BM GEOLOGICAL SERVICES

DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON THE SITE OF A PROPOSED SOLAR POWER PRODUCTION FACILITY KNOWN AS THE PONGOLA SOLAR ENERGY FACILITY TO BE LOCATED ON PORTION 260 OF THE FARM PONGOLA 61, KWA-ZULA NATAL PROVINCE

16 July 2014

Prepared for:
Heritage Contracts and Archaeological Consulting CC

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On Behalf of:

Building Energy SPA

Prepared By:

Prof B.D. Millsteed

EXECUTIVE SUMMARY

Building Energy SPA, an Independent Power Producer (IPP), is proposing the establishment of a small-scale commercial solar energy facility (using photovoltaic technology) of approximately 2.5M W in capacity. The site is located within the Pongola urban area on Portion 260 of the farm Pongola 61, in Kwa-Zulu Natal. The photovoltaic production facility will have an aerial extent of 3.8 ha and the construction of an overhead power transmission line of approximately 150 m length will also be required to connect the project to the national power grid. The proposed project will be referred to as the Pongola Solar Energy Facility.

Building Energy SPA has appointed Savannah Environmental (Pty) Ltd to undertake a Basic Environmental Impact Assessment of the proposed project. Savannah Environmental (Pty) Ltd has appointed Heritage Contract and Archaeological Consulting CC, as independent consultants, to undertake a desktop Heritage Impact Assessment of the project area. Heritage Contract and Archaeological Consulting CC has contracted BM Geological Services to provide a desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project that will form part of the final Heritage Impact Assessment Report.

The project area is completely underlain by potentially fossiliferous sedimentary rocks of the Early Permian Vryheid Formation and a Cenozoic alluvial regolith. The potential for the proposed project to result in a negative impact upon the palaeontological heritage of the site has been assessed as low if the thickness of the regolith cover exceeds that of the maximum planned excavation depth, but moderate if this is not the case. The fossils known to be present within the Vryheid Formation elsewhere in South Africa are known to contain highly scientifically and culturally significant fossils, particularly the plant macrofossils of the *Glossopteris* flora. Any fossil materials that may be present within the regolith cover may be highly significant to an understanding of the palaeoecology and paleoenvironment of the area at the time of deposition of the alluvium. Any damage caused to the fossil materials that may be present within the strata underlying the project area would be both permanent and irreversible. It is recommended that the sites of those excavations that are performed (including along the route of the power line) be inspected by a palaeontologist to assess if any fossil materials are present. Should scientifically or culturally significant fossil material exist within the excavations a series of damage mitigation protocols are outlined herein.

The project has been assessed as being socially beneficial, herein, as it would provide renewable electricity to an increasingly stressed national power grid. Should the damage mitigation and prevention protocols outlined, herein, be implemented this would minimise the possibility of any negative impact upon the fossil heritage of the area.

In summary, this desktop study has not identified any palaeontological reason to prejudice the progression of the Pongola Solar Energy Facility subject to the necessary damage mitigation and avoidance protocols being implemented.

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1 TERMS OF REFERENCE AND SCOPE OF THE STUDY

The terms of reference for this study were as follows:-

- Conduct a desktop assessment of the potential impact of the proposed project on the palaeontological heritage of the project area.
- Describe the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Quantify the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Provide an overview of the applicable legislative framework.
- Make recommendations concerning future work programs as, and if, necessary.

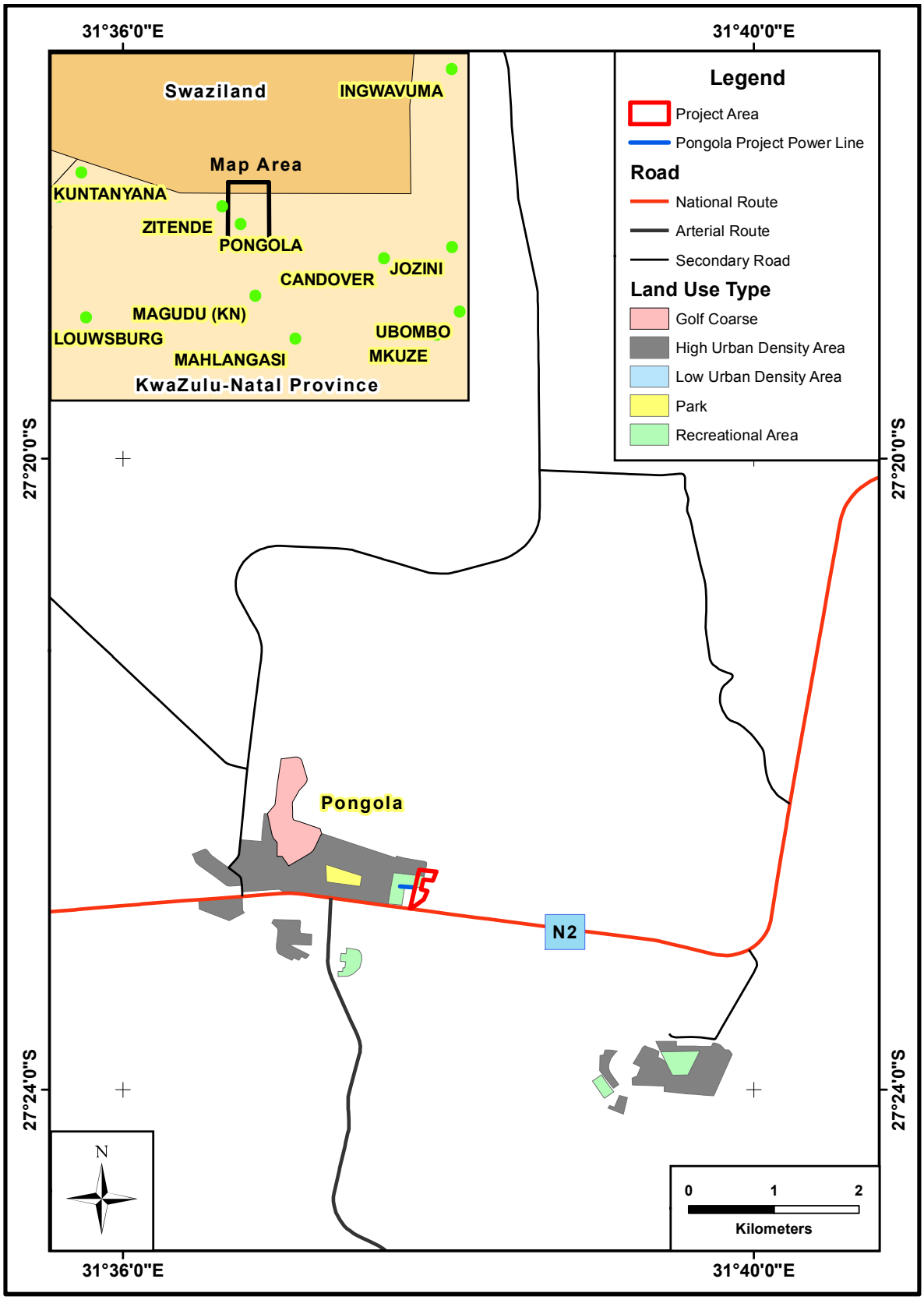

Figure 1: Location map showing the position of the Pongola Solar Energy Facility and its associated proposed power line.

2 LEGISLATIVE REQUIREMENTS

South Africa's cultural resources are primarily dealt with in two Acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

2.1 The National Heritage Resources Act

The following are protected as cultural heritage resources by the National Heritage Resources Act:

- Archaeological artefacts, structures and sites older than 100 years,
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography,
- Objects of decorative and visual arts,
- Military objects, structures and sites older than 75 years,
- Historical objects, structures and sites older than 60 years,
- Proclaimed heritage sites,
- Grave yards and graves older than 60 years,
- Meteorites and fossils,
- Objects, structures and sites or scientific or technological value.

The Act also states that those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities. The national estate includes the following:

- Places, buildings, structures and equipment of cultural significance,
- Places to which oral traditions are attached or which are associated with living heritage,
- Historical settlements and townscapes,
- Landscapes and features of cultural significance,
- Geological sites of scientific or cultural importance,
- Sites of Archaeological and palaeontological importance,
- Graves and burial grounds,
- Sites of significance relating to the history of slavery,
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

2.2 Need for Impact Assessment Reports

Section 38 of the Act stipulates that any person who intends to undertake an activity that falls within the following:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300 m in length,
- The construction of a bridge or similar structure exceeding 50 m in length,

- Any development or other activity that will change the character of a site and exceed 5 000 m^2 or involve three or more existing erven or subdivisions thereof,
- Re-zoning of a site exceeding 10 000 m^2,
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. If there is reason to believe that heritage resources will be affected by such development, the developer may be notified to submit an impact assessment report. A Palaeontological Impact Assessment (PIA) only looks at the potential impact of the development palaeontological resources of the proposed area to be affected.

2.3 Legislation Specifically Pertinent to Palaeontology*

*****Note: Section 2 of the Act defines "palaeontological" material as "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains".

Section 35(4) of this Act specifically deals with archaeology, palaeontology and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

- Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite,
- Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite,
- Trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
- Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites,
- Alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned palaeontological objects may only be disturbed or moved by a palaeontologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Further to the above point, Section 35(3) of this Act indicates that "any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority". Thus, regardless of the granting of any official clearance to proceed with any development based on an earlier assessment of its impact on the Palaeontological Heritage of an area, the development should be halted and the relevant authorities informed should fossil objects be uncovered during the progress of the development.

2.4 The National Environmental Management Act [as amended]

This Act does not provide the detailed protections and administrative procedures for the protection and management of the nation's Palaeontological Heritage as are detailed in the National Heritage Resources Act, but is more general in is application. In particular Section 2(2) of the Act states that environmental management must place people and their needs at the forefront of its concerns and, amongst other issues, serve their cultural interests equitably. Further to this point section 2(4)(a)(iii) states that disturbances of sites that constitute the nation's cultural heritage should be avoided, and where it cannot be avoided should be minimised and remedied.

Section 23(1) indicates that a general objective of integrated environmental management is to identify, predict and evaluate the actual and potential impact of activities upon the cultural heritage. This section also highlights the need to identify options for mitigating of negative effects of activities with a view to minimising negative impacts.

In order to give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on cultural heritage of activities that require authorisation or permission by law must be investigated and assessed prior to their implementation and reported to the relevant organ of state. Thus, a survey and evaluation of cultural resources must be done in areas where development projects that will potentially negatively affect the cultural heritage will be performed. During this process the impact on the cultural heritage will be determined and proposals for the mitigation of the negative effects made.

3 RELEVENT EXPERIENCE

Prof Millsteed holds a PhD in palaeontology and has previously been employed as a professional palaeontologist with the Council for Geoscience in South Africa. He is currently the principle of BM Geological Services and has sufficient knowledge of palaeontology and the relevant legislation required to produce this Palaeontological Impact Assessment Report. Dr Millsteed is registered with the South African Council for Natural Scientific Professions (SACNASP), and is a member of the Palaeontological Society of South African and the Geological Society of South Africa.

4 INDEPENDENCE

Prof Millsteed was contracted as an independent consultant to conduct this Palaeontological Heritage Impact Assessment study and shall receive fair remuneration for these professional services. Neither Prof Millsteed nor BM Geological Services has any financial interest either in Building Energy SPA or the proposed Pongola Solar Energy Facility.

5 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area is completely underlain by bedrock comprised of the Early Permian Vryheid Formation. It is evident from Figure 3 that the area underlying the project site (including the power line) and thier surrounding environs have an extensive cover sequence of Cenozoic regolith. A summary of the characteristics of both the Vryheid Formation and Cenozoic regolith, as well as their fossiliferous potentials follows.

5.1 Vryheid Formation

5.1.1 Geology

The Main Karoo Basin consists of a retro-arc foreland basin filled with a lithological succession ranging in age from the Late Carboniferous to the Middle Jurassic (Johnson *et al*., 2006). The basin-fill sequence wedges out northwards over the adjacent Kaapvaal Craton.

In the Main Karoo Basin of South Africa the Vryheid Formation is a sandstone and coal-rich stratigraphic unit that interfingers with (i.e., is transitional with and partially time equivalent to) the overlying Volkrust and underlying Pietermaritzburg Formations; both of which are both are predominantly argillaceous (Figure 4). Genetically the formation can be divided into lower fluvial-dominated deltaic interval, a middle fluvial interval (the coal-bearing zone) and an upper fluvial-dominated deltaic interval (Johnson *et al*., 2006)

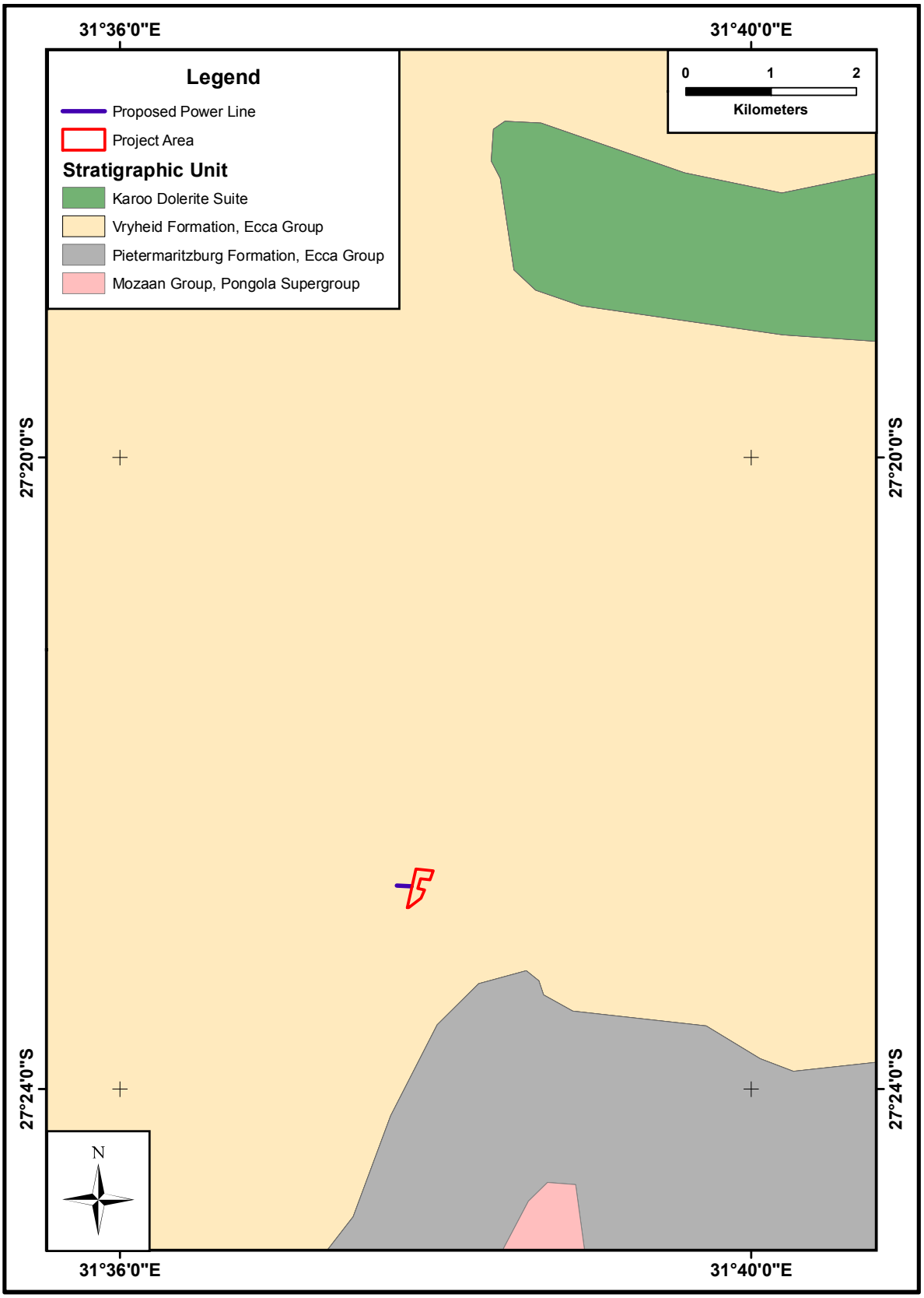

Figure 2: Geological map of the bedrock units underlying the Pongola Solar Energy Facility and its associated power line

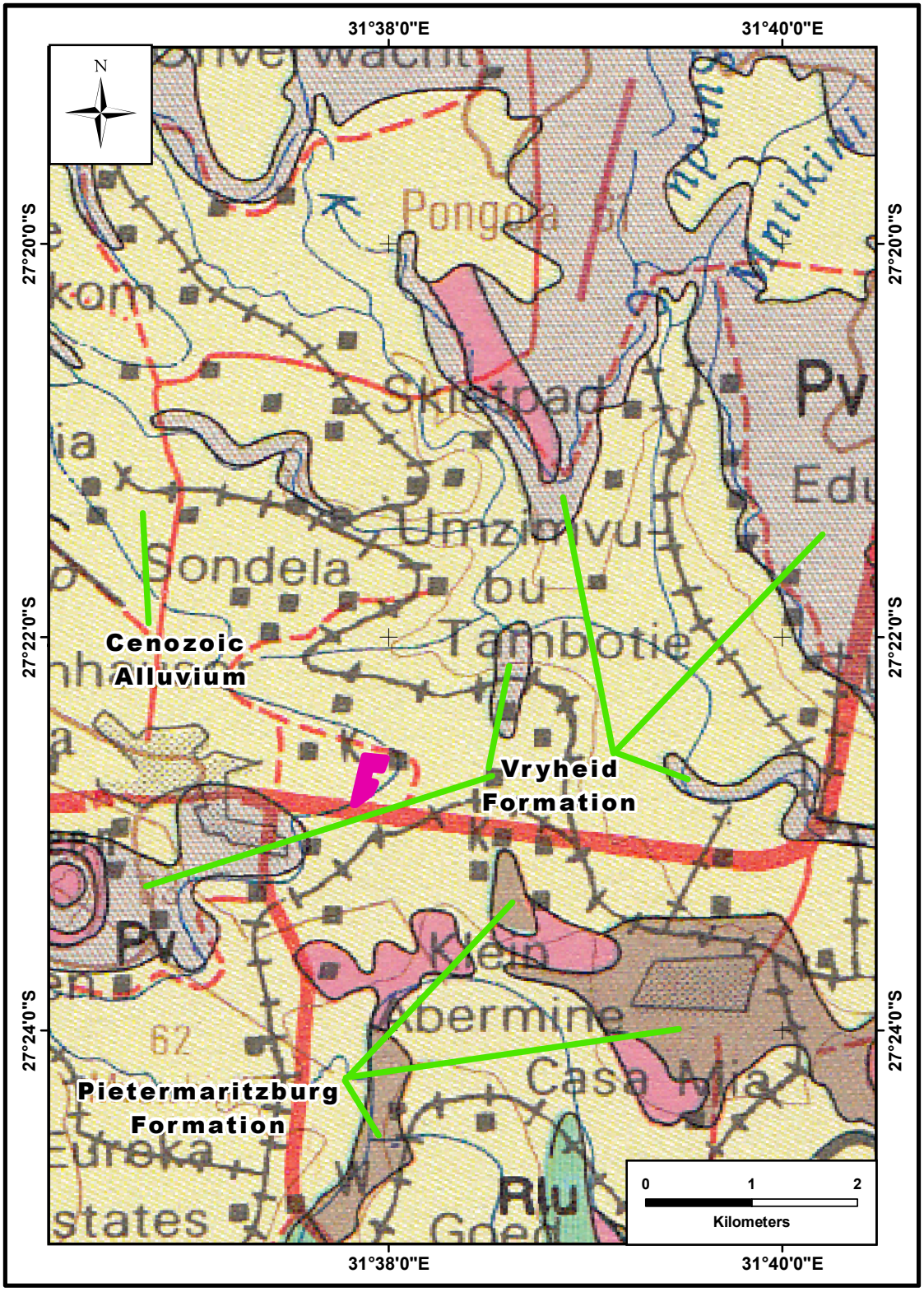

Figure 3: Geological map of the superficial geology of the Pongola Solar Power Facility and its general environs. Indicated (using the green lines are the locations of outcrops of major bedrock units as well as the Cenozoic alluvial regolith cover (modified from Geological Survey of South Africa, 1988).

The thickness and frequency of the sandstone units increases from the base of the formation, reaching their maximum in the middle fluvial interval and then decrease again towards the overlying Volksrust Formation. To the south and south-east the

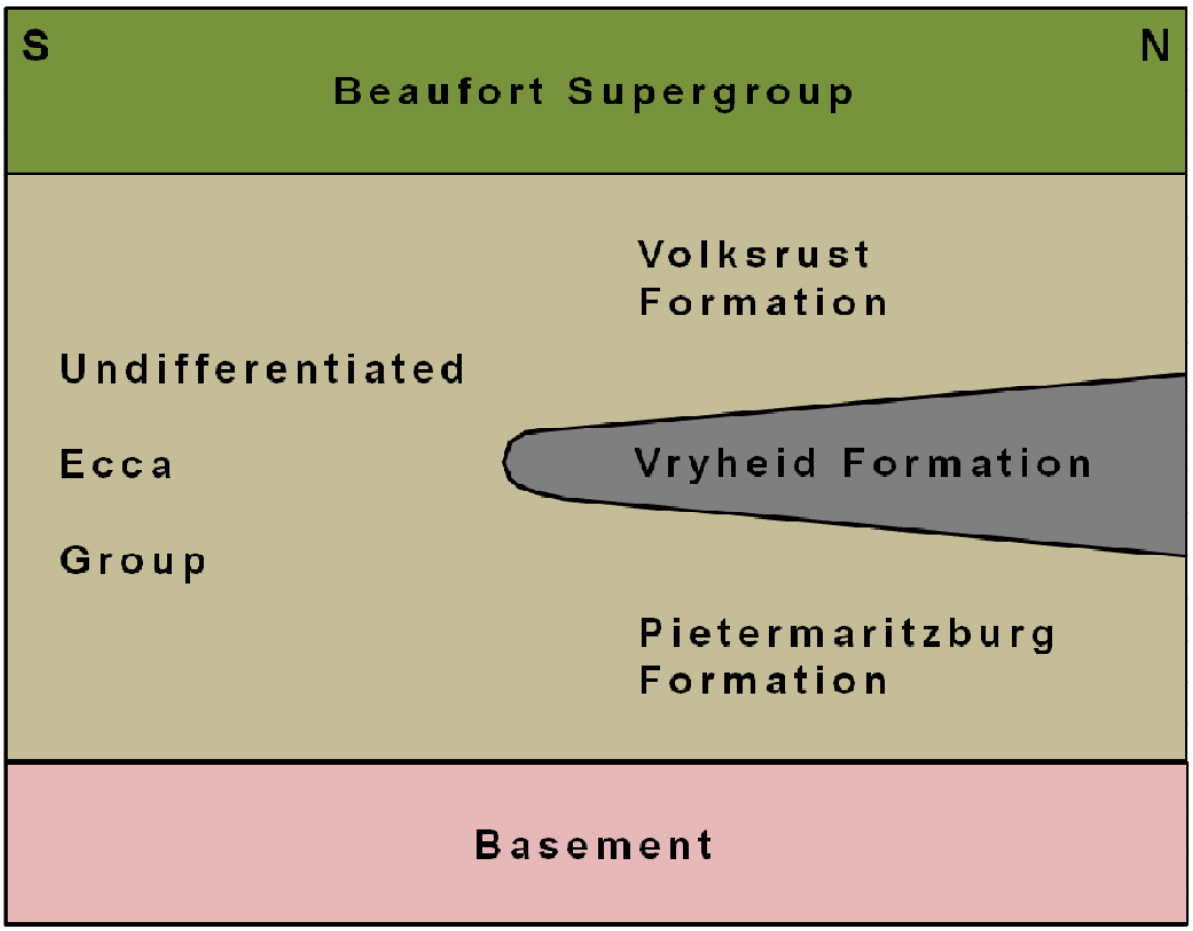

Figure 4: Schematic north-south oriented stratigraphic section of the Ecca Group in the north-east corner of the Karoo Basin. The Volksrust and Pietermaritzburg Formations can only be recognised when the Vryheid Formation forms part of the vertical sequence. In the north and north-western portions of the basin the Pietermaritzburg Formation was not deposited and the coal-bearing strata of the Vryheid Formation rest directly upon the basement.

Vryheid Formation grades laterally into undifferentiated, deep-water argillites of the Ecca Group (Figure 4).

The Vryheid Formation is one of sixteen (16) recognised stratigraphic units that constitute the Permian Ecca Group. During the deposition of the Ecca Group the basin was dominated by a large sea (the salinity levels of this water body remain unresolved).

The exception to this model was the deposition of the coal-bearing strata of the Vryheid Formation along the northern margin during an episode of deltaic progradation into the basin.

Deposition of the Vryheid Formation was terminated by a basin-wide transgression that drowned the Vryheid deltas and their coal swamps resulting in the deposition of the deep water sediments of the Volksrust Formation.

5.1.2 Palaeontological potential

The most conspicuous and common components of the palaeontological record of the Ecca Group in general are the plant macrofossils of the *Glossopteris* flora. Two large and conspicuous leaf form taxa dominate the *Glossopteris* flora; these being *Glossopteris* and *Gangamopteris*. Within the upper Ecca (containing the Vryheid Formation) *Gangamopteris* has ceased to occur with only *Glossopteris* present (Anderson and McLauchlan, 1976). The palaeobotanical record of the Ecca Group is diverse and the literature describing it is voluminous (numerous papers having been published by E. Plumstead, H. Anderson, J. Anderson, E. Kovaks-Endrődy and M. Bamford amongst others). A comprehensive review of the flora in the Karoo Basin literature is, accordingly, beyond the scope of this study, but a thorough review of the palaeobotanical content of the Ecca Group in general and the Vryheid Formation in particular is presented in Bamford (2004). In that summary it is indicated that the Vryheid Formation can be expected to contain the plant macrofossils *Buthelezia*, *Sphenophyllum*, *Rangia*, *Phyllotheca*, *Schizoneura*, *Sphenopteris*, *Noeggerathiopsis*, *Taeniopteris*, *Pagiophyllum* and *Benlightfootia* and the wood taxa *Australoxylon* and *Prototaxoxylon*. In addition to the above records can be added the observations of Tavener-Smith *et al*., (1988) where it was noted that both *Glossopteris* and *Vertebraria* occur within the palaeontological record of the formation.

In portions of the formation that are typified by low thermal alteration abundant assemblages of palynomorph plant microfossils (including acritarchs) can be expected (Anderson, 1977).

Jubb and Gardiner (1975) report the presence of fragmentary fish fossils within the Ecca sequence of southern Africa; these being *Coelacanthus dendrites* from the Somkele coal-field of northern Natal and *Namaicthys digitata* from correlative strata in the Senge Coal-fields of Zimbabwe. While fish faunas are obviously rare and none have been reported from the Vryheid Formation the possibility remains that they may be present.

Animal body fossils are rare within the Ecca Group in general (excepting the time equivalent faunas of the Whitehill Formation). However, no reptile fossils have been identified within the Vryheid Formation.

Hobday and Tavener-Smith (1975) reviewed trace fossil assemblages identified within the Vryheid Formation. Within that fossil assemblage they identified two forms (*Helminthiopsis* and *Taphrelminthopsis* within horizontally laminated siltstones and mudstones that represent part of the deep water *Nerites* community.

5.2 Cenozoic alluvium

5.2.1 Geology

The area surrounding the project site and the town of Pongola in general has an aerially extensive regolith cover of Cenozoic alluvium present. The extensive nature of this regolith cover suggests that the unit should be reasonably thick, at least in part, but no data is available to the author that documents the thickness of the unit. Similarly, there is no information to hand concerning the lithological characteristics of the alluvium. It may, however, be assumed from the location of this regolith deposit either side of a significant perennial stream, the Phongolo River and its tributary system that the deposit is probably genetically related to the Phongolo River and may represent fluvial deposits of that river system.

5.2.2 Palaeontological potential

Cainozoic age palaeontological sites are occasionally identified in alluvial terraces and dongas throughout South Africa. It may be expected that large mammal bones, dentition, horn cores, micromammal bones and fresh water molluscs may be identified within strata of this age.

6 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The area reported upon herein for the photovoltaic facility is moderately large, being approximately 3.8 ha in extent. In addition an electrical transmission line of approximately 150 m length is also proposed to connect the photovoltaic facility to the national power grid. The power line will exit the photovoltaic facility on its western margin and extend westwards towards into Pongola. Examination of Google earth imagery (Figure 5) indicates that the proposed location of the photovoltaic generation facility is immediately adjacent to the eastern margin of Pongola. Built structures are present in some numbers along the northern margin, the north-eastern corner, the south-western margin and the centre of the eastern margin of the photovoltaic facility's designated area. Piet Retief Road (the N2) forms the southern margin of the area and an unnamed road forms the western margin; the eastern margin of the photovoltaic site is demarcated by what appears to be an irrigation canal. The route of the proposed power line runs parallel to the southern boundary of a vacant allotment.

The original vegetation of the area consisted of the Delgoa Lowveld veld type (Figure 6). The conservation status of the Delgoa Lowveld veld type has been classified by Mucina and Rutherford (2006) as vulnerable. However, as is visible on Figure 5 the land underlying the photovoltaic facility has been almost completely utilised for crop cultivation and, as such, little to nil of the original vegetation is expected to be extant due to the land cultivation processes employed. The status of the vegetation underlying the route of the propose power line is unknown, but given that the site is located within Pongola is unlikely to be in a pristine state. Figure 7 indicates that the project site is located approximately 1.5 km north of the Phongolo River and 1.8 km west of the Rietspruit River. No significant fluvial drainage lines cross-cut the site of either the photovoltaic facility or the proposed power line. The land surface underlying the project area is otherwise flat and featureless.

Figure 5: Google earth image of the site of the proposed Pongola Solar Energy Facility (red polygon) and its associated power line (yellow line).

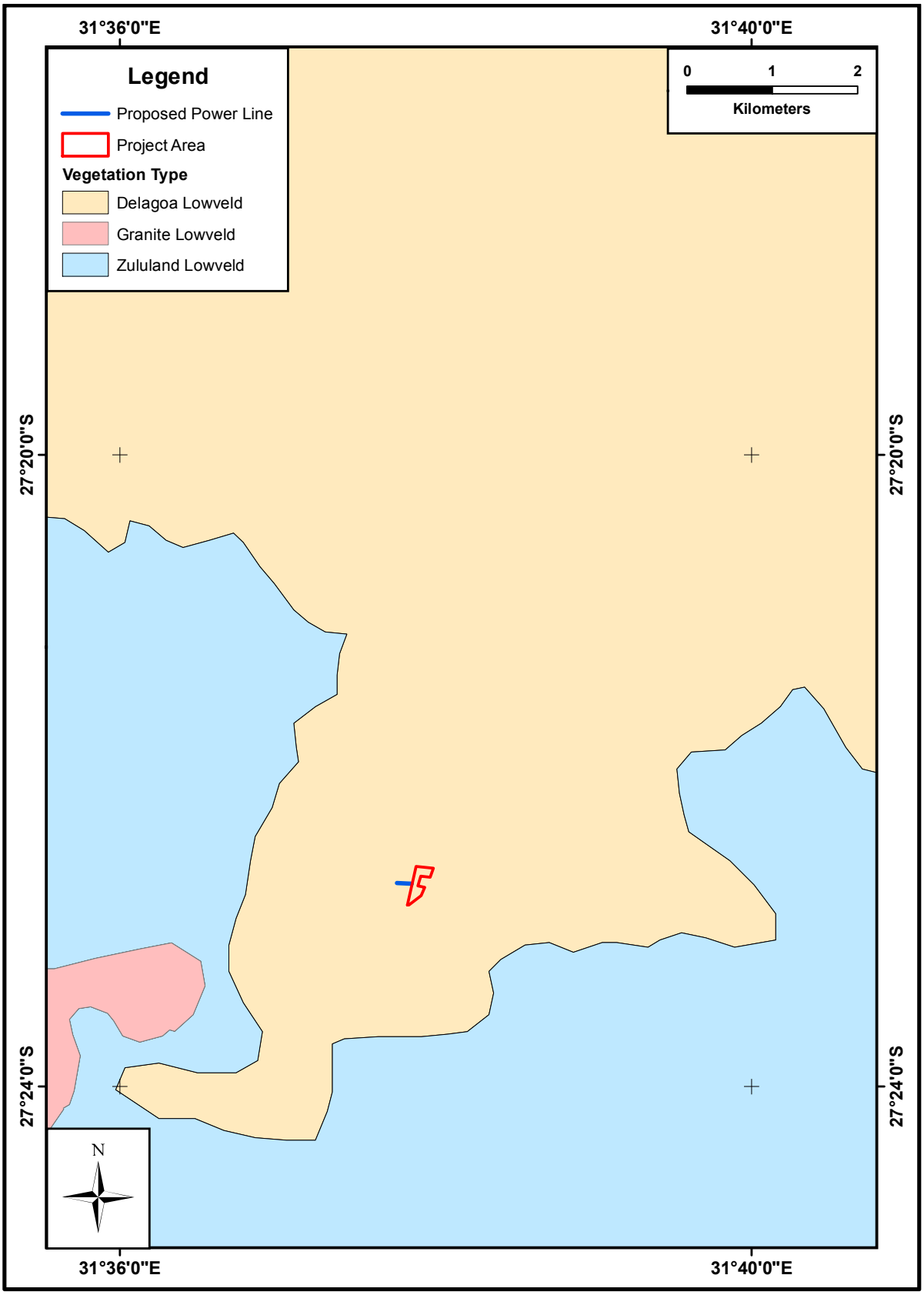

Figure 6: Map of the distribution of the vegetation veld types located beneath the project area and within its immediate environs (after Mucina and Rutherford, 2006).

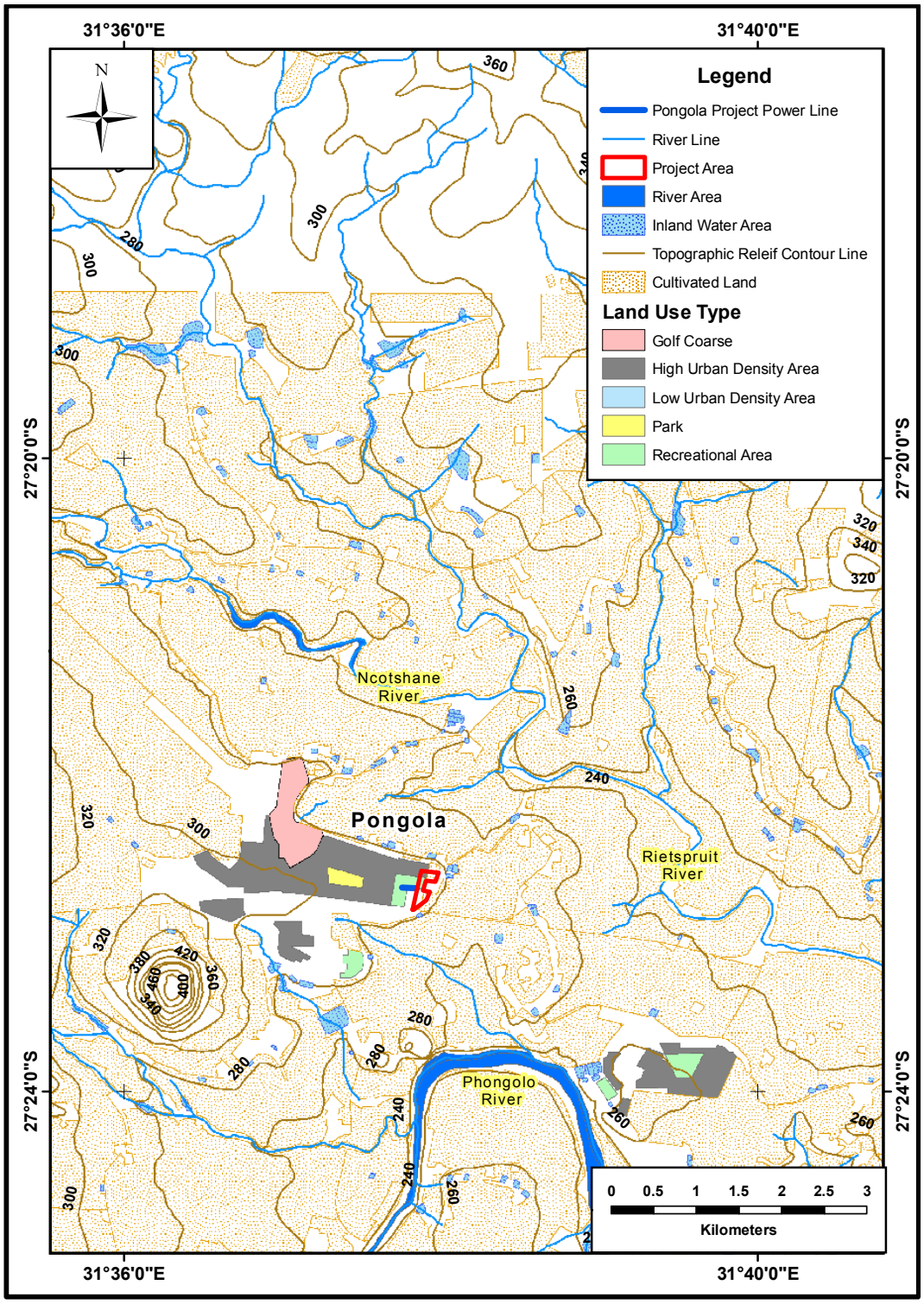

Figure 7: Map of the project area and its immediate environs. The project area lies immediately to the east of Pongola and, as such, is proximal to the built environment and human habitation. No significant fluvial systems traverse the proposed power production infrastructure, but the site lies close to the Phongolo and Rietspruit Rivers. The surrounding environs are extensively utilised for crop production. The topographic contour interval is 20 m.

7 OVERVIEW OF SCOPE OF THE PROJECT

The development footprint of the proposed Newcastle Solar Energy Facility will be less than 3.8 ha in extent for the area to underlie the photovoltaic array. An overhead electrical transmission line of approximately 150 m length is also proposed to link the electricity production facility to the national power grid. Within this general framework the following infrastructure will be established:

The facility development footprint will be less than 3.8ha in extent within which the following infrastructure will be established:

- Arrays of photovoltaic (PV) panels with a capacity of up to 2.5 MW.
- Mounting structures to support the PV panels.
- Cabling between the project components, to be lain underground.
- Inverters/transformer enclosures.
- An on-site switching station.
- An overhead power line of approx. 150 m to facilitate the connection between the solar energy facility and the existing power line located to the west of the facility via a loop in loop out
- Internal access roads.
- Fencing and workshop area for maintenance, storage and an on-site office.

7.1 Effect of project on the geology

It may be interpreted from Section 8 above that the development anticipated within the project area could be expected to be restricted to the upper 1-2 m of the land surface, with the deepest anticipated impacts upon the underlying geology resulting from the excavations required to lay the underground cables and for the foundations required for the various buildings, photovoltaic panels or the power line pylons.

8 IMPACT ASSESSMENT

The potential impact of the proposed mining area is categorised below according to the following criteria:-

8.1 Nature of Impact

The potential negative impacts of the proposed project on the palaeontological heritage of the area are:

- Damage or destruction of fossil materials during the construction of project infrastructural elements to a maximum depth of those excavations. Many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any

single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building or construction of the projects infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

- Movement of fossil materials during the construction phase, such that they are no longer *in situ* when discovered. The fact that the fossils are not *in situ* would either significantly reduce or completely destroy their scientific significance.
- The loss of access for scientific study to any fossil materials present beneath infrastructural elements for the life span of the existence of those constructions and facilities.

8.2 Extent of impact

The possible extent of the permanent impact of the proposed project on the palaeontological heritage of South Africa is restricted to the damage, destruction or accidental relocation of fossil material caused by the excavations and construction of the necessary infrastructure elements forming part of the project. The possible source of a less permanent negative impact on the palaeontological heritage is the loss of access for scientific research to any fossil materials that become covered by the various infrastructural elements that comprise the project. The **extent of the area of potential impact is, accordingly, categorised as local** (i.e., restricted to the project site).

8.3 Duration of impact

The anticipated duration of the identified potential impact is assessed as potentially **permanent to long term**. This is assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below the structures and infrastructural elements that will constitute the solar power facility and the associated power line pylons will be unavailable for scientific study for the life of the existence of those features. The life of the facility is expected to be permanent herein.

8.4 Probability of impact

The Cenozoic regolith cover is potentially fossiliferous, particularly given the proximity of the site to the Phongola River. The probability of any negative impact upon fossil materials that may be present within the alluvium is assessed as **low** due to the fact that the fossils (particularly vertebrate fossils) are generally sparsely and erratically distributed within geological units. In addition, the entire land surface associated with

the photovoltaic facility has been cultivated for crop production and any fossil materials that will have been present at surface will have been damaged, destroyed or moved historically.

The sediments of the Vryheid Formation are noted for containing an important palaeontological heritage particularly in respect of plant macrofossils of the *Glossopteris* flora. However, the occurrence of fossils within the geological record is erratic in general and the chance of impacting upon most macrofossil types at any particular point within the Vryheid Formation is low. It must be noted however, that where plant macrofossils or trace fossils are present within a sequence (as they are in the Vryheid Formation) they are often in dense accumulations and the probability of a negative impact is accordingly assessed as being **moderate**. However, if the regolith cover of the project area is thicker that 1-2 m it is unlikely that the Vryheid Formation will be directly affected by the development and the probability of negative impact would be **low**. In this scenario, the major negative impact upon the palaeontological heritage of the Vryheid Formation would be the loss of access to the fossils for scientific study during the term of life of the project infrastructure. The magnitude of any probability of a negative impact resulting from the project is accordingly dependent upon the thickness of the regolith cover.

8.5 Significance of the impact

Should the project progress without due care to the possibility of fossils being present within the Vryheid Formation the resultant damage, destruction or inadvertent relocation any affected fossils will be permanent and irreversible. This potential for negative impact is accentuated by the fact that often the plant macrofossils and trace fossils that are known to be present in this formation often occur in dense accumulations, and as such, if any negative impact occurs it may well affect many fossils simultaneously. The delta top/fluvial/coal swamp environments that existed during the deposition of the Vryheid Formation provide an important window into the evolution of plant life of the famous *Glossopteris* flora during the Early Permian within the Main Karoo Basin. Their significance is due to the uniqueness of their terrestrial environments within the basin fill of the Main Karoo Basin at that time. Any fossil materials that may be present within the Cenozoic regolith cover may be potentially highly significant for assessing the paleoenvironment and palaeoecology of the area at the time of deposition of the regolith. Thus, any fossil materials occurring within the project area are potentially extremely scientifically and culturally significant and any negative impact on them would be of **high significance**.

The scientific and cultural significance of fossil materials is underscored by the fact that many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage

to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the construction of project infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

The certainty of the exact *in situ* location of fossils and their precise location within the stratigraphic sequence is essential to the scientific value of fossils. The movement of any fossil material during the construction of the facility that results in the exact original location of the fossil becoming unknown will either greatly diminish or destroy the scientific value of the fossil.

8.6 Severity / Benefit scale

The proposed project is categorised, herein, as being potentially **beneficial**. This classification is based on the intention that the project will provide renewable energy to an increasingly strained national power grid. The probability of a negative impact on the palaeontological heritage of the project areas has been categorised as low to moderate (depending upon the thickness of the regolith cover). However, the implementation of suitable damage mitigation and avoidance protocols, as outlined below, will minimise the probability of any negative impact occurring.

8.7 Status

The proposed project would provide electricity to the national power grid, which is currently regularly failing to meet the demands placed upon it. As such, the project is determined as having a **positive status** herein.

9 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSABLE LOSS

The degree to which the possible negative effects of the proposed project can be mitigated, reversed or will result in irreversible loss of the palaeontological heritage can be determined as discussed below.

9.1 Mitigation

Due to the demonstrably degraded nature of the land surface beneath the area proposed for the photovoltaic facility there will be little value in conducting a full Palaeontological Impact Assessment study on the area prior to commencement of the project. It is accordingly recommended that, should permission be granted for the project to proceed to commencement, a close examination of all excavations be made by a palaeontologist while they are occurring. Should any fossil materials be identified, the excavations

should be halted and SAHRA informed of the discovery (as required in Section 3.3 above). A significant potential benefit of the examination of the excavations associated with the construction of the project is that currently unobservable fossils may be uncovered. As long as the construction process is closely monitored it is possible that potentially significant fossil material may be made available for scientific study.

Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by the excavation of the fossil(s) (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved.

9.2 Reversal of damage

Any damage to, or the destruction of, palaeontological materials or reduction of scientific value due to a loss of the original location is **irreversible**.

9.3 Degree of irreversible loss

Once a fossil is damaged, destroyed or moved from its original position without its geographical position and stratigraphic location being recorded the **damage is irreversible**.

Fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area are low. However, any fossil material is potentially of the greatest scientific and cultural importance. Thus, the potential always exists during construction and excavation within potentially fossiliferous rocks for the permanent and irreversible loss of extremely significant or irreplaceable fossil material. This said, many fossils are incomplete in their state of preservation or are examples of relatively common taxa. As such, just because a fossil is present it is not necessarily of great scientific value. Accordingly, not all fossils are necessary significant culturally of scientifically significant and the potential degree of irreversible loss will vary from case to case. The judgement on the significance of the fossil must be made by an experienced palaeontologist.

10 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The information provided within this report was derived from a desktop study of available maps and scientific literature; no direct observation was made of the area as result of a site visit.

11 ENVIRONMENTAL IMPACT STATEMENT

A desktop Palaeontological Impact Assessment Study has been conducted on the site of the proposed photovoltaic array and associated power transmission line; collectively named the Pongola Solar Power Facility. The proposed project area is moderately large, consisting of an approximately 3.8 ha in extent for the photovoltaic array as well as a length of approximately 150 m for the associated power line. Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the required infrastructure and the extent of any impacts is accordingly characterised as local.

The direct effects of the required construction operations to the palaeontological heritage of the geological strata underlying the project area will be restricted to the Cenozoic regolith cover and possibly (dependent upon the thickness of the regolith) to the underlying Vryheid Formation. Both the Cenozoic regolith and the Early Permian Vryheid Formation are potentially fossiliferous. The probability of the project resulting in a negative impact on the palaeontological heritage of the Vryheid Formation has been assessed as low to moderate (depending on the thickness of the regolith and if its thickness exceeds the maximum depth of any excavations. If the thickness of the regolith exceeds the excavation depth the probability will be low, but if it is thinner that the depth of the excavations the probability will be moderate. Any negative impact on the fossil materials will potentially be highly significant due to the scientific and cultural importance of many of the fossils that may be expected to be present. However, the social benefits of the project have been classified as beneficial, herein, as the project aims to provide renewable electricity to the increasingly stressed national power grid. It is accordingly recommended that the excavations associated with the construction of the project should be inspected by a palaeontologist to assess if any fossil materials are present. Should scientifically or culturally significant fossil material exist within the excavations any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved. Should any fossil material be discovered at any time during the construction of the solar power facility the excavation in that area must be halted and SAHRA informed of the discovery as is required by legislation (see Section 3.4 above). The implementation of this protocol will minimise the potential negative impact of the project.

This desktop study has not identified any palaeontological reason to prejudice the progression of the Pongola Solar Energy Facility, subject to the recommended damage mitigation procedures being enacted.

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