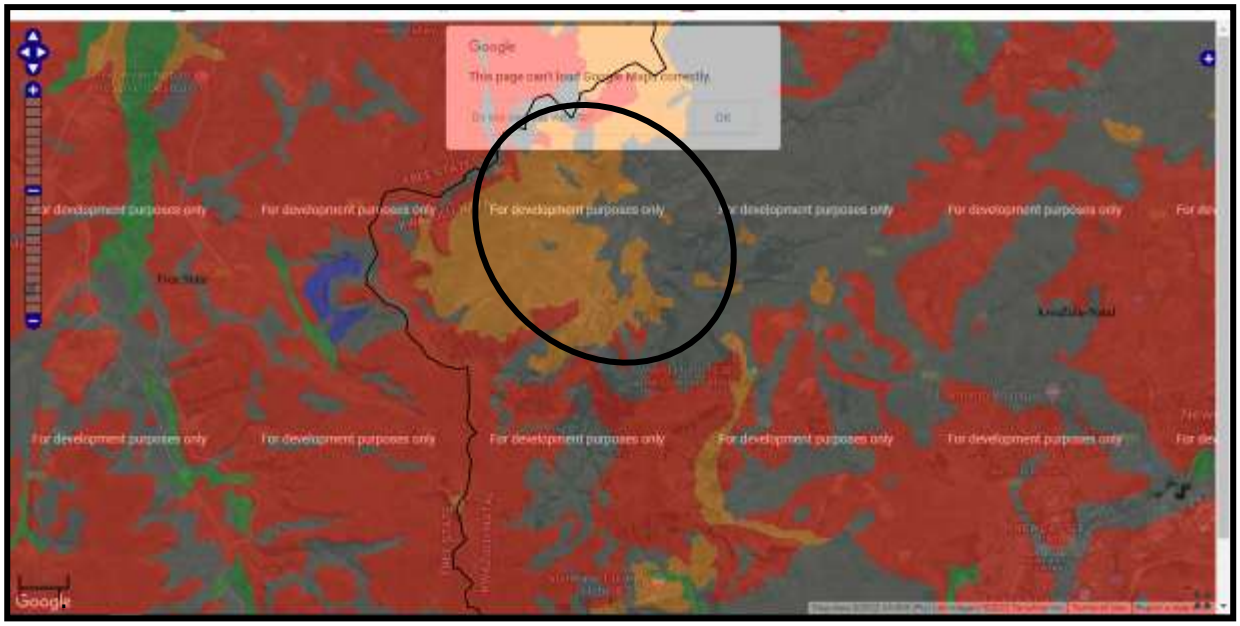
PALAEONTOLOGICAL SENSITIVITY

Dr Alan Smith (Appenidx A & B) undertook the PIA desktop and fieldwork study for this project as some of the land was considered to be of high palaeontological significance (fig. 17). He states: “This site is dominated by Karoo Dolerite, which is an intrusive igneous rock and not fossiliferous. However the remaining lithologies may be fossiliferous. The areas underlain by significant fossiliferous lithologies are restricted to deep depressions and steep slopes, areas where turbine construction is very unlikely. These lithologies are adequately catered for by the “Chance find protocol” (see Appendix 2). The gridlines will cross Vryheid

Formation. Although this is considered sensitive by the SAHRIS Palaeosensitivity Map, in practice no significant palaeontological material has been encountered. The gridlines follow existing industrial corridors (railway and Eskom powerline routes). For this reason it is the recommendation of this Field Report that no further palaeontological work needs to be undertaken, unless the “Chance Find Protocol” is triggered.

On a separate note, road access to the site was extremely difficult. It is presumed that a road may need to be constructed from the northern side in order to gain access to the site for the transport and assembly of heavy wind turbine equipment. A palaeontological investigation may need to be undertaken, depending on the route selected.”

FIG. 17: PALAEONTOLOGICAL SENSITIVITY MAP



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.

FIELD SURVEY

A field survey was undertaken in February 2022. Those sites noted in the desktop study were surveyed where possible, as well as the two phases of the project. Ground visibility in the lower lying areas was poor due to the dense (grass) vegetation. Often the basic outlines of buildings could be seen, but not the detail. The extensive wattle plantations also limited access in several areas. One site, Ruins 2, could not be assessed due to a wetland on the one side and dense wattle trees on the other sides. This area will not be affected by the WEF. Photography at many of the sites was hampered due to the long grass, especially for surface features. The location of the recorded sites is shown in fig. 17 and Table 6.

The survey was undertaken for the entire study area, andot just the location of the proposed turbines.

TABLE 6: LOCATION OF RECORDED SITES

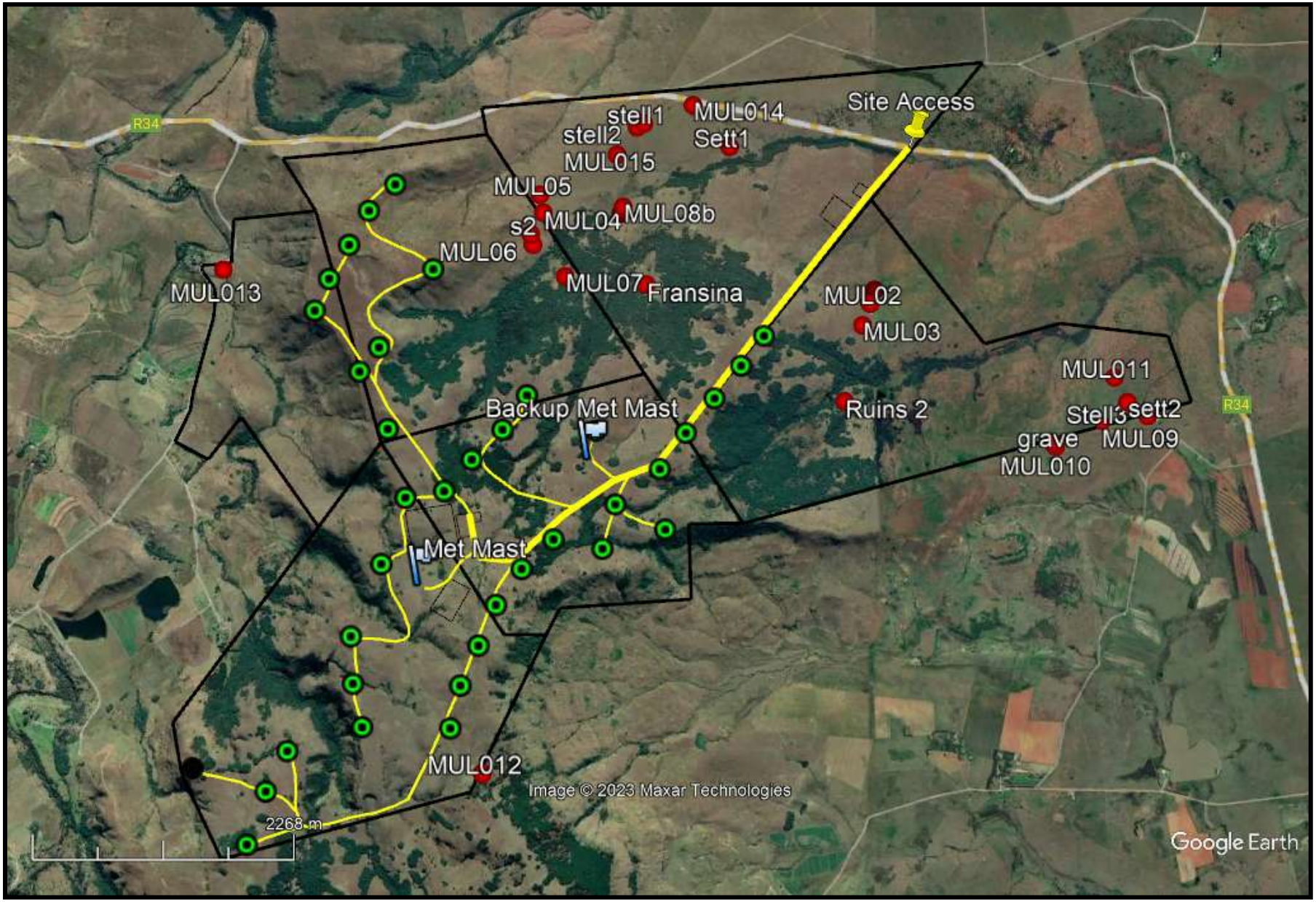
Name	Latitude	Longitude	Description	Phase
Fransina	-27.649609519	29.813543772	Farmhouse	Phase 1
Grave?	-27.650912200	29.833026700	Grave at MUL02	Phase 1
grave	-27.662100000	29.849420800	Grave at MUL010	Phase 1
MUL01	-27.649958000	29.833488700	kraal	Phase 1
MUL02	-27.651035000	29.833097500	2 x bedroom house, rectangular kraal, small rectangular foundations	Phase 1
MUL03	-27.652721301	29.832404402	Sheep dip	Phase 1
MUL04	-27.644106603	29.804623515	‘circular’ 12m wide. has small 2ndry walling x1	Phase 1
MUL05	-27.642706300	29.804330000	8x4 walling. some sides are natural	Phase 1

MUL06	-27.646584176	29.803736214	single grave with fence	Phase 1
MUL07	-27.648996395	29.806500156	General area of several houses. possible 4 generations	Phase 1
MUL08a	-27.644058154	29.811344404	foundations of house. thick grass	Phase 1
MUL08b	-27.643573312	29.811535353	foundations of house. thick grass	Phase 1
MUL09	-27.659711914	29.857628621	settlement still in use	Phase 1
MUL010	-27.661850214	29.849176046	Settlement foundations and walling and grave	Phase 1
MUL011	-27.656708700	29.854696300	walling	Phase 1
MUL012	-27.686450658	29.799753075	1 house, 2 rooms 4x3m. uphill large kraal and smaller to the right	Phase 2
MUL013	-27.648412200	29.776702400	3 x graves	Phase 1
MUL014	-27.635703448	29.817630339	ruins or rubbish from road works?	Phase 1
MUL015	-27.639563000	29.811007800	10 x 14m not rectangular structure. 2ndry wall downslope	Phase 1
Ruins 2	-27.658572673	29.830881131	not accessible: old farm building	Phase 1
Stell1	-27.637154000	29.813353900	Stone stella	Phase 1
Stell2	-27.637438400	29.812765100	Stone stella	Phase 1
Stell3	-27.660278000	29.853583000	Stone stellae	Phase 1
Sett1	-27.638854354	29.820852863	Settlement on 1975 aerial but not seen on survey	Phase 1
Sett2	-27.658629508	29.855843412	Settlement on 1975 aerial but not seen on survey	Phase 1

PHASE 1

The location of recorded sites in Phase 1 are shown in fig. 18. All of the sites are in the lower lying areas.

FIG. 18: LOCATION OF HERITAGE SITES IN RELATION TO PHASE 1 INFRASTRUCTURE



Fransina

The site is located on a small hill facing north (fig.19). Only the main house and the foundation floor of a second structure were still visible. Fransina might be on of the first farmhouses on the Farm Geelhoutboom. The SG drawing mentions the Farm Fransinea as a subdivision in 1866. According to the aerial photographs (956_003_00144) the farmhouse had been abandoned before 1991. The farmhouse and adjacent building has been built from dolerite blocks with an interior plaster. The aerial photography suggest the main building was a 4 – 6 room structure, with a 'barn' to the west. The vegetation was too dense to observe any other features or details: in some places the grass was over 1.5m in height. No family cemetery was observed, although this could be a result of the vegetation.

Middens would occur in the general area.

Significance: If the house dates to the 1860s onwards then it has historical significance, especially the contents of the middens. The site has potential to yield information regarding early colonial farm life in the area.

Mitigation: A 100m buffer around the houses should be placed as a highly sensitive area. This buffer zone would need to be re-assessed (in late winter) if it is to be affected.

SAHRA Rating:3B

FIG. 19: REMAINS OF FARM FRANSINA

MUL01

The site is located on the top of a flat hill (fig. 20). The site consists of a dolerite stone walled kraal. It is ~25m x 30m in size. The kraal may relate to MUL02 that is 100m to the south.

Significance: The stone walling is of low significance.

Mitigation: No mitigation is currently required as the nearest turbine is 980m to the southwest. If it is to be affected then it will need to be accurately measured and photographed. A permit will be required if it will be damaged.

SAHRA Rating: 3C

FIG. 20: STONE WALLING AT MUL01

MUL02

The site is located 100m south of MUL01 (fig. 21). The site consists of three built structures all made from dolerite. The main house is a two roomed structure, 4m x 4m each in size. Approx. 10m to the north is a smaller stone cairn amongst trees and dense underbrush. A smaller rectangular kraal occurs 36m to the south of the main house. No other structures were noted in the general area. The buildings predate 1953 as they occur on those aerial photographs.

The northwest corner of the fenced off field to the south may have had a built feature; however nothing was clearly visible.

Significance: The site will need to be re-assessed if it will be affected by the development. This assessment will need to occur in late winter when the vegetation will be loess dense. There may be historical middens.

Mitigation: The site will not be affected by the current turbine layout. A 100m buffer around the site should be maintained before mitigation is required.

SAHRA Rating: 3B

MUL03

The site is located ~200m south-southwest from MUL02. The site consists of a single sheep/goat dip made from Newcastle bricks (fig.22).the use of bricks instead of dolerite suggests that it might post-date MUL01 and MUL02.

Significance: The feature is of low significance

Mitigation: if the sheep dip was to be affected it will need to be mapped and photographed in detail.

SAHRA Rating: 3C

FIG. 21: BUILT STRUCTURES AT MUL02

FIG. 22: SHEEP DIP AT MUL03

MUL04

The site is located halfway up a hill and is currently under an *Acacia spp.* tree (fig. 23). The kraal is ~12m in length and breadth and has a secondary enclosure. The walling is nearly subsurface, suggesting that it is considerably older than other stone walled kraals. No features were noted within the kraal.

Significance: the site is of low significance.

Mitigation: the site s currently not affected by the project. If it is it will need to be mapped and photographed.

SAHRA Rating: 3C

FIG. 23: STONE WALLING AT MUL04

MUL05

The site is located halfway up the hill amongst an isolated dolerite outcrop. The site consists of a rectangular stone walled kraal that has used large boulders as part of the construction (fig. 24). The kraal is 4m x 8m in size and only the basal stones remain

The site will not be affected by current WEF plans.

Significance: the site is of low significance
Mitigation: No further mitigation is required.
SAHRA Rating:

MUL06

The site is located halfway up the hill near the site and ‘s2’ from the desktop. The site consists of a single grave that has been fenced off (fig. 25). The site ‘s2’’ occurs about 80-m northwards and consists of a single terrace cut into the hill.

MUL06 will not be affected by the WEF.

Significance: The grave is of high significance.
Mitigation: No mitigation is currently required.
SAHRA Rating: 3A

FIG. 24: STONE WALLED KRAAL AT MUL05

FIG. 24:GRAVE AT MUL06

MUL07

The site is located near the base of the hill. The site consists of several houses that appear to be part of a settlement that dates back to at least 1954, if not earlier (fig. 26). The houses are currently occupied. There are probably graves related to this settlement.

MUL07 will not be affected by the WEF.

Significance: Any graves would be of high significance. The buildings are not the original wattle and daub and have been rebuilt over time.

Mitigation: none required.

SAHRA Rating:

FIG. 26: HOUSES AT MUL07

MUL08A & 8B

The site is located on a flat area overlooking a small stream (fig. 28). This site is ‘s1’ from the desktop study. The site consists of two small settlements approximately 150m apart. The vegetation was too dense to see the ground; however, several raised area indicating house foundations were noted. There are some sisal plants that could be the remains of a kraal.

MUL08a-b will not be affected by the WEF.

Significance: The site is of low significance if there are no graves.

Mitigation: No mitigation currently required. The general area would need to be resurveyed if affected. A 100m buffer should be placed around this site, as there might be multiple settlements.

SAHRA Rating: currently 3C

FIG. 27: GENERAL LOCATION OF MUL08

MUL09

The site is on the southern side of a long spur. The site relates to ‘s5’ from the desktop study. The settlement (fig 28) has been in use since at lest the 1950s. No graves were noted; however, the grass was very long.

The settlement might be affected by access roads.

Significance: Currently of low heritage significance.

Mitigation: None required; however, if an access road occurs nearby the area needs to be resurveyed near the end of winter.

SAHRA Rating: n/a

FIG. 28: EXISITNG SETTLEMENT AT MUL09

MUL010

The site is located 550m southwest of MUL09 and corresponds with #s6# from the desktop study. MUL010 consists of at lest two house foundations, a stone walled terrace and at least one grave (fig. 29). The site is ¬80m x 60m in size. The house walls consist of two rows of dolerite blocks with a stone 'rubble' infill. The grave is ¬1m x 2m in size. There are larger dolerite blocks marking the edge, while smaller stones have been used as a fill. There might be another sunken grave to the west.

The site will not be affected by the WEF; however, the access road and pylons may occur within the buffer.

Significance: The site is of high significance due to the grave(s).

Mitigation: A 100m buffer should be placed around the site since the grass was too long to note (sub)surface features. This buffer will need to be resurveyed if the access road or pylon occurs within it. The grave(s) should have a 20m exclusion buffer. The graves will need to be clearly demarcated before construction activity.

SAHRA Rating: 3A

FIG. 29: HOUSE FOUNDATIONS AND GRAVE & MUIL010

MUL011

The site is located ¬400m north of MUL09 and at the top of the spur. The site consists of a low stone wall 10m x 15m in size (fig. 30). It appears as if there was a natural rock outcrop on this hill and several area have been cleared to form kraals that no longer have walling, and/or fields for crops.

The site will not be affected by the WEF.

Significance: The site is of low significance
Mitigation: No mitigation is currently required.
SAHRA Rating: 3C

FIG. 30: STONE WALLED KRAAL AT MUL011

MUL013

The site is located at the base of the mountain on a small spur overlooking a river. MUL013 could relate to ‘s7’ from the desktop study. The site consists of three graves in a row with an east-west orientation (fig. 31). Unmarked headstones occur on the eastern side of the graves. No evidence for a settlement could be seen.

The site will not be affected by the proposed WEF.

Significance: The graves are of high significance.

Mitigation: No mitigation required.

SAHRA Rating: 3A

FIG. 31: GRAVES AT MUL013

MUL014

The site is located on the edge of the property next to the R34. The site was marked as 'Ruins' on the 1968 topographical map; however, they do not show on the 1954 aerial photos. The site consists of three areas of dolerite blocks of which some have plaster (fig.32). There is no formal pattern and it appears to be possible building rubble that has been pushed into three piles. One pile closest to the R34 has piles of tar used for the road on it.

The site will not be affected by the WEF.

Significance: The site is of low significance
Mitigation: No mitigation is required
SAHRA Rating: 3C

FIG. 32: CONCENTRATION OF WORKED DOLERITE ROCKS

MUL015

The site is located on a small gradient of the hill. The site consists of a rectangular stone walled kraal with one or two smaller secondary enclosures to the south (fig. 33). The secondary enclosures have completely toppled. The main enclosure is 10m x 14m in size and only the base of the walling remains.

The site will not be affected by the WEF.

Significance: The site is of low significance.
Mitigation: No mitigation is currently required.
SAHRA Rating: 3C

FIG. 33: SECONDARY WALLING AT MUL015

STEL01

The site is located on the edge of the property and the original R34. It consists of a single stella and is could indicate the turnoff onto the Fransina road from the R34 (fig. 34). Stellae indicate old boundary markers and or fencing practices and should be considered as part of the cultural landscape, regardless of their significance.

Significance: The stella is of low significance.
Mitigation: The stella should not be (re)moved
SAHRA Rating: 3C

FIG. 34: STONE STELLA

STEL02

The site is located 60m southwest of STEL02. It is probably the opposite side of the road turnoff marker (fig. 35). The white arrow in figure 34 indicates the location of STEL01

Significance:

Mitigation:

SAHRA Rating:

FIG. 35: STEL02

STEL03

The site is located on the boundary of Geelhoutboom and Roose Boom. There are two stellae remaining in the field (fig. 36). The close proximity of the two suggests that they were part of a gate entrance.

The site will not be directly affected by the WEF; however, the grid connection pylons could affect the stellae.

Significance: The stellae are of low significance but should not be affected.
Mitigation: A 20m buffer around the stella should be made.
SAHRA Rating: 3C

FIG. 36: STEL03

RUINS2

The site is located on a small hill between to rivers. It was originally a farmhouse with agricultural fields up to early 1970s and was then abandoned (fig. 37). During the field survey, the heavy rains had made the southern part of the access to the site a large wetland, while the rest of the site was bordered by dense wattle plantations. No visible structures could be seen from two vantage points; however, these could also have been hidden by the dense grass.

The site will not be affected by the WEF

Significance: to be finalised

Mitigation: If the area is affected by the wind farm, then this hill needs to be resurveyed. A 100m buffer should be placed around the site.

SAHRA Rating: to be finalised

FIG. 37: LOCATION OF RUINS 2

SETT1

SETT1 is located in the northern part of the study area overlooking a small river. The site appears on the 1975 aerial photograph (fig. 38), but could not be located during the survey. One of the cattle feeding areas appears to be located at SETT1. The foundations and subsurface features could occur but were not visible due to the grass. The site is a semi-circle of four to five wattle and daub houses.

SETT1 will not be affected by the WEF.

Significance: to be finalised

Mitigation: If the area is affected by the wind farm, then this hill needs to be resurveyed. A 100m buffer should be placed around the site.

SAHRA Rating: to be finalised

FIG. 38: AERIAL PHOTOGRAPH OF SETT1

SETT2

SETT2 is located between MUL09 and MUL011. The site appears on the 1975 aerial photograph (fig. 39), but could not be located during the survey. The site is a small settlement with agricultural fields to the east. The foundations and subsurface features could occur but were not visible due to the grass.

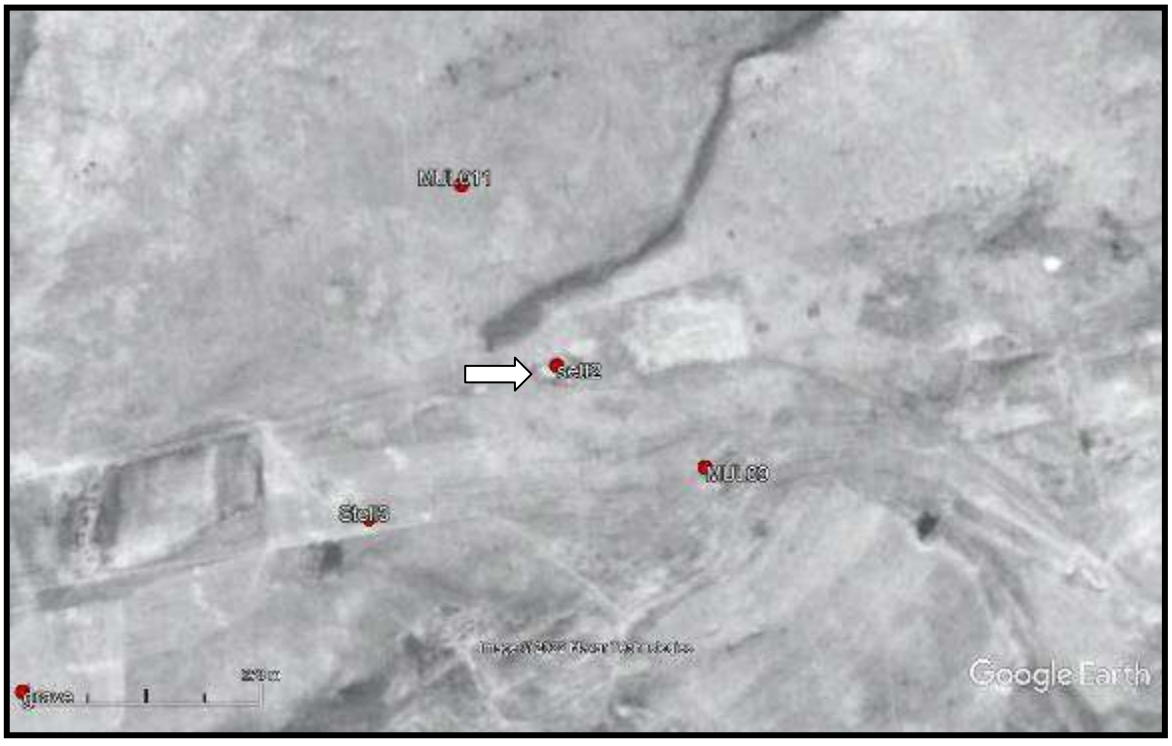
SETT2 may be affected by the Grid Connection options.

Significance: to be finalised

Mitigation: If the area is affected by the wind farm, then this hill needs to be resurveyed. A 100m buffer should be placed around the site.

SAHRA Rating: to be finalised

FIG. 39: AERIAL PHOTOGRAPH OF SETT2



PHASE 2

The location of the recorded site in Phase 2 is shown in fig. 40.

MUL012

The site is located on a small plateau near the top of the mountain. The site consists of three features: House, large kraal and a small kraal (fig. 41). All features are built from local dolerite. The house is a two bedroom building with each room 3m x 4m in size. Much of the walling has fallen over. The large kraal uses natural rock outcrop as part of the walling and is built on the gradient of the hill. It is 25m x 15m in size. The smaller kraal is to the north and is 3m x 5m in size. No other features were noted in the nearby area.

It appears that the original 'road' passes the front of the house.

The site may occur on the 1954 aerial photograph; however, that specific photo is not clear. It is in a similar style to MUL01 and MUL02 and could be predate the 1950s.

Turbine 27 (Phase 2) will occur 140m to the northeast of MUL012.

Significance: The site is of medium significance in terms of the (remaining) vernacular architecture and potential historical middens.

Mitigation: The area should be resurveyed once the grass is shorter and if the turbine and related infrastructure will occur within a 100m radius of MUL012. Mitigation could be in the form of full on site mapping and sampling of the middens.

SAHRA Rating: 3B

FIG. 40 LOCATION OF THE RECORDED SITE IN PHASE 2

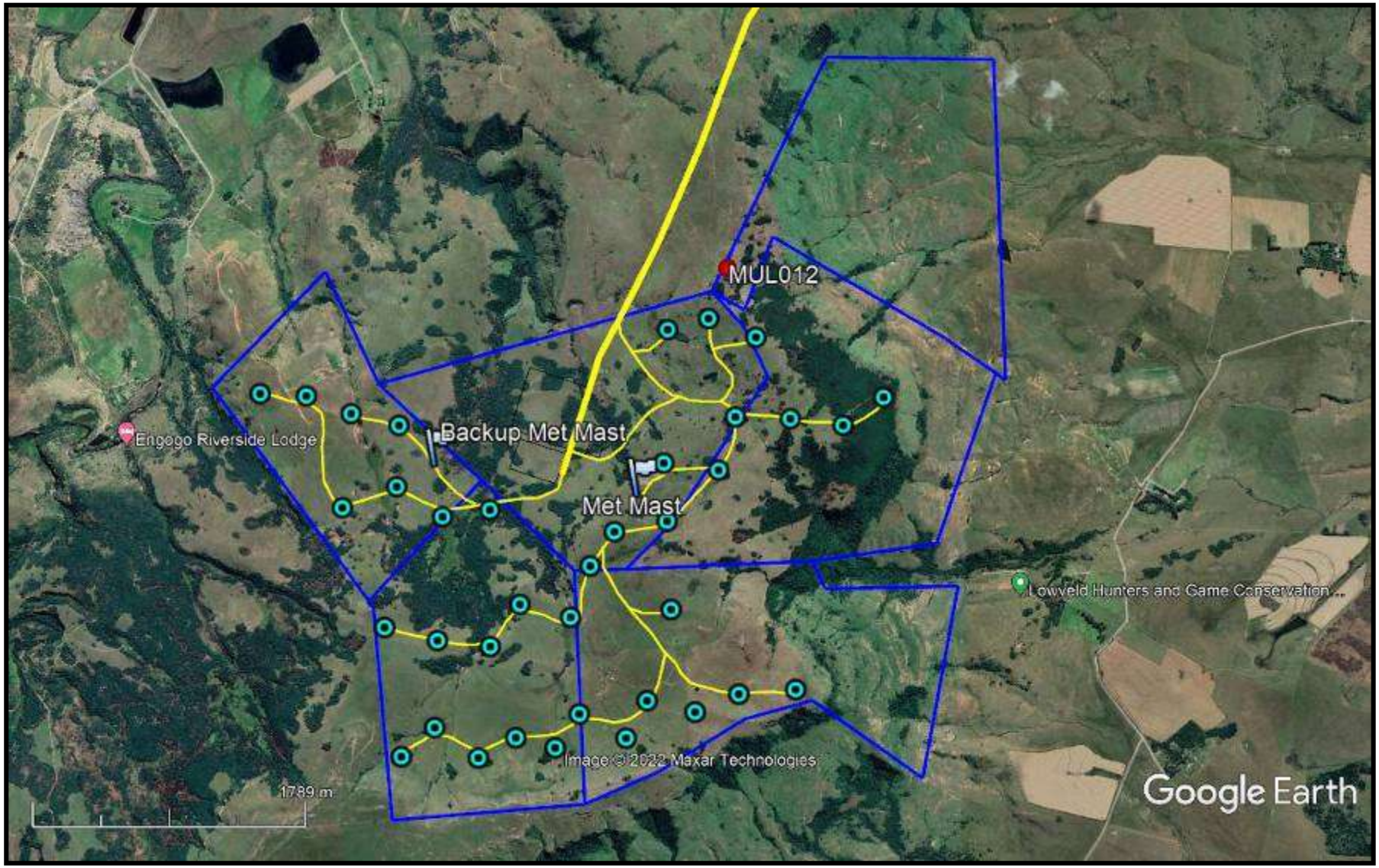


FIG. 41: BUILT FEATURES AT MUL012

ROCK ART

Several areas were noted as potential rock art sites. During fieldwork, it was established that these upper areas were of dolerite and there were no shelters. In addition to that, the incline was too steep for viable shelters/overhangs with deposit.

RECOMMENDATIONS

Most of the sites recorded during the survey will not be directly affected by the proposed WEF. The infrastructure such as roads and power grids will however occur close to several of the sites.

All graves, or assumed graves, need to be avoided. Any grave within 50m of a servitude needs to have a 20m buffer. This buffer needs to be clearly demarcated before construction begins.

Built structures need to be mapped and photographed, ff they are to be affected.

Access roads will need to be reviewed under a desktop study first and then a possible field survey. This would be especially important in areas that had dense grassland vegetation during the initial survey. Any future surveys should occur near the end of winter or after the area has had a controlled burn.

Any site that will be affected by the WEF will need a permit from KZNARI.

Table 4 summarises the significance of impacts for each site category.

TABLE 4: IMPACTS AND MITIGATION MEASURES FOR ALL PHASES OF THE PROPOSED DEVELOPMENT.

POTENTIAL ISSUE	ALT	DESCRIPTION / SOURCE OF IMPACT	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
PLANNING AND DESIGN PHASE														
The planned layout and siting of construction activities and infrastructure will currently not affect known heritage sites	Preferred	Buildings.	none	Indirect,	Slight	Study area	Short term	Unsure	Irreversible	Resource will not be lost	Easily achievable	**Low**	• 50m buffer between development and the sites.	**Low-**
		Graves	none	Indirect,	Slight	Study area	Short term	Unsure	Irreversible	Resource will not be lost	Easily achievable	**LOW -**		**LOW -**
		Non-colonial stone walled features	none	Indirect,	Slight	Study area	Short term	Unsure	Irreversible	Resource will not be lost	Easily achievable	**LOW -**		**LOW -**

CONCLUSION

A HIA of the proposed Mulilo Newcastle WEF was undertaken at a desktop and field survey level. The desktop noted several heritage sites using topographical maps and aerial photographs.

These desktop sites were surveyed in addition to the rest of study area. Most of the wind turbine locations are situated in areas that would not be used for human occupation due to the height, except for MUL012. The access roads will not affect any known heritage sites.

All recorded sites will have an initial 100m buffer around them. This will flag sites that need to be resurveyed at a later date. The servitudes should be at least 50m from the heritage sites wherever possible.

The final layout of the proposed windfarm and access roads will not affect any heritage sites.

REFERENCES

2729DB 1968, 2000 Newcastle (North)

SG MAPS

N_3988T2
N_A413T2

N_A643T1

N_2A77T1

N_2F32T1

N_BD8DT1

N_BD8DT1

N_B49DT1

N_BB8DT1

N_8539T1

DATABASES

KZN Museum

SAHRIS

Umlando

EXPERIENCE OF THE HERITAGE CONSULTANT

Gavin Anderson has a M. Phil (in archaeology and social psychology) degree from the University of Cape Town. Gavin has been working as a professional archaeologist and heritage impact assessor since 1995. He joined the Association of Professional Archaeologists of Southern Africa in 1998 when it was formed. Gavin is rated as a Principle Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

DECLARATION OF INDEPENDENCE

I, Gavin Anderson, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Gavin Anderson
Archaeologist/Heritage Impact Assessor

APPENDIX A
PIA DESKTOP STUDY

DESK-TOP PALAEONTOLOGICAL REPORT:

PROPOSED MULILO NEWCASTLE (Pty) Ltd WIND POWER 1 AND 2 WIND FARMS BETWEEN NEWCASTLE AND MEMEL IN KWAZULU-NATAL

FOR

UMLANDO: Archaeological Surveys & Heritage Management
PO Box 102532, Meerensee, KwaZulu-Natal 3901
phone (035)7531785 fax: 0865445631
cell: 0836585362 / 0723481327

Facebook: Umlando and Umlando South Africa

Email:umlando@gmail.com

by

Dr Alan Smith

Alan Smith Consulting

29 Browns Grove, Sherwood, Durban, 4091, South Africa

Telephone: 031 208 6896

asconsulting@telkomsa.net

12 December, 2021

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

EXECUTIVE SUMMARY

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm between Newcastle and Memel, within KwaZulu-Natal.

This proposed Wind Farm Footprint is underlain by rocks of the Karoo Supergroup. This contains the following lithologies:

- Karoo Dolerite
- Volksrust Formation
- Adelaide Subgroup
- Tarkastad Subgroup
- Alluvium

The Karoo Dolerite is the commonest lithology, but is not fossiliferous. Alluvium is also unlikely to be so. The Volksrust Formation could be fossiliferous, but is also unlikely as significant fossils are rare. In contrast, the Adelaide and Tarkastad Subgroups could contain significant fossil material. For this reason it is the recommendation of this report that a Palaeontological Field Assessment by a competent palaeontologist be undertaken.

1. PROPOSED PROJECT

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm in KwaZulu-Natal between Newcastle and Memel (Figures 1 & 2).

Figure 1: Location of the proposed Mulilo Newcastle (Pty) Ltd WEF. Source map GoogleEarth.

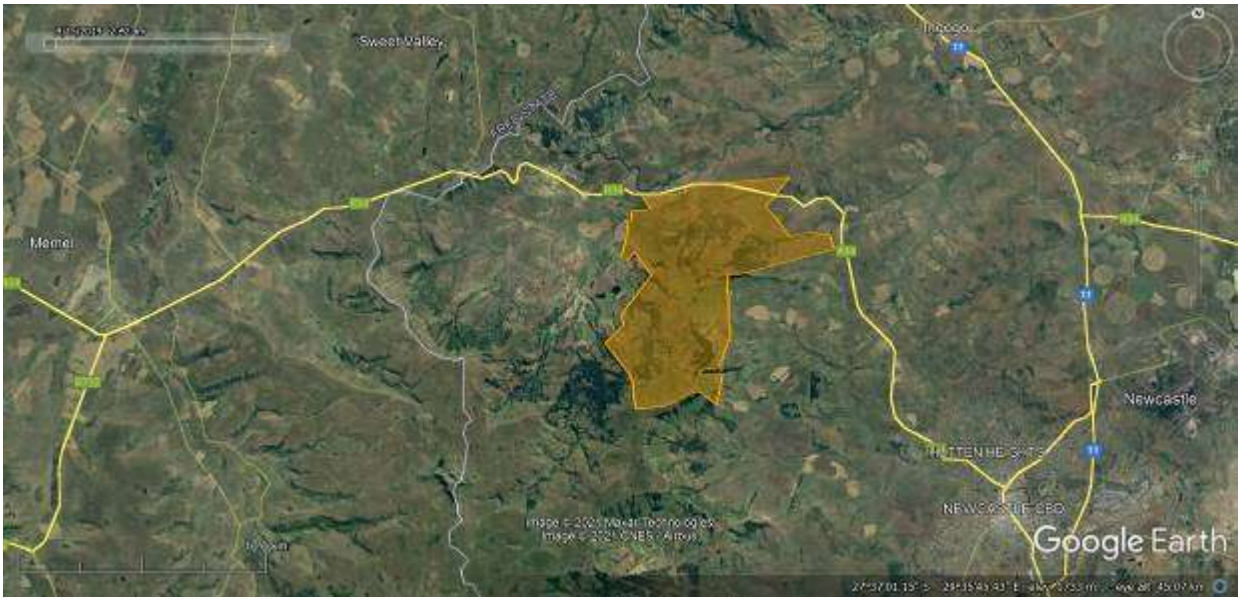


Figure 2: Zoomed in location of WEF. Source GoogleEarth.

The footprint will cover the following farms:

1. Portion 1 of the Farm Geelhoutboom No. 3350
2. Remainder Farm Bernard No. 9447
3. Remainder Farm Cliffdale No. 9439
4. Remainder Farm Spitskop No. 16302

5. Remainder Farm Byron No. 9448
6. Remainder Farm Geelhoutboom No. 3350
7. Remainder Farm Embosweni No. 17421
8. Remainder Farm Paardeplaat A Dene Heights
9. Remainder Farm Paardeplaat B No. 9390
10. Remainder Portion 1 of the Farm Franzhoek No. 8800
11. Remainder Farm Glendower No. 2901
12. Remainder Farm Lot B of Paardeplaat A No. 9389

2. GEOLOGY

The proposed project footprint site is located on Karoo Supergroup rocks (Figure 3). Anticipated rock units are as follows:

1. Dolerite (red)
2. Volksrust Formation (orange)
3. Adelaide Subgroup (Green)
4. Tarkastad Subgroup (Light green)
5. Alluvium (yellow) may be present

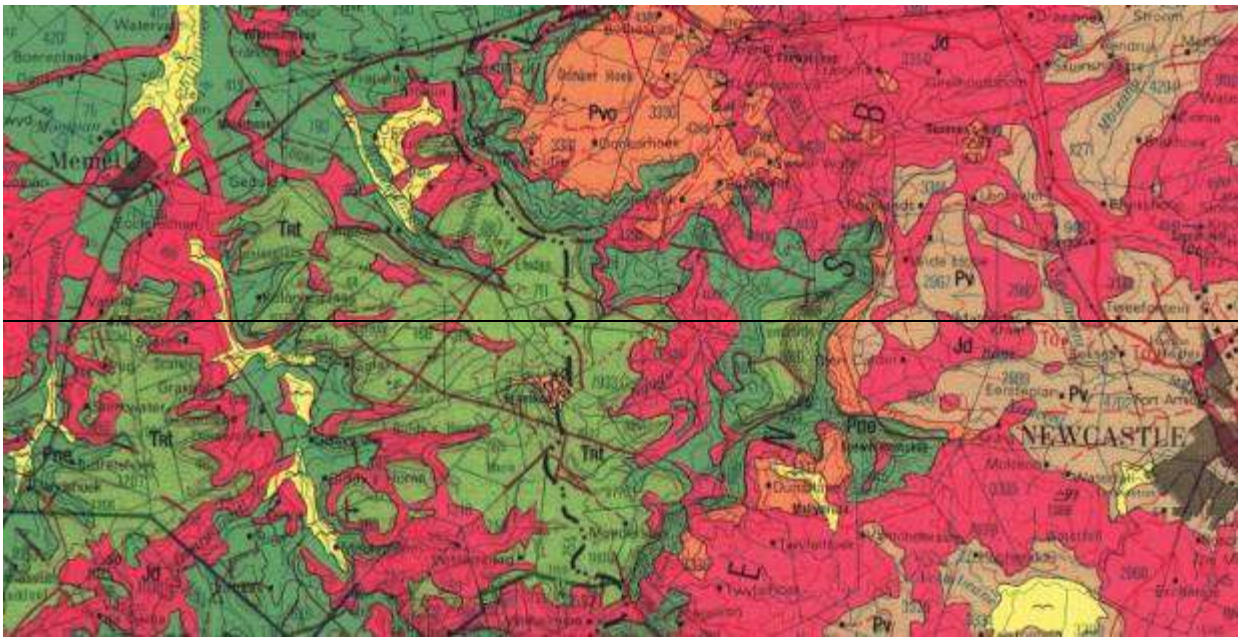


Figure 3: Extract from the Frankfort 2728 1:250 000 Geological Ma. This shows the lithologies that will be encountered. Dark Green (Pa) is described as Adelaide Subgroup, Light Green (Tkt) is Tarkastad Subgroup and Red (Jd) is Karoo Dolerite.

1. ***Karoo Dolerite***

Dolerite intrusions may be present. These are 184 million years (Ma) old and represent the onset of the break-up of the Gondwana Supercontinent (Hastie et al (2014). According to Watkeys (2006), Gondwana rifting commenced between 155 and 135 Ma.

2. Volksrust Formation

The Volksrust Formation is Late Permian in age (Cairncross et al. 2005). Typically, it comprises a blue-black shale (Figure 4). This unit was deposited in generally non-marine conditions (Cataneneau et al., 1998), but pockets of marine conditions were present (Cairncross et al., 2005). Quaternary sediments comprise alluvium (river deposits) and colluvium (hill slope deposits).

Figure 4: Example of the Volksrust Formation. This lithology is typically a blue shale and very weathered.

3. Adelaide Subgroup

The Beaufort Group (part of the Karoo Supergroup) is a sequence of fluvio-lacustrine sedimentary rocks that accumulated in a landlocked, intracratonic foreland basin in SW Gondwana during the Middle Permian to Middle Triassic (Neveling et al., 2005).

The Lower Beaufort Group is represented here by the Adelaide Subgroup (SACS, 1980). In Kwazulu-Natal the Adelaide Subgroup is represented by the Permian Estcourt Formation, which forms flat terrain, in the middle, by the Belmont Formation, and the upper by the Otterburn Formation (Green, 1998). This subdivision is not represented on the Frankfort 1: 250 000 geological map (Figure 3). These rocks formed from sediments originally deposited within a fluvial-floodplain constructed by meandering rivers in a semi-arid climate (Figure5), flowing into a large inland sea (Karoo Sea). Lacustrine environments alternate with fluvial environments indicating a series of transgressive-regressive lacustrine episodes (Green, 1998).

Field Investigation PIA: Newcastle Pase 1 and 2 Wind Farms

Figure 5: Example of what a channel cutting down into red shales of the Adelaide Sub-Group would look like (image near Bergville).

4. Tarkastad Subgroup

The Tarkastad Subgroup is Triassic in age (252 to 201 Ma or million years) and is characterized characterized by alternating sandstones (which crop out as cliffs) and mudstones (often red in colour). These are often arranged in fining-upward units (coarse-grained sandstone at the base and mudstones above. The original sediments were deposited by fluvial processes within an arid landscape. In this area, river flow was generally north to south. Fossils would be expected to be within the floodplain mudstones, rather than the river channels where preservation is unlikely.

5. Alluvium

This is modern sands and muds deposited along a water course.

.

3. PALAEONTOLOGY

The palaeosensitivity of this area is shown in Figure 6. It is mostly grey, which is not fossiliferous, but also contains colour codes of red and yellow. According to SAHRIS, a Field Assessment is essential for the red shaded areas, and possibly for the yellow.

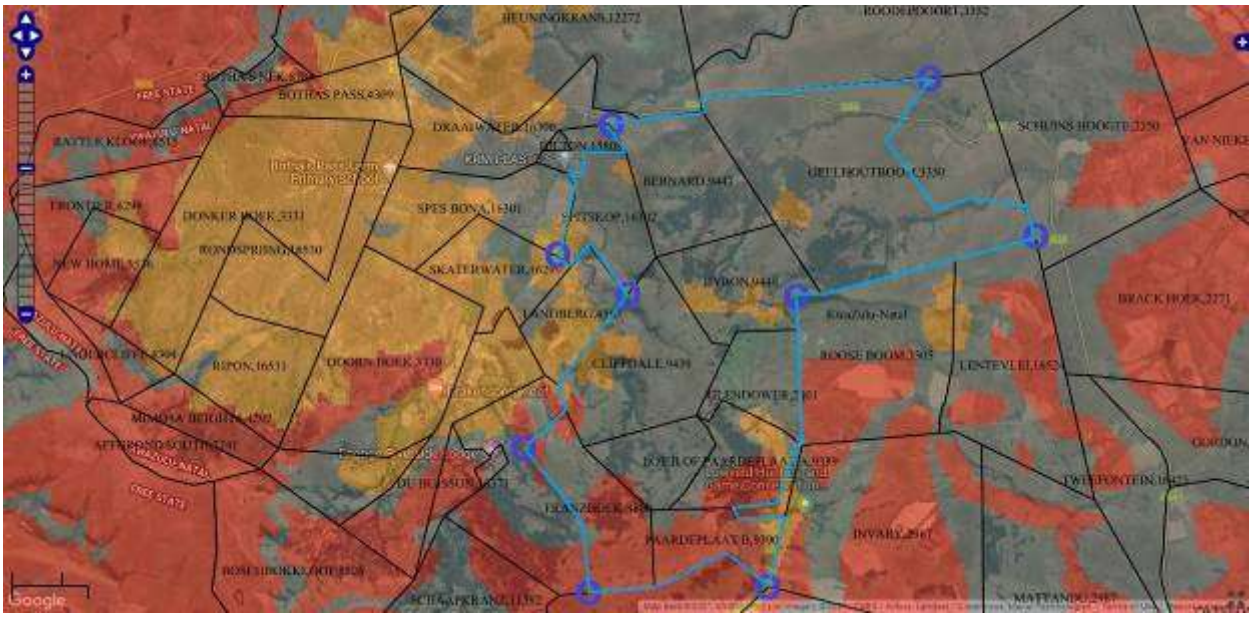


Figure 6: Palaeosensitivity of rocks in the Mulilo Newcastle WEF footprint (blue outline). Most of the area is dolerite (grey) and of no concern however the thickness of the dolerite is unknown.

The Volksrust Formation

Evidence of trace fossil bioturbation is common within the Volksrust Formation siltstones and mudstones, however the various trace fossil (ichnofossil) types are not always identifiable. These are common and of little Palaeontological Significance.

The bivalve *Megadesmus* has been recoded from the Volksrust Formation (Cairncross et al., 2005). This fossil is large, 9 cm dorsally and 8.4 cm laterally (Figure 7). *Megadesmus* is

known from other parts of the Gondwana Supercontinent (Australia, India, Siberia, South America and Tasmania). Its presence indicates exclusively marine conditions. The implication for the northeastern Karoo Basin during the Late Permian is that a marine enclave still existed in

this geographic area and that terrestrial conditions did not yet prevail as in the southern basin region (Cairncross et al, 2005).

Fig. 7: Megadesmus bivalve. This image was obtained from Cairncross et al. (2005).

Adelaide Subgroup

The Adelaide Subgroup may contain Permo-Triassic Boundary, if it has been preserved. The Upper Permian is separated from the Triassic by the Permo-Triassic Extension (PT Boundary), the greatest of the Phanerozoic (541Ma to present) Extinction Events. This occurrence is also known as the Great Dying, a time in Earth's history when 95% of all life on Earth became extinct. The reasons for this are still controversial. There have been five great extinction events in the Phanerozoic Era, but the Permo-Triassic Boundary represents the greatest extinction event in the Earth's history. If this is present it will be fundamental in palaeontological importance.

The P/T Boundary is expected to be found within marine sediments where a complete time deposition record may accumulate. In contrast, the Adelaide Subgroup comprises terrestrial sediments as sedimentary rocks. Preservation requires a large number of geological processes to come together, but these are less likely to take place during terrestrial deposition. Consequently the placement of the Permo-Triassic Boundary is not accurately known, if it has in fact been preserved in southern Africa. Present evidence indicates that the Permo-Triassic Boundary is unlikely to be located in the development area but must be considered.

Evidence of bioturbation is ubiquitous within the Adelaide Subgroup siltstones and mudstones, however the various trace fossil (ichnofossil) types are not always identifiable. Trace fossils are very common within the Beaufort Group (Figures 8 & 9). These have limited **Palaeontological** value.

Figure 8: Examples of trace fossils found near Bergville, similar examples could be found on the Mulilo Newcastle WEF 1 and 2 sites. This trace fossil could be *Arenicolites*.

Figure 9: Trace fossils of unknown species, possibly a shrimp that could be found in these rocks..

The Adelaide Subgroup is known internationally for its fossils (Cisneros et al., 2008). It contains plant- and animal- fossils. The latter include a wide variety of body fossils, including the mammal-like reptiles such as the Upper Permian- Dicynodon (Figure 10) and the Triassic- aged Lystrosaurus (Neveling et al., 2005) and trace fossils (Green, 1997).

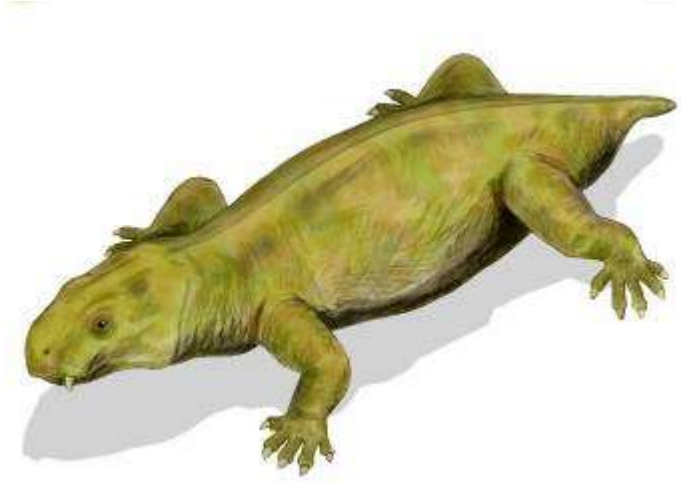


Figure 10: Dicynadon reproduction (Wikepedia).

Tarkastad Subgroup

The Tarkastad Subgroup is an important fossil bearing rock (Neveling et al., 2006). It is considered highly palaeontologically sensitive as it may record the post PT Boundary record. can be recorded within this based on the important post-extinction (PT Event) continental biotas of Early Triassic age recorded from this unit in the Main Karoo Basin (SAHRIS website). This level is known to contain palaeontologically important Early Triassic terrestrial fossils from the period around 252 million years old, or post PT Boundary (Groenewald & Kitching 1995, Rubidge 2005, Smith et al. 2012). This fauna is dominated by therapsids or “mammal-like reptiles” and other tetrapods. Rare vascular plants and some trace fossils are known. The uppermost two biozones of the Beaufort Group, the *Lystrosaurus* and *Cynognathus* assemblage zones, record terrestrial biotic recovery following the Permo-Triassic mass extinction event (Neveling et al 2006).

Karoo Dolerite

Karoo Dolerite is also present. This is an igneous intrusive rock and by definition cannot be fossiliferous.

Alluvium

Reworked palaeontological Material could be found in the Quaternary alluvium sediments, but is unlikely.

4. SUMMARY AND CONCLUSIONS

This site is dominated by Karoo Dolerite which is not fossiliferous. Similarly any alluvium can also be ignored. However the remaining lithologies may be fossiliferous. The Volksrust Formation could be fossiliferous, but is also unlikely to be so as significant fossils are rare. In

contrast, the Adelaide and Tarkastad Subgroups might contain significant fossil material. For this reason it is the recommendation of this report that a Palaeontological Field Assessment by a competent palaeontologist be undertaken.

5. REFERENCES

Cairncross, B; Beukes, NJ; Coetzee, LL; Rehfeld, U. (2005) The bivalve Megadesmus from the Permian Volksrust Shale Formation (Karoo Supergroup), northeastern Karoo Basin, South Africa: implications for late Permian Basin development. South African Journal of Geology, 108: 547-556.

Catuneanu, O., Hancox, P.J., Rubidge, B.S., 1998. Reciprocal flexural behaviour and

contrasting stratigraphies: a new basin development model for the Karoo retroarc foreland system, South Africa. Basin Res. 10, 417–439.

Cisneros, J. C., Rubidge, B. S., Mason, R. & Dube, C. (2008). "Analysis of millerettid parareptile relationships in the light of new material of Broomia perplexa Watson, 1914, from the Permian of South Africa. Journal of Systematic Palaeontology, 6, 453-462". Journal of Systematic Palaeontology. **6**(4): 453–462.

Green, D (1997). Palaeoenvironments of the Estcourt Formation (Beaufort Group), KwaZulu-Natal. MsC (unpubl.), Department of Geology and Applied Geology, University of Natal Durban.

Groenevald, G (2017). Chance find protocol “for the proposed Greater Bulwer DonnyBrook Bulk Water SupplyA Scheme (GBDBWSS): Harry Gwala district Municiplality, KwaZuluNatal.

Groeneweld, G.H. & Kitching, J.W. 1995. Biostratigraphy of the Lystrosaurus Assemblage Zone. Pp. 35-39 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1, 46 pp. Council for Geoscience, Pretoria.

Harrismith 2828 1: 250 000 Geological Map. Council for Geosciences, Pretoria.

Field Investigation PIA: Newcastle Pase 1 and 2 Wind Farms

Hastie, WW; Watkeys, MK; Aubourg, C (2014). Magma flow in dyke swarms of the Karoo LIP: Implications for the mantle plume hypothesis. Gondwana Research 25 (2014) 736–755.

Neveling, P.J. Hancox & B.S. Rubidge (2005) Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of early Triassic tetrapods. *Palaeont. afr.*) 41: 81–87.

Rubidge, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. South African Journal of Geology 108: 135-172.

SACS (South African Committee for Stratigraphy (1980). Council for Geosciences, Pretoria.

Sahris. https://sahris.sahra.org.za/map/palaeo

Smith, R., Rubidge, B. & van Der Walt, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis

Watkeys, M.K., 2006. Gondwana break-up: a South African perspective. In: M.R. Johnson, C.R. Anhaeusser and R.J. Thomas (Editors), The Geology of South Africa, Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 531-539.

7. DETAILS OF SPECIALIST

Dr Alan Smith

Private Consultant: ***Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091***

&

Honorary Research Fellow: ***Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban***.

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Scientific Research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published more than 50 journal articles with 360 citations (detailed CV available on request).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.
- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.

Field Investigation PIA: Newcastle Pase 1 and 2 Wind Farms

- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.

APPENDIX B
PIA FIELD SURVEY

FIELD INVESTIGATION PALAEONTOLOGICAL REPORT: PROPOSED MULILO NEWCASTLE (Pty) Ltd FOR:

- **WEF PHASE 1,**
- **WEF PHASE 2**
- **& ASSOCIATED POWER GRIDLINES**

TO BE ERECTED BETWEEN NEWCASTLE IN KWAZULU-NATAL AND MEMEL IN THE FREE STATE

FOR

UMLANDO: Archaeological Surveys & Heritage Management
PO Box 102532, Meerensee, KwaZulu-Natal 3901
phone (035)7531785 fax: 0865445631
cell: 0836585362 / 0723481327
Facebook: Umlando and Umlando South Africa
Email:umlando@gmail.com

by

Dr Alan Smith
Alan Smith Consulting
29 Browns Grove, Sherwood, Durban, 4091, South Africa
Telephone: 031 208 6896
asconsulting@telkomsa.net

17 May, 2022

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

EXECUTIVE SUMMARY

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm within KwaZulu-Natal between the towns of Newcastle and Memel (Free State province). This report was compiled by Dr Alan Smith of Alan Smith Consulting (Appendix 1) and follows the Desk-Top PIA report recommendation that a Field Investigation should be under taken.

This proposed Wind Farm footprint (WEF Phase 1 and WEF Phase 2) is underlain by rocks of the Karoo Supergroup. The powerlines are underlain by rocks belonging to the upper Vryheid Formation. This contains trace fossils and fossil woods, but vertebrate fossils have not been recorded. A "Chance Find Protocol" will suffice for this (Appendix 2.

WEF Phase 1: This is to be developed almost entirely on dolerite which is not fossiliferous. Those that may contain fossils are depressions which are unlikely to be developed. The Chace Find Protocol (Appendix 2) will provide sufficient mitigation for these areas

WEF Phase 2: The Desk-Top PIA report (Appendix 3) indicated that the southern part of WEF Phase 2 of the Wind Farm was to be constructed on Adelaide Subgroup (Normandien Formation) and Tarkastad Subgroup. Both these subgroups are known for their vertebrate fossils. Fieldwork proves that the Frankfort (2728) 1: 125 000 geological map is incorrect at this point and that the entire plateau is dolerite and not fossilferous. Fossiliferous lithologies are present in WEF Phase 2, but these are located within depressions, areas where wind turbines are unlikely to be placed. The "Chance Find Protocol" (Appendix 2) provides sufficient mitigation.

The power gridlines traverse dolerite (non-fossiliferous) and Vryheid Formation (possible rare fossils). The dolerite can be ignored. The "Chance Find Protocol" (Appendix 2) will mitigate the Vryheid Formation.

No further palaeontological work is required for this project's current footprint (WEF Phase 1 & 2 and power gridlines).

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

1. PROPOSED PROJECT

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm in KwaZulu-Natal (KZN) between Newcastle and Memel (Figures 1 & 2). The Wind Energy Farm (WEF) footprint will cover the following farms:

13. Portion 1 of the Farm Geelhoutboom No. 3350
14. Remainder Farm Bernard No. 9447
15. Remainder Farm Cliffdale No. 9439
16. Remainder Farm Spitskop No. 16302
17. Remainder Farm Byron No. 9448
18. Remainder Farm Geelhoutboom No. 3350
19. Remainder Farm Embosweni No. 17421
20. Remainder Farm Paardeplaat A Dene Heights
21. Remainder Farm Paardeplaat B No. 9390
22. Remainder Portion 1 of the Farm Franzhoek No. 8800
23. Remainder Farm Glendower No. 2901
24. Remainder Farm Lot B of Paardeplaat A No. 9389

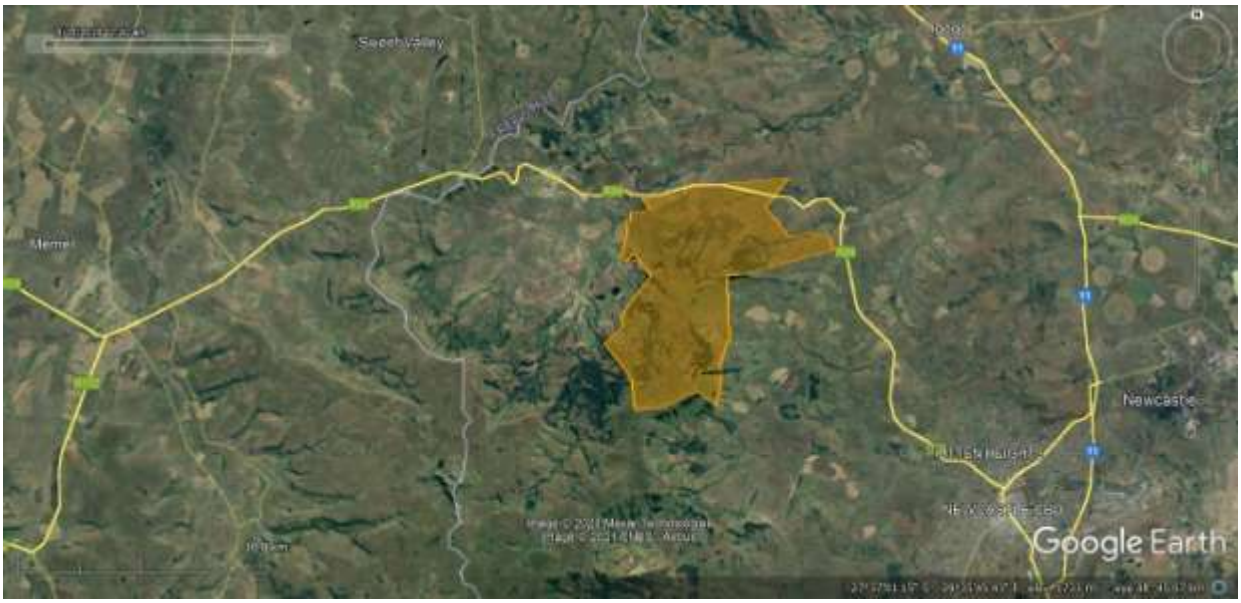


Figure 1: Location of the proposed Mulilo Newcastle (Pty) Ltd wind farm between Newcastle and Memel. Only the WEF footprint is shown. Major roads are indicated in yellow and the provincial border between KZN and the Free State is indicated in grey.

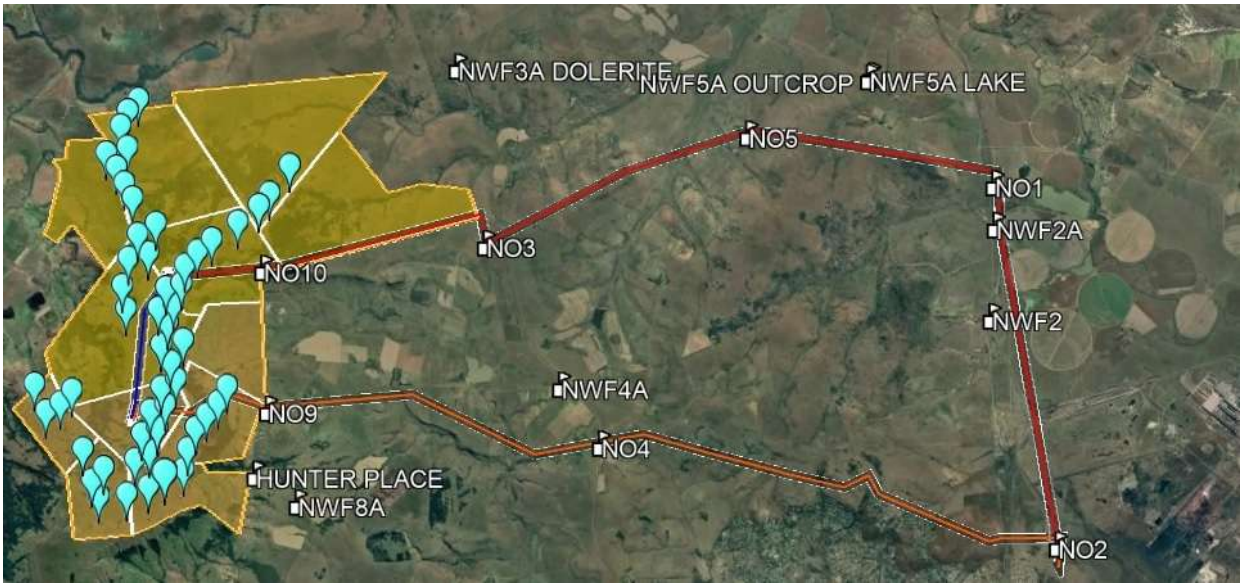


Figure 2: Zoomed in location of WEF. The blue balloons are proposed wind turbine placements. The red lines are the power line grid. The codes are positions which were visited during the ground truthing (refer Table 1).

2. GEOMORPHOLOGY

The proposed Wind Energy Farm (WEF) location is dominated by a plateau in the west and lowlands to the east. The plateau is the proposed site for the WEF and the lowland that of the connecting power grids (Figures 1 & 2). The plateau is structurally controlled by a dolerite sill. The lowlands comprise wetlands, underlain by Vryheid Formation sandstone and low, rounded dolerite hills.

3 GEOLOGY

The proposed WEF project footprint site is located on rocks of the Karoo Supergroup (Figure 3). Anticipated rock units from the Frankfort (2728) Geological map (Figure 3) are as follows:

6. Dolerite (Red)
7. Vryheid Formation (light brown: this underlies the proposed gridlines).
8. Volksrust Formation (Orange)
9. Normandien Formation of the Adelaide Subgroup (Green)
10. Tarkastad Subgroup (Light green)

Figure 3: Extract from the Frankfort 2728 1:250 000 Geological Map. This shows the lithologies encountered. Dark Green (Pa) is described as Adelaide Subgroup, Light Green (Tkt) is Tarkastad Subgroup and Red (Jd) is Karoo Dolerite.

3.1 FIELD GROUND-TRUTHING

A fieldwork investigation was undertaken during 21 – 25 March 2022. The area in question is illustrated in Figure 4. Field location points are provided in Table 1, along with key location reference points taken from the kmz files supplied.

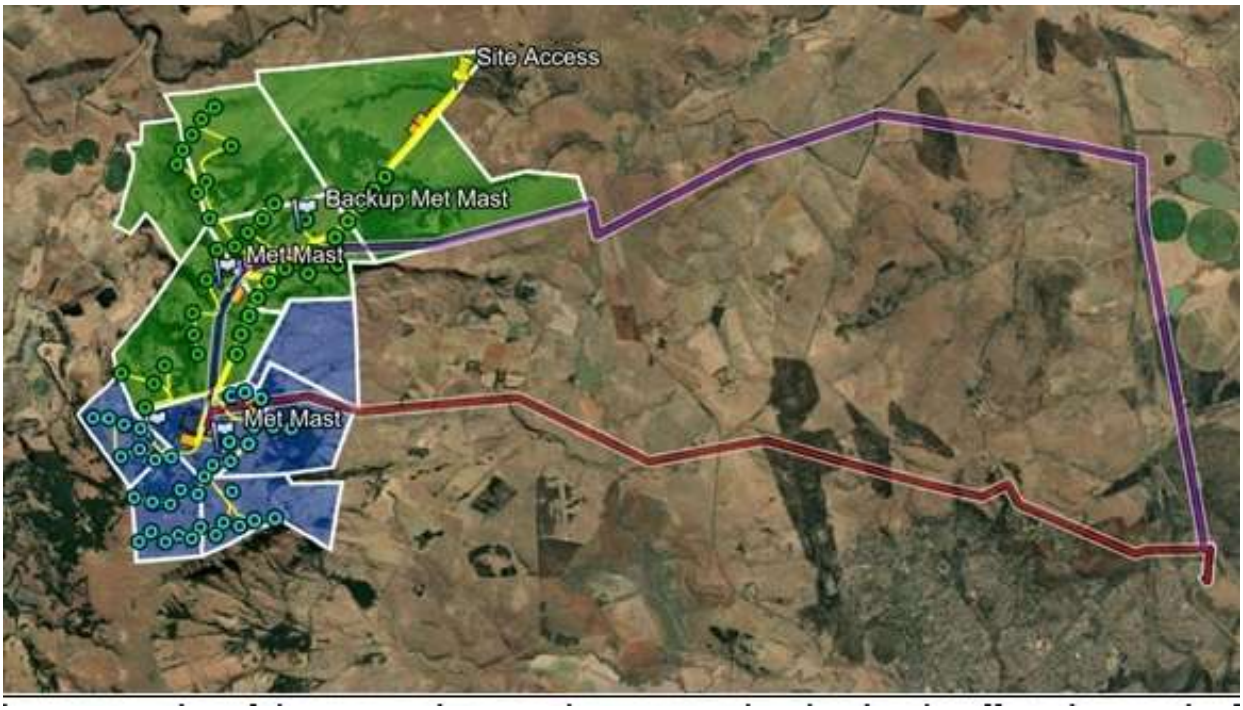


Figure 12: Location of the proposed Newcastle WEF Complex. WEF Phase 1 (Green) and WEF Phase 2 (Blue). Proposed Gridlines are shown as purple and red lines.

Table 1: Locations where data was captured during 21-25 March 2022

Name	latitude	longitude	elevation
GPS SITE VISITS			
NWF2	-27.6762	29.9663	1223.58
NWF2A	-27.6597	29.9671	1201.18
NWF5A LAKE	-27.6329	29.9413	1241.82
NWF5A OUTCROP	-27.6326	29.9417	1237.85
NWF3A DOLERITE	-27.6310	29.8573	1400.66
NWF4A	-27.6886	29.8785	1340.88
NWF8A	-27.7098	29.8247	1383.74
HUNTER PLACE	-27.7046	29.8161	1457.20
SWEETWATER	-27.6651	29.7738	1583.36
VO X CUT	-27.8293	29.6600	1867.04
MOORFIELD	-27.8758	29.7084	1779.04
TKT1	-27.7067	29.8121	1559.92
TKT VIEW	-27.7093	29.8070	1746.03
TOP GATE	-27.7090	29.8040	1852.31
T36 TO T29 JD	-27.7079	29.8011	1860.24
DOLERITE	-27.7071	29.8007	1859.83
T29 VIEW	-27.7065	29.8011	1846.11
POWER LINE REFERENCES			
NO1	-27.6521	29.9669	1209.75
NO2	-27.7174	29.9798	
NO3	-27.6629	29.8631	1385.56
NO4	-27.6992	29.8866	1320.36
NO5	-27.6431	29.9166	1212.55
NO9	-27.6929	29.8186	1358.87
NO10	-27.6674	29.8177	1318.49
TURBINE REFERENCES			
T008	-27.7109	29.7826	1435.57
T010	-27.6758	29.7888	1228.74
T011	-27.7053	29.7808	1240.42
T013	-27.7139	29.7840	1444.10
T020	-27.6936	29.7709	1235.81
T021	-27.6968	29.8084	1279.89
T029	-27.7053	29.8021	1392.88
T033	-27.7087	29.7850	1571.19
T036	-27.7090	29.8013	1397.74
TO38	-27.6518	29.7856	1223.82

3.1.1 WEF Gridlines Footprint

The proposed power gridlines were not included in the desk-top PIA, as this information was not available. When the gridlines were considered, it was found that they would cross Vryheid Formation sandstone and Karoo dolerite. The Vryheid Formation is represented by flat terrain, often covered by wetlands. The dolerite here is represented by low, rounded hills. The gridlines will follow some existing corridors occupied by Eskom powerlines and railway lines (Figure 4).

Figure 4: View across a proposed grid line location. This is the north-south section that includes the railway (location NWF2, on section NO1 to NO2, in Figure 2).

SECTION 1: NO2 – NWF2 – NWF2A - NO1 (Figure 2)

This section follows the main Newcastle Railway Line. The rock is very weathered and mostly flat and covered with wetlands. In order to traverse these wetlands, the railway line has been elevated on rock embankments (Figure 5). This rock has been sourced both locally and from elsewhere. At the extreme north of this traverse the scenery changes to flat terrain separating low, rounded dolerite hills (Figure 5).

Figure 5: Image showing the railway line embankment, Eskom electricity powerlines and the low-rounded hills to the north.

SECTION 2: NO1- NO5 – NO3 (Figure 2)

Section 2 comprises mostly low, rounded hills and wetlands, similar to Section 1. At location NO5A the rock comprises very poorly sorted-to-pebbly sandstone (Figure 5). This is very weathered, but may contain *skolithos* trace fossils.

Figure 7: Wetland at locality NWF5A. Outcrop is sparse in this region and this image was near the proposed grid line.

Figure 8: Close up of the rock outcropping in the lake at locality NWF5A. This rock is very poorly sorted, coarse-grained and cross bedded.

Figure 9: Eastward view across to the plateau. Image captured at NO5 (Figure 2).

SECTION 3: NO5 – NO3 – NO9 (Figure 2)

This was very similar to Section 3.

SECTION 4: NO5 – NWF$A – NO4 (Figure 2)

This geology was as before. The route paralleled the plateau to the west (Figure 10).

Figure 10: The flat terrain can be observed, with the plateau to the west.

SECTION 5: NO4- NWF8A – NO9 (Figure 2)

Topography was similar to before. However, Volksrust Formation was observed at point NWF8A, to the south of the proposed WEF. This rock was very weathered, however evidence of slumping on a metre-scale was observed (Figure 11).

Figure 11: Example of the Volksrust Formation. Image captured at NWF8A (Figure 2). This lithology is typically a black or blue shale, but can be brown, as in this case, when weathered. The rock shows evidence of slumping, probably indicating a deltaic origin.

3.1.2 Rocks underlain by the Proposed Turbine Farm

3.1.2.1 WEF Phase 1

Most of the proposed WEF Phase-1 is to be developed on dolerite (Figure 3). The relative competency of this rock and the forces of erosion have carved this dolerite sill into a prominent plateau (Figure 10).

3.1.2.2 WEF Phase 2

WEF Phase 2 is proposed to be erected on the southern portion of the same plateau as WEF Phase -1 (Figure 4). According to the information contained within the Frankfort 2728 1:250 000 Geological Map, the southern part of the plateau, on which the proposed WEF Phase 2 is to be constructed, would be on Normandien Formation (Adelaide Subgroup: green) and Tarkastad Subgroup (light green) rocks (Figure 12).

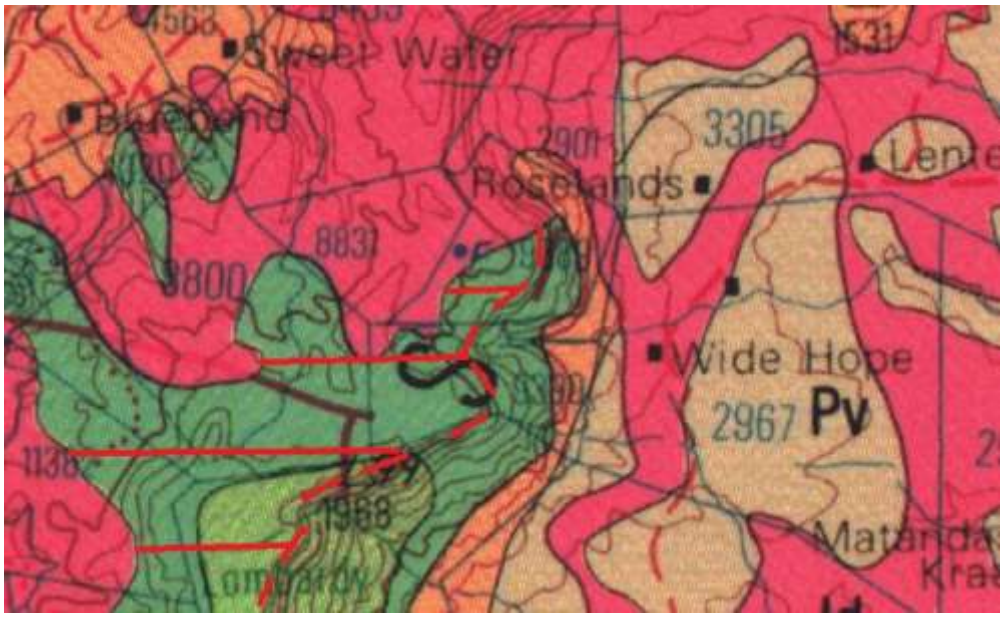


Figure 12: This extract from the Frankfort (2728) 125 000 geological map shows the actual situation. The red hashed region between the dolerite red (top, right centre) and the red dashed SW-NE line (bottom centre) is dolerite. The dashed line follows the top of a prominent dolerite cliff line (see figure .).

Road access to the proposed WEF Phase-2 site proved somewhat difficult. A field traverse from Wide Hope (Hunter Place on Figure 2) up the eastern slope of the plateau onto the southern section of the proposed wind turbine farm showed that the Frankfort Geological map is incorrect. The geology is comprised of dolerite (red: Figure 12) all the way to the red-dotted line (which marks the escarpment edge). Thus a possible problematic palaeontological section (see Palaeontology) identified from the SAHRIS Palaeosensitivity map, which is informed by the geological map, at the southern section is resolved.

Figure 13: View NW from location NO9 (Figure 2). The prominent upper cliff (top left of image) is the edge of a dolerite sill that forms the plateau on which the proposed WEF will be located. The slope leading up to the basalt plateau shows a lower cliff (right of image) which is Tarkastad Subgroup sandstone; below this is Normandien Formation (Adelaide Subgroup) marked by the grass slope. The wooded valley is underlain by Volksrust Formation sandstone.

The plateau surface varies from relatively flat to gently undulating (Figures 14 & 15).

Figure 14: Typical dolerite plateau topography. This image was captured in the location of proposed Wind Turbine 021 in the proposed WEF Phase-2 locality. This area is classified code red in the palaeosensitivity map due to the error in the Frankfort (2728) geological map. It should be classified grey, as it is of no palaeontological significance (Figure 16).

Figure 15: Surface of the dolerite sill (the sill that creates the plateau on which the proposed WEF would be erected) showing loose dolerite boulders. Image captured near the view shown in Figure 14.

3.2 SUMMARY OF GEOLOGY

3.2.1 Major Lithologies

3.2.1.1 Karoo Dolerite

This dolerite sill was intruded 184 million years (Ma) ago and represents the onset of the break-up of the Gondwana Supercontinent (Hastie et al (2014). According to Watkeys (2006), Gondwana rifting commenced between 155 and 135 million year ago (Ma).

3.2.1.2 Vryheid Formation

The Permian aged Vryheid Formation (Kungurian Stage ¬ 260Ma: Green and Smith, 2012) comprises predominantly coarse-grained sandstone and siltstones, interbedded by dark shales and coal beds. The Formation is interpreted as "near-shore sandbars" and deltaic deposits that prograded into the ancient Karoo Sea. The latter was located within central part of the Gondwana supercontinent (Johnson et al, 2009).

3.2.2 Subordinate Lithologies

These lithologies occur on the southeasterly slope below the dolerite plateau. At present there is no plan to erect turbines on this slope. Consequently, although these lithologies occur on the WEF Footprint, they are not "in play".

3.2.2.1 Volksrust Formation

The Volksrust Formation is Late Permian in age (Cairncross et al. 2005), typically, it comprises blue-black shale (Figure 4). This unit was deposited in generally non-marine conditions (Cataneneau et al., 1998), but pockets of marine conditions were present (Cairncross et al., 2005).

3.2.2.2 Normandien Formation (Adelaide Subgroup)

This occurs on the southeastern plateau slope. The Beaufort Group (part of the Karoo Supergroup) is a sequence of fluvio-lacustrine sedimentary rocks that accumulated in a landlocked, intracratonic foreland basin in SW Gondwana during the Middle Permian to Middle Triassic (Neveling et al., 2005).

The Lower Beaufort Group is represented here by the Adelaide Subgroup (SACS, 1980). In Kwazulu-Natal the Adelaide Subgroup is represented by the *Permian Estcourt Formation*, which forms flat terrain, in the middle, by the *Belmont Formation*, and the upper by the *Otterburn Formation* (Green, 1998). This subdivision is not represented on the Frankfort 1: 250 000 geological map (Figure 3). These rocks formed from sediments originally deposited within a fluvial-floodplain, constructed by meandering rivers in a semi-arid climate, flowing into a large inland sea (Karoo Sea). In the rock record, lacustrine environments alternate with fluvial environments, indicating a series of transgressive-regressive lacustrine episodes (Green, 1998).

3.2.2.3 Tarkastad Subgroup

The Tarkastad Subgroup is Triassic in age (252 to 201 Ma or million years) and is characterized by alternating sandstones (which crop out as cliffs) and mudstones (often red in colour). These are often arranged in fining-upward units (coarse-grained sandstone at the base and mudstones above). The original sediments were deposited by fluvial processes within an arid landscape. In this area, river flow was generally north to south. Fossils would be expected to be within the floodplain mudstones, rather than the river channels, where preservation is unlikely.

.

4. PALAEONTOLOGY

4.1 WEF Phase-1

The WEF Phase-2 area is grey with scattered yellow patches. Grey requires no palaeontological work. The yellow patches are discussed in Section: 4.3).

4.2 WEF Phase-2

The palaeosensitivity of this area, as shown in the SAHRIS Palaeosensitivity map, is provided in Figure 16. It is mostly grey (in this case, corresponding to dolerite), which is not fossiliferous. However, the southern portion is coded red and triggered a Field Assessment. Fieldwork has shown that the dolerite plateau extends beyond the Wind Farm (Figure 16). In **practice the entire proposed WEF area is located on a dolerite plateau (Figure 12).**

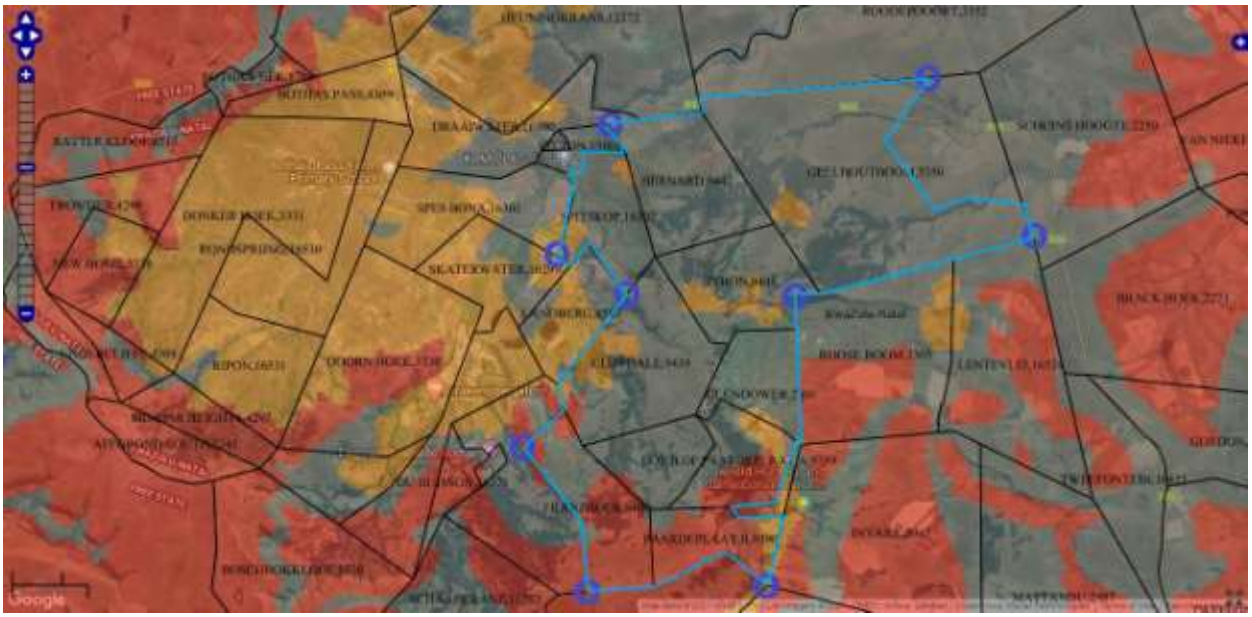


Figure 16: Palaeosensitivity of rocks in the Mulilo Newcastle WEF footprint (blue outline). Most of the area is dolerite (grey) and this includes the red patch at the southern end of the proposed WEF site (see section 3: Geology). The yellow patches are Volksrust Formation which is of lesser palaeontological significance.

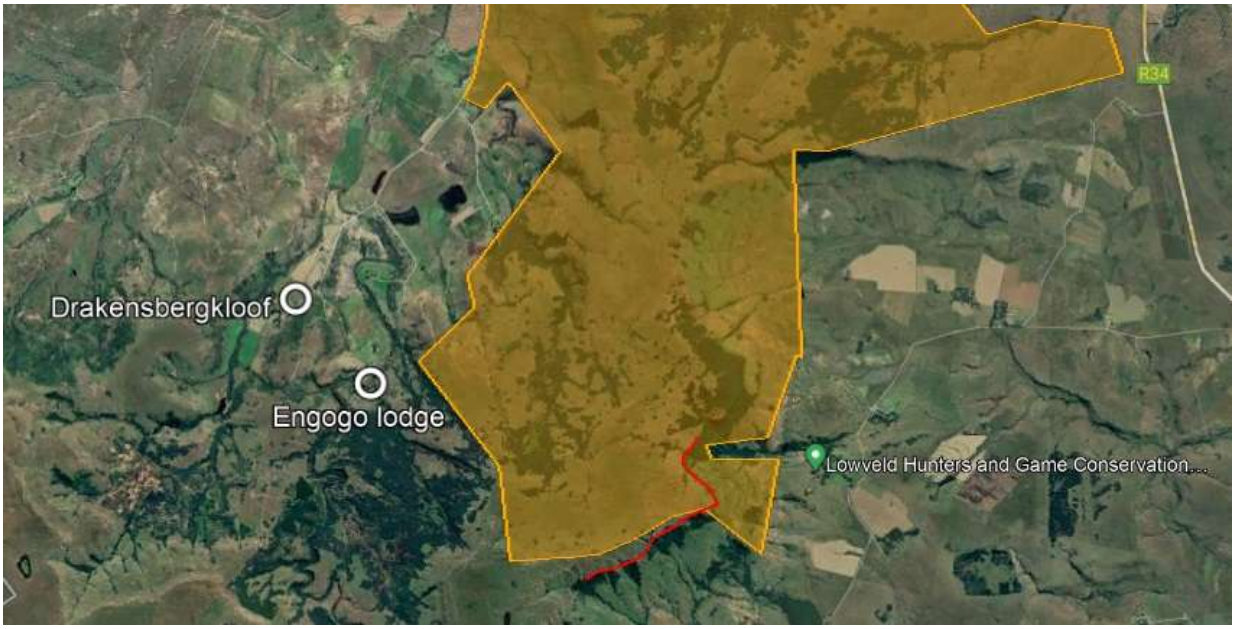


Figure 15: The red line marks the southern boundary of the Dolerite Plateau. No wind turbines are proposed to be erected southeast of the Dolerite Plateau boundary as this is a steep slope and access is difficult.

4.1.2 The Vryheid Formation

The SAHRIS Palaeosensitivity Map considers the Vryheid Formation as a **Very High Palaeosensitivity Zone**. In practice, no vertebrate fossils have been recorded from the Vryheid Formation in this area, however invertebrate trace fossils are common (Tavener Smith, 1983; Mason and Christie, 1985; Hastie et al., 2019). The aquatic reptile, *Mesosaurus* (earliest known reptile from the Karoo Basin), as well as the fish, *Palaeoniscus capensis*, have been recorded in the Whitehill Formation in the southern part of the Main Karoo basin (MacRae, 1999), in which the sediments which became lithified to become the Vryheid Formation, are believed to have been deposited. The Whitehill Formation (500 km to the southwest), within the Main Karoo Basin, *may* be a correlative of the Vryheid Formation, however they are not physically connected. Further, recent research has shown that the lower part of the Vryheid Formation in this area has a different source (Maurice Ewing Bank) to the rest of the Vryheid Formation (Hastie et al., 2019).

Coal seams are known from the Vryheid Formation in this region (Tavener Smith, 1982; Hastie et al., 2019), however at this stratigraphic level they are unlikely and if encountered will be very thin. Coal comprises compressed plant material and thus constitutes a fossil. Plants such as *glossopteris*, *gangamopteris* and *sigillaria* can be recognized, but these are common. Thin beds containing fossil woods are possible. Trace fossils are to be expected, but these are not significant.

4.3 Minor Palaeontological Implications

The area covered by high sensitivity lithologies has been significantly reduced. Minor pockets of the following lithologies, considered highly sensitive by the SAHRIS Palaeosensitivity Map may be encountered:

- **Volksrust Formation**
- **Normandien Formation (Adelaide Subgroup)**
- **Tarkastad Subgroup**

These lithologies will occur on steep slopes and in depressions, areas where wind turbines are unlikely to be located. Outcrop of these lithologies was scarce. The palaeontology of these lithologies has been adequately dealt with in the Desk-Top study (Appendix 3).

5. PALAEONTOLOGICAL IMPACT ASSESSMENT

TABLE 2: IMPACT ASSEMENT

PROJECT	PHASE 1	PHASE 2	GRIDLINES
POTENTIAL ISSUE	palaeo material loss	palaeo material loss	palaeo material loss
ALT	none	none	none
IMPACT	zero-low	zero-low	low-moderate
NATURE	neutral	neutral	negative
TYPE	direct	direct	direct
CONSEQUENCE	zero-low	zero-low	low-mod
EXTENT	phase 1	phase 2	Gridlines
DURATION	permanent	permanent	permanent
PROBABILITY	definite	definite	definite
REVERSABILITY	irreversible	irreversible	irreversibile
IRRIPLACEABLE LOSS	zero-low	zero-low	low-mod
MITIGATION POTENTIAL	chance find protocol	chance find protocol	chance find protocol
SIGNIFICANCE WITHOUT MITTIGATION	zero-low	zero-low	low-moderate
MITIGATION MEASURES	chance find protocol	chance find protocol	chance find protocol
SIGNIFICANCE WITH MITTIGATION	zero-low	zero-low	low-moderate

6. SUMMARY AND CONCLUSIONS

This site is dominated by Karoo Dolerite, which is an intrusive igneous rock and not fossiliferous. However the remaining lithologies may be fossiliferous. The areas underlain by significant fossiliferous lithologies are restricted to deep depressions and steep slopes, areas where turbine construction is very unlikely. These lithologies are adequately catered for by the "Chance find protocol" (see Appendix 2). The gridlines will cross Vryheid Formation. Although this is considered sensitive by the SAHRIS Palaeosensitivity Map, in practice no significant palaeontological material has been encountered. The gridlines follow existing industrial corridors (railway and Eskom powerline routes). For this reason it is the recommendation of this Field Report that no further palaeontological work needs to be undertaken, unless the "Chance Find Protocol" is triggered.

On a separate note, road access to the site was extremely difficult. It is presumed that a road may need to be constructed from the northern side in order to gain access to the site for the transport and assembly of heavy wind turbine equipment. A palaeontological investigation may need to be undertaken, depending on the route selected,

7. *REFERENCES*

Cairncross, B; Beukes, NJ; Coetzee, LL; Rehfeld, U. (2005) The bivalve Megadesmus from the Permian Volksrust Shale Formation (Karoo Supergroup), northeastern Karoo Basin, South Africa: implications for late Permian Basin development. South African Journal of Geology, 108: 547-556.

Catuneanu, O., Hancox, P.J., Rubidge, B.S., 1998. Reciprocal flexural behaviour and contrasting stratigraphies: a new basin development model for the Karoo retroarc foreland system, South Africa. Basin Res. 10, 417–439.

Cisneros, J. C., Rubidge, B. S., Mason, R. & Dube, C. (2008). "Analysis of millerettid parareptile relationships in the light of new material of Broomia perplexa Watson, 1914, from the Permian of South Africa. Journal of Systematic Palaeontology, 6, 453-462". Journal of Systematic Palaeontology. **6**(4): 453–462.

Frankfort (2728) 125 000, Council for Geosciences, Government Printer, Pretoria

Green, D (1997). Palaeoenvironments of the Estcourt Formation (Beaufort Group), KwaZulu-Natal. MsC (unpubl.), Department of Geology and Applied Geology, University of Natal Durban.

Groenevald, G (2017). Chance find protocol “for the proposed Greater Bulwer DonnyBrook Bulk Water SupplyA Scheme (GBDBWSS): Harry Gwala district Municiplality, KwaZuluNatal.

Groeneweld, G.H. & Kitching, J.W. 1995. Biostratigraphy of the Lystrosaurus Assemblage Zone. Pp. 35-39 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1, 46 pp. Council for Geoscience, Pretoria.

Groenewald (2018). Desktop Palaeontological Assessment and for the Proposed Sibaya Node 6 Development in the Ithekwini Metropolitan Municipality in the Kwazulunatal Province, FOR Umlando DATE: 6 June 2018.

Hastie, WW; Watkeys, MK; Aubourg, C (2014). Magma flow in dyke swarms of the Karoo LIP: Implications for the mantle plume hypothesis. Gondwana Research 25 (2014) 736–755.

Hastie, W; Watkeys, MK; Smith, AM, (2019). Tectonic significance of the sedimentary and palaeocurrent record at the eastern edge of the Karoo Basin. Journal of African Earth Sciences 158 (2019) 103543.

Johnson MR, Anhaeusser CR and Thomas RJ (Eds). (2009). The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.

MacRae C. (1999). Life Etched in Stone. Geological Society of South Africa, Linden, South Africa.

Mason, TR and Christie AC, (1986). Palaeoevironmental significance of Ichnogenus Diplocraterion torell from the Permian Vryheid Formation of the Karoo Supergroup, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology, 52.

Neveling, P.J. Hancox & B.S. Rubidge (2005) Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of early Triassic tetrapods. *Palaeont. afr.*) 41: 81–87.

Rubidge, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. South African Journal of Geology 108: 135-172.

SACS (South African Committee for Stratigraphy (1980). Council for Geosciences, Pretoria.

Sahris Palaeosensitivity Map: https://sahris.sahra.org.za/map/palaeo

Smith, R., Rubidge, B. & van Der Walt, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis.

Tavener Smith, (1982). Prograding coastal facies associations in the Vryheid formation (Permian) at Effingham quarries near Durban, South Africa. Sedimentary Geology Volume 32, Issues 1–2, May 1982, Pages 111-14

Watkeys, M.K., 2006. Gondwana break-up: a South African perspective. In: M.R. Johnson, C.R. Anhaeusser and R.J. Thomas (Editors), The Geology of South Africa, Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 531-539.

APPENDIX 1: DETAILS OF SPECIALIST

Dr Alan Smith
Private Consultant: ***Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091***

&

Honorary Research Fellow: ***Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban***.

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Scientific Research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published more than 50 journal articles with 360 citations (detailed CV available on request).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.
- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.
- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic Field Investigation PIA: Newcastle Pase 1 and 2 Wind Farms

Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.

APPENDIX 2: CHANCE FIND PROTOCOL

This Chance Find Protocol must be included in the site EMPr.

If any fossils are found, a Palaeontologist must be notified immediately by the ECO and/or EAP and a site visit must be arranged at the earliest possible time with the Palaeontologist.

In the case of the ECO or the Site Manager becoming aware of suspicious looking palaeo-material:

- The construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.

- Mitigation will involve the attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labeled, and boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure that a representative archive of palaeontological samples and other records is assembled to characterize the palaeontological occurrences affected by the excavation operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas.

3. Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological

sections, and by providing aid in the surveying of positions where significant fossils are found.

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities for a work area for sorting, labeling and boxing/bagging samples.

6. Costs of basic curation and storage until collected. Documentary record of palaeontological occurrences must be done.

7. The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.

8. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

9. Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

APPENDIX 3: DESK-TOP PALAEONTOLOGICAL REPORT:

PROPOSED MULILO NEWCASTLE (Pty) Ltd WIND POWER 1 AND 2 WIND FARMS BETWEEN NEWCASTLE AND MEMEL IN KWAZULU-NATAL

FOR

UMLANDO: Archaeological Surveys & Heritage Management
PO Box 102532, Meerensee, KwaZulu-Natal 3901
phone (035)7531785 fax: 0865445631
cell: 0836585362 / 0723481327
Facebook: Umlando and Umlando South Africa
Email:umlando@gmail.com

by

Dr Alan Smith
Alan Smith Consulting
29 Browns Grove, Sherwood, Durban, 4091, South Africa
Telephone: 031 208 6896
asconsulting@telkomsa.net

12 December, 2021

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

EXECUTIVE SUMMARY

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm between Newcastle and Memel, within KwaZulu-Natal.

This proposed Wind Farm Footprint is underlain by rocks of the Karoo Supergroup. This contains the following lithologies:

- Karoo Dolerite
- Volksrust Formation
- Adelaide Subgroup
- Tarkastad Subgroup
- Alluvium

The Karoo Dolerite is the commonest lithology, but is not fossiliferous. Alluvium is also unlikely to be so. The Volksrust Formation could be fossiliferous, but is also unlikely as significant fossils are rare. In contrast, the Adelaide and Tarkastad Subgroups could contain significant fossil material. For this reason it is the recommendation of this report that a Palaeontological Field Assessment by a competent palaeontologist be undertaken.

1. PROPOSED PROJECT

Mulilo Newcastle (Pty) Ltd proposes to construct a Wind Farm in KwaZulu-Natal between Newcastle and Memel (Figures 1 & 2).

Figure 1: Location of the proposed Mulilo Newcastle (Pty) Ltd WEF. Source map GoogleEarth.

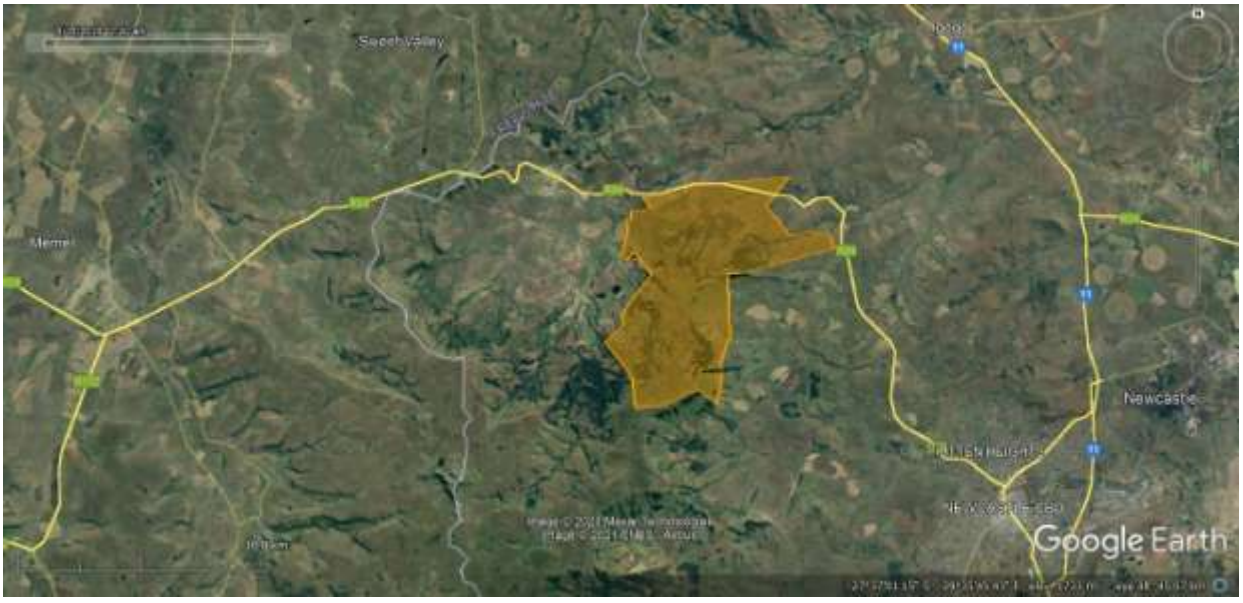


Figure 2: Zoomed in location of WEF. Source GoogleEarth.

The footprint will cover the following farms:

25. Portion 1 of the Farm Geelhoutboom No. 3350
26. Remainder Farm Bernard No. 9447
27. Remainder Farm Cliffdale No. 9439

28. Remainder Farm Spitskop No. 16302
29. Remainder Farm Byron No. 9448
30. Remainder Farm Geelhoutboom No. 3350
31. Remainder Farm Embosweni No. 17421
32. Remainder Farm Paardeplaat A Dene Heights
33. Remainder Farm Paardeplaat B No. 9390
34. Remainder Portion 1 of the Farm Franzhoek No. 8800
35. Remainder Farm Glendower No. 2901
36. Remainder Farm Lot B of Paardeplaat A No. 9389

2. GEOLOGY

The proposed project footprint site is located on Karoo Supergroup rocks (Figure 3). Anticipated rock units are as follows:

5 Dolerite (red)
6 Volksrust Formation (orange)
7 Adelaide Subgroup (Green)
8 Tarkastad Subgroup (Light green)
9 Alluvium (yellow) may be present

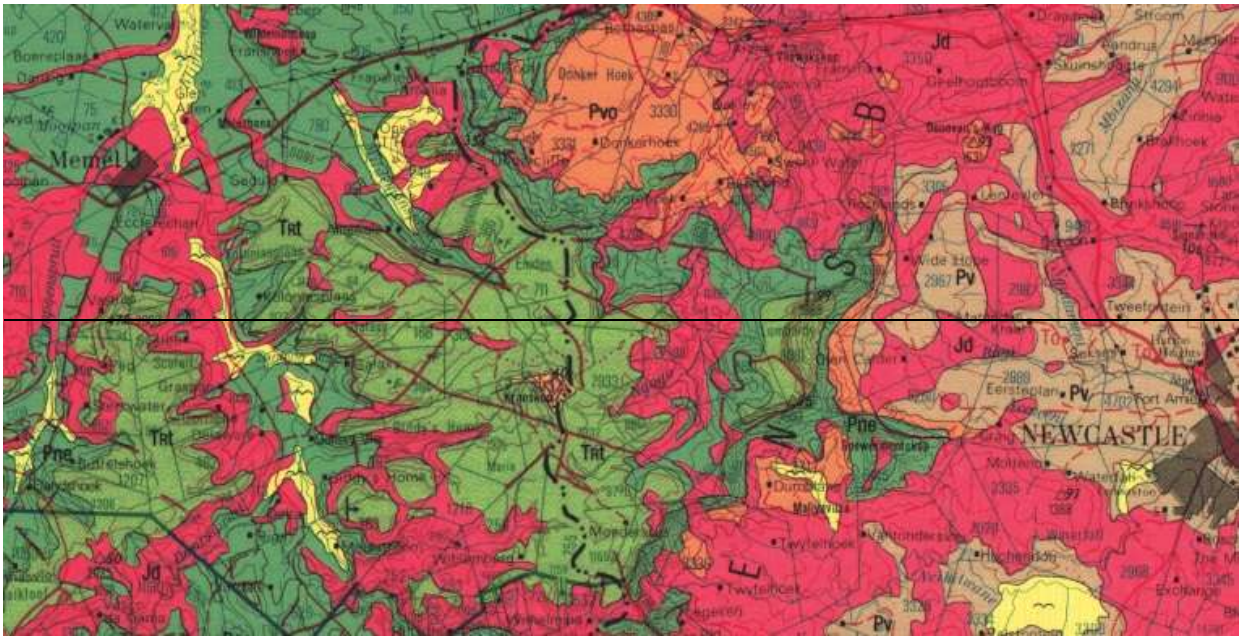


Figure 3: Extract from the Frankfort 2728 1:250 000 Geological Ma. This shows the lithologies that will be encountered. Dark Green (Pa) is described as Adelaide Subgroup, Light Green (Tkt) is Tarkastad Subgroup and Red (Jd) is Karoo Dolerite.

6. Karoo Dolerite

Dolerite intrusions may be present. These are 184 million years (Ma) old and represent the onset of the break-up of the Gondwana Supercontinent (Hastie et al (2014). According to Watkeys (2006), Gondwana rifting commenced between 155 and 135 Ma.

7. Volksrust Formation

The Volksrust Formation is Late Permian in age (Cairncross et al. 2005). Typically, it comprises a blue-black shale (Figure 4). This unit was deposited in generally non-marine conditions (Cataneneau et al., 1998), but pockets of marine conditions were present (Cairncross et al., 2005). Quaternary sediments comprise alluvium (river deposits) and colluvium (hill slope deposits).

Figure 4: Example of the Volksrust Formation. This lithology is typically a blue shale and very weathered.

8. Adelaide Subgroup

The Beaufort Group (part of the Karoo Supergroup) is a sequence of fluvio-lacustrine sedimentary rocks that accumulated in a landlocked, intracratonic foreland basin in SW Gondwana during the Middle Permian to Middle Triassic (Neveling et al., 2005).

The Lower Beaufort Group is represented here by the Adelaide Subgroup (SACS, 1980). In Kwazulu-Natal the Adelaide Subgroup is represented by the Permian Estcourt Formation, which forms flat terrain, in the middle, by the Belmont Formation, and the upper by the Otterburn Formation (Green, 1998). This subdivision is not represented on the Frankfort 1: 250 000 geological map (Figure 3). These rocks formed from sediments originally deposited within a fluvial-floodplain constructed by meandering rivers in a semi-arid climate (Figure5), flowing into a large inland sea (Karoo Sea). Lacustrine environments alternate with fluvial environments indicating a series of transgressive-regressive lacustrine episodes (Green, 1998).

Figure 5: Example of what a channel cutting down into red shales of the Adelaide Sub-Group would look like (image near Bergville).

9. Tarkastad Subgroup

The Tarkastad Subgroup is Triassic in age (252 to 201 Ma or million years) and is characterized characterized by alternating sandstones (which crop out as cliffs) and mudstones (often red in colour). These are often arranged in fining-upward units (coarse-grained sandstone at the base and mudstones above. The original sediments were deposited by fluvial processes within an arid landscape. In this area, river flow was generally north to south. Fossils would be expected to be within the floodplain mudstones, rather than the river channels where preservation is unlikely.

10. Alluvium

This is modern sands and muds deposited along a water course.

.

3. PALAEONTOLOGY

The palaeosensitivity of this area is shown in Figure 6. It is mostly grey, which is not fossiliferous, but also contains colour codes of red and yellow. According to Sahris, a Field Assessment is essential for the red shaded areas, and possibly for the yellow.

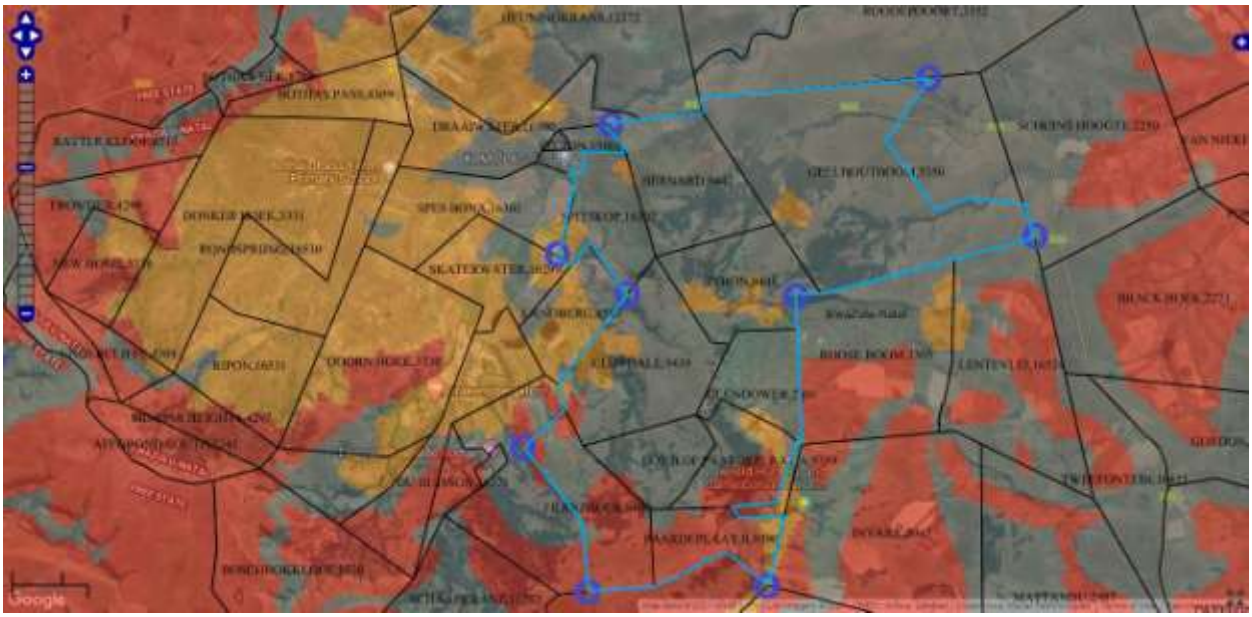


Figure 6: Palaeosensitivity of rocks in the Mulilo Newcastle WEF footprint (blue outline). Most of the area is dolerite (grey) and of no concern however the thickness of the dolerite is unknown.

The Volksrust Formation

Evidence of trace fossil bioturbation is common within the Volksrust Formation siltstones and mudstones, however the various trace fossil (ichnofossil) types are not always identifiable. These are common and of little Palaeontological Significance.

The bivalve *Megadesmus* has been recoded from the Volksrust Formation (Cairncross et al., 2005). This fossil is large, 9 cm dorsally and 8.4 cm laterally (Figure 7). *Megadesmus* is

known from other parts of the Gondwana Supercontinent (Australia, India, Siberia, South America and Tasmania). Its presence indicates exclusively marine conditions. The

implication for the northeastern Karoo Basin during the Late Permian is that a marine enclave still existed in this geographic area and that terrestrial conditions did not yet prevail as in the southern basin region (Cairncross et al, 2005).

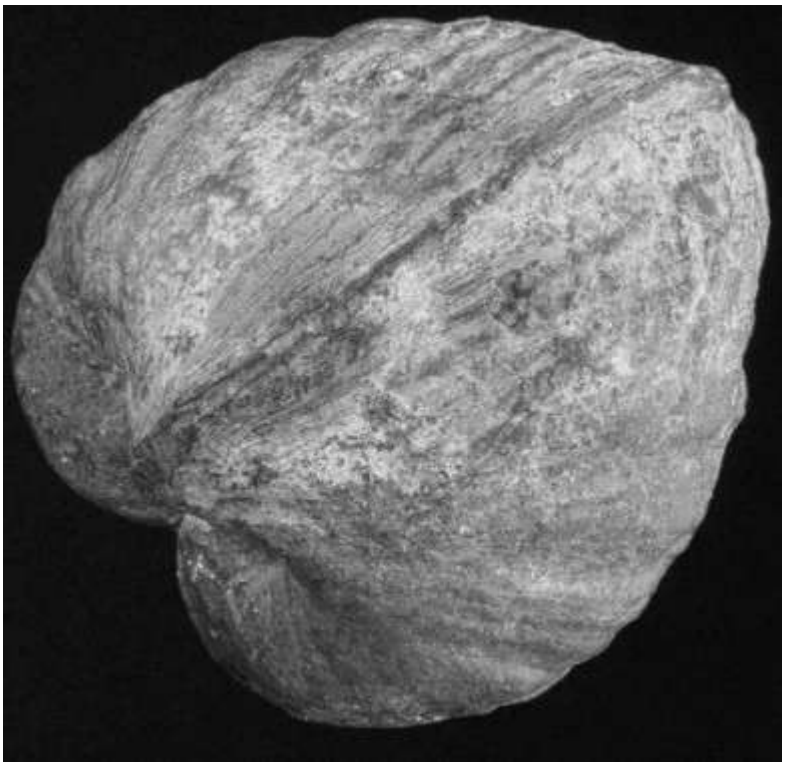


Fig. 7: Megadesmus bivalve. This image was obtained from Cairncross et al. (2005).

Adelaide Subgroup

The Adelaide Subgroup may contain Permo-Triassic Boundary, if it has been preserved. The Upper Permian is separated from the Triassic by the Permo-Triassic Extension (PT Boundary), the greatest of the Phanerozoic (541Ma to present) Extinction Events. This occurrence is also known as the Great Dying, a time in Earth's history when 95% of all life on Earth became extinct. The reasons for this are still controversial. There have been five great extinction events in the Phanerozoic Era, but the Permo-Triassic Boundary

represents the greatest extinction event in the Earth's history. If this is present it will be fundamental in palaeontological importance.

The P/T Boundary is expected to be found within marine sediments where a complete time deposition record may accumulate. In contrast, the Adelaide Subgroup comprises terrestrial sediments as sedimentary rocks. Preservation requires a large number of geological processes to come together, but these are less likely to take place during terrestrial deposition. Consequently the placement of the Permo-Triassic Boundary is not accurately known, if it has in fact been preserved in southern Africa. Present evidence indicates that the Permo-Triassic Boundary is unlikely to be located in the development area but must be considered.

Evidence of bioturbation is ubiquitous within the Adelaide Subgroup siltstones and mudstones, however the various trace fossil (ichnofossil) types are not always identifiable. Trace fossils are very common within the Beaufort Group (Figures 8 & 9). These have limited **Palaeontological** value.

Figure 8: Examples of trace fossils found near Bergville, similar examples could be found on the Mulilo Newcastle WEF 1 and 2 sites. This trace fossil could be *Arenicolites*.

Figure 9: Trace fossils of unknown species, possibly a shrimp that could be found in these rocks..

The Adelaide Subgroup is known internationally for its fossils (Cisneros et al., 2008). It contains plant- and animal- fossils. The latter include a wide variety of body fossils, including the mammal-like reptiles such as the Upper Permian- Dicynodon (Figure 10) and the Triassic- aged Lystrosaurus (Neveling et al., 2005) and trace fossils (Green, 1997).

Figure 10: Dicynadon reproduction (Wikepedia).

Tarkastad Subgroup

The Tarkastad Subgroup is an important fossil bearing rock (Neveling et al., 2006). It is considered highly palaeontologically sensitive as it may record the post PT Boundary record. can be recorded within this based on the important post-extinction (PT Event) continental biotas of Early Triassic age recorded from this unit in the Main Karoo Basin (SAHRIS website). This level is known to contain palaeontologically important Early Triassic terrestrial fossils from the period around 252 million years old, or post PT Boundary (Groenewald & Kitching 1995, Rubidge 2005, Smith et al. 2012). This fauna is dominated by therapsids or "mammal-like reptiles" and other tetrapods. Rare vascular plants and some trace fossils are known. The uppermost two biozones of the Beaufort Group, the *Lystrosaurus* and *Cynognathus* assemblage zones, record terrestrial biotic recovery following the Permo-Triassic mass extinction event (Neveling et al 2006).

Karoo Dolerite

Karoo Dolerite is also present. This is an igneous intrusive rock and by definition cannot be fossiliferous.

Alluvium

Reworked palaeontological Material could be found in the Quaternary alluvium sediments, but is unlikely.

4. SUMMARY AND CONCLUSIONS

This site is dominated by Karoo Dolerite which is not fossiliferous. Similarly any alluvium can also be ignored. However the remaining lithologies may be fossiliferous. The Volksrust Formation could be fossiliferous, but is also unlikely to be so as significant fossils are rare. In contrast, the Adelaide and Tarkastad Subgroups might contain significant fossil material. For this reason it is the recommendation of this report that a Palaeontological Field Assessment by a competent palaeontologist be undertaken.

5. REFERENCES

Cairncross, B; Beukes, NJ; Coetzee, LL; Rehfeld, U. (2005) The bivalve Megadesmus from the Permian Volksrust Shale Formation (Karoo Supergroup), northeastern Karoo Basin, South Africa: implications for late Permian Basin development. South African Journal of Geology, 108: 547-556.

Catuneanu, O., Hancox, P.J., Rubidge, B.S., 1998. Reciprocal flexural behaviour and contrasting stratigraphies: a new basin development model for the Karoo retroarc foreland system, South Africa. Basin Res. 10, 417–439.

Cisneros, J. C., Rubidge, B. S., Mason, R. & Dube, C. (2008). "Analysis of millerettid parareptile relationships in the light of new material of Broomia perplexa Watson, 1914, from the Permian of South Africa. Journal of Systematic Palaeontology, 6, 453-462". Journal of Systematic Palaeontology. **6**(4): 453–462.

Green, D (1997). Palaeoenvironments of the Estcourt Formation (Beaufort Group), KwaZulu-Natal. MsC (unpubl.), Department of Geology and Applied Geology, University of Natal Durban.

Groenevald, G (2017). Chance find protocol "for the proposed Greater Bulwer DonnyBrook Bulk Water SupplyA Scheme (GBDBWSS): Harry Gwala district Municiplality, KwaZuluNatal.

Groeneweld, G.H. & Kitching, J.W. 1995. Biostratigraphy of the Lystrosaurus Assemblage Zone. Pp. 35-39 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1, 46 pp. Council for Geoscience, Pretoria.

Harrismith 2828 1: 250 000 Geological Map. Council for Geosciences, Pretoria.

Hastie, WW; Watkeys, MK; Aubourg, C (2014). Magma flow in dyke swarms of the Karoo LIP: Implications for the mantle plume hypothesis. Gondwana Research 25 (2014) 736–755.

Neveling, P.J. Hancox & B.S. Rubidge (2005) Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of early Triassic tetrapods. *Palaeont. afr.*) 41: 81–87.

Rubidge, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. South African Journal of Geology 108: 135-172.

SACS (South African Committee for Stratigraphy (1980). Council for Geosciences, Pretoria.

Sahris. https://sahris.sahra.org.za/map/palaeo

Smith, R., Rubidge, B. & van Der Walt, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis

Watkeys, M.K., 2006. Gondwana break-up: a South African perspective. In: M.R. Johnson, C.R. Anhaeusser and R.J. Thomas (Editors), The Geology of South Africa, Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 531-539.

7. DETAILS OF SPECIALIST

Dr Alan Smith
Private Consultant: ***Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091***

&

Honorary Research Fellow: ***Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban***.

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Scientific Research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published more than 50 journal articles with 360 citations (detailed CV available on request).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.
- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.
- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic

Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.