PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT

THE PROPOSED THOMAS RIVER WIND ENERGY FACILITY

Stutterheim, Eastern Cape Province South Africa

Farms: Stonehenge 309, Arundel 123, Rexfield 308, Southgate 124, Havelock Portion 318; 319; 323 - 328; 330 – 338, The Willows 316; 317; 319; Elvadell (Hove) 125 in the *Amatola District Municipality*

Developer: INNOWIND (PTY) LTD

Consultant:

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EXECUTIVE SUMMARY

The development of a Wind Energy Facility near Stutterheim in the Eastern Cape is an initiative of InnoWind (Pty) Ltd. Coastal and Environmental Services (CES) commissioned this Palaeontological Impact Assessment as part of the Heritage Impact Assessment. The purpose of the Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

The proposed development sites are on various farms along the N6 in an area called Thomas River, which is situated between Cathcart and Stutterheim in the Eastern Cape Province. The proposed project is planned to host between 26 and 33 turbines, each with a nominal power output of between 2 and 3 megawatts (MW). A photovoltaic (PV) array of up to 5 MW is also proposed for the site. The maximum total potential output of the wind farm and PV combined, is 80MW.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken. A site field investigation was conducted on 7 June 2011, with the aim to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The study area is underlain by the Katberg Formation of the Tarkastad Subgroup, Beaufort Group (shale, mudstones and sandstones). The Katberg Formation consists of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones.

The field investigation confirms that the development site is dominated by rolling hill topography with poor outcrops of the Katberg Formation. These outcrops consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations.

The Katberg Formation areas in the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations, the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) will be a beneficial palaeontological impact.

It is recommended that the project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase and the excavated bedrock during the construction phase. If fossil material is discovered it must be properly protected and the discovery reported to a palaeontologist for the removal thereof as per SAHRA's legislation.

SIGNIFICANCE RATING							
Rock Unit	**Temporal Scale**	**Spatial Scale**	**Degree of Confidence**	**Impact Severity**		**Overall Significance**	
				With mitigation	**Without mitigation**	**With mitigation**	**Without mitigation**
Katberg Formation	permanent	international	possible	beneficial	very severe	beneficial	High negative

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1. INTRODUCTION

The development of a Wind Energy Facility near Stutterheim in the Eastern Cape is an initiative of InnoWind (Pty) Ltd. Coastal and Environmental Services (CES) commissioned this Palaeontological Impact Assessment as part of the Heritage Impact Assessment. The purpose of the Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

1.1. Legal Requirements

This report forms part of the Environmental Impact Assessment for the Thomas River Energy Facility and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the Lushington Park Wind Energy Facility Project.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

2. PROPOSED DEVELOPMENT DESCRIPTION

InnoWind (Pty) Ltd, a Franco-South African renewable energy generator that develops, finances, builds, operates and maintains commercial wind powered generation facilities, plans to develop a wind and photovoltaic power generation facility on various farms along the N6 in an area called Thomas River, which is situated between Cathcart and Stutterheim in the Eastern Cape Province of South Africa (Figure 2.1)

The proposed project is planned to host between 26 and 33 turbines, each with a nominal power output of between 2 and 3 megawatts (MW). A photovoltaic (PV) array of up to 5 MW is also proposed for the site. The maximum total potential output of the wind farm and PV combined is 80MW. Other infrastructure associated with the proposed wind farm will include the following.

- Concrete foundations to support the wind towers.
- Approximately 5 meter wide internal access roads to each turbine.
- Underground cables connecting the wind turbines.
- A building to house the control instrumentation and backup power support.
- A storeroom for maintenance equipment.

The ultimate size of the wind turbines will depend on further technical assessments but will typically consist of rotor turbines (3 x 50m blades) with rotor diameters of around 80 - 100 meters atop a 100 meter high steel or hybrid tower. The tower and turbine design and colour will be optimised to minimise visual impact.

The proposed thin-film PV modules are 2.6 x 2.2m in size and comprise four panels. Each module is mounted on a metal supporting structure (± 1m above ground level) and has a potential output of 380W. Modules will be organized into groups of 1 MW (approximately 1.5 ha). In total, the Thomas River PV installation would cover between 7.5 and 10 hectares.

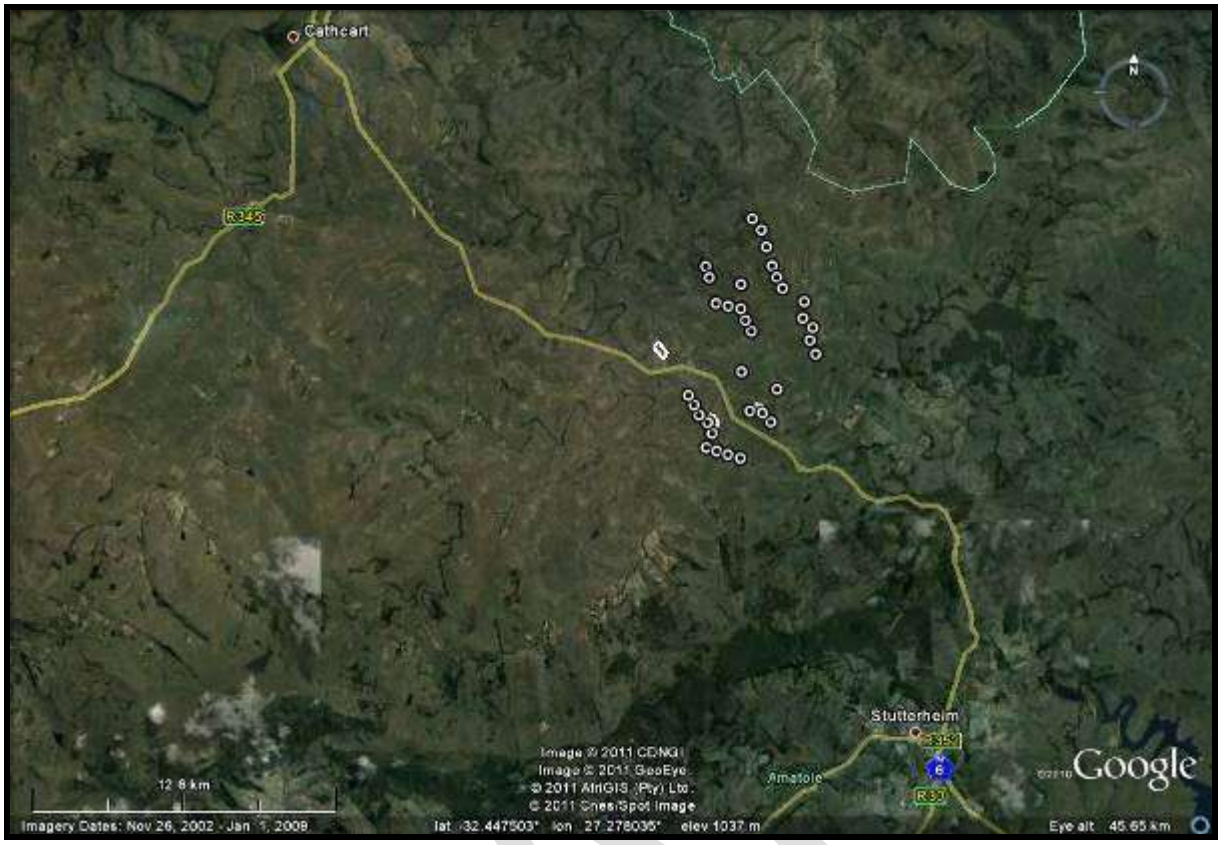

Figure 2.1 Location and Layout of the Proposed Thomas River Wind Energy Facility

3. AIMS AND METHODS

Following a desk top study, reported to SAHRA during September 2009, a request for a Phase 1 Palaeontological Impact Assessment (PIA) was received. Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the PIA were:

- identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- assessing the level of palaeontological significance of these formations;
- conducting fieldwork to assess the immediate risk to exposed fossils as well as to document and sample these localities;
- commenting on the impact of the development on these exposed and/or potential fossil resources;
- making recommendations as to how the developer should conserve or mitigate damage to these resources.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken.

A field investigation of the site was conducted on 7 June 2011 by Dr G Groenewald and Mr T Hugo, both experienced fieldworkers. The aims of the fieldwork were to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

4. GEOLOGY OF THE AREA

The Amahlathi area consists predominantly of the Adelaide and Tarkastad Subgroups of the Beaufort Group of the Karoo Supergroup. The Tarkastad Subgroup comprises mostly of a lower sandstone rich Katberg Formation and overlying red mudstone rich Burgersdorp Formation (Groenewald, 1996). Karoo Dolerite intrusions are present over the entire study area and due to its resistance to weathering, underlie most of the higher topography in the region (Figure 4.1).

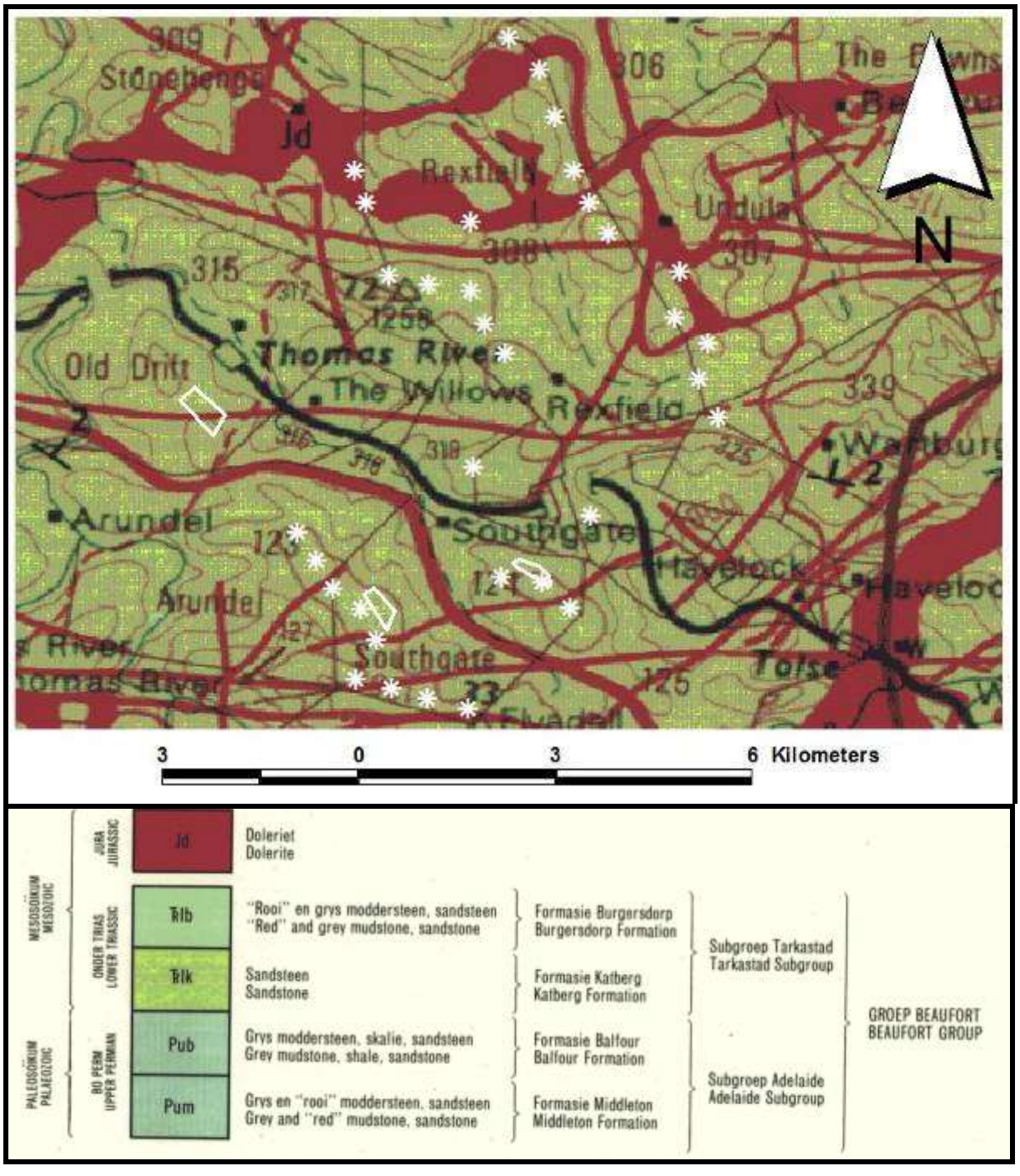

Figure 4.1 The Geology (Geo Map 3226- King William's Town) of Thomas River Development

4.1. The Katberg Formation

The study area is specifically underlain by the Katberg Formation of the Tarkastad Subgroup, Beaufort Group (shale, mudstones and sandstones). The Katberg Formation consists of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones.

Soils on sandstone hills are deep, freely drained and highly weathered. Soils that are derived from underlying mudstone are generally shallow and low in fertility. Due to the nature of the dispersive soils derived from the underlying mudstone, erosion of the topsoil happens fast. The erosion leads to high percentages of suspended solids in the rivers, reducing the quality of water in the rivers and dams, as well as silting up of dams.

4.2. Karoo Dolerite

Karoo Dolerite intrusions are present over the entire study area. Due to its resistance to weathering, it underlies most of the higher topography in the region.

5. PALAEONTOLOGY OF THE AREA

The value of vertebrate fossils in rocks of the Beaufort Group lies in its use as distinguishable biostratigraphic criteria to refine further subdivision of the group. The biozones employed are based on the vertebrate fossil remains that are so abundant in these rocks.

5.1. The Katberg Formation

The Triassic Katberg Formation overlies the Palingkloof Member of the Balfour Formation and contains important international biostratigraphic information. The Balfour and Katberg Formations represent a time period that includes the Middle Permian to Middle Triassic and contain fossil remains of animals that transcends from reptiles to mammals. The Katberg Formation correlates with the middle and upper part of the *Lystrosaurus* Assemblage Zone, containing fossils of both vertebrates and invertebrates of the Triassic era.

The Katberg Formation also contains some unique well-preserved vertebrate burrows (Groenewald, 1991) that are associated with the *Lystrosaurus* and *Procolophon* fauna that dominates this stratigraphic unit.

Excavations for the foundations of the turbine towers, as well as the roads and other infrastructure, may provide an opportunity to inspect fresh unweathered rock of this assemblage zone in the study area.

5.2. Karoo Dolerite

Due to the igneous character of this rock type it does not contain fossils.

6. FIELD INVESTIGATION

The development area is dominated by rolling hill topography with outcrops of the Katberg Formation. These outcrops consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones (Figure 6.1).

The Katberg Formation's sandstones characteristically comprise repeating, mutually truncating, trough cross-bedded channel-fill sand lenses, and mud-pebble conglomerates are often present at the base (Figure 6.2). The sandstones are by far the dominant element, with mudstones tending to be thin (2-10m) (Figure 6.3 and 6.4) and of limited lateral extent (Groenewald, 1996).

Figure 6.1 Rolling Hill Topography of Interbedded Sandstone and Mudstone of the Katberg Formation (S32.43602; E27.28911)

Figure 6.2 Characteristic Extensive Sandstone Beds of the Katberg Formation (S32.43602; E27.28911)

Figure 6.3 Interbedded Red Mudstone in the Katberg Formation (S32.43945; E27.28313)

Figure 6.4 Thin Sandstone Lenses in the Katberg Mudstone Units (S32.43783; E27.28427)

The upper boundary of the Katberg Formation conformably grades into the Burgersdorp Formation, a predominantly red mudstone unit that is not present in the study area.

Field investigations confirmed that very few outcrops of potential fossil-rich mudstone beds are present in the study area. Sandstone outcrops are abundantly present on the steeper hill slopes, in river valleys and in road cuttings. Careful examination of these outcrops did not reveal fossil material. The absence of fossils in the few outcrops examined should not be seen as an indication of the general absence of fossils from these beds, as fossils can be concentrated in specific rock units over very short distances.

7. PALAEONTOLOGICAL SIGNIFICANCE AND RATING

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews, as well as information gathered during the field investigation. The palaeontological significance and rating as per CES supplied template is summarised in Table 7.1 and 7.2. For the methodology and definitions of impact rating and significance see *Proposed Thomas River Wind Energy Facility Final Scoping Report* (CES 2011).

Table 7.1 Palaeontological Significance of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Drakensberg Group	Dolerite Dykes & Sills (Igneous Intrusions)	None	None	Nil
Katberg Formation	Medium to Coarse-Grained Sandstone EARLY TRIASSIC	Vertebrate fossils including amphibians, *Captorhinids, Eosuchids, Dicynodonts, Therocephalians, Cynodonts* and trace fossils.	*Lystrosaurus* Assemblage Zone	High sensitivity

Table 7.2 Significance Rating Table as Per CES Template

Rock Unit	Temporal Scale (duration of impact)	Spatial Scale (area in which impact will have an effect)	Degree of confidence (confidence with which one has predicted the significance of an impact)	Impact severity (severity of negative impacts, or how beneficial positive impacts would be)		Overall Significance (The combination of all the other criteria as an overall significance)	
				Without mitigation	With mitigation	Without mitigation	With mitigation
Katberg Formation	permanent	international	possible	very severe	beneficial	High negative	beneficial

There is a possibility that fossils could be encountered during excavation of non-doleritic bedrock within the development footprint, and these fossils would be of international significance. If effective mitigation are in place at the time of exposure, and the fossils are successfully excavated for study, this would represent a beneficial palaeontological impact.

However, within the Katberg Formation there is no way of assessing the likelihood of encountering fossils during excavation. As evidenced in other similar areas with exposures, fossils were apparently absent or very scarce over large areas, but locally dense accumulations were found.

Therefore, fossils within the development site could be characterised as rare but highly significant. The damage and/or loss of these fossils due to inadequate mitigation would be a highly negative palaeontological impact. However, the exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) to a qualified palaeontologist for excavation will be a beneficial palaeontological impact.

8. PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The field investigation confirms that most of the area is underlain by the Katberg Formation with Dolerite intrusions.

The Katberg Formation is interbedded with mud- and siltstones that do have potential to yield fossils. The excavation of foundations as well as access roads to the various turbines on the slopes will have the potential to uncover the mud rock and sandstone of the Katberg Formation. Therefore monitoring and mitigation in terms of the palaeontological heritage are required.

Due to the igneous character of Dolerite it does not contain fossils and any excavations into dolerite do not require monitoring or mitigation in terms of palaeontological heritage.

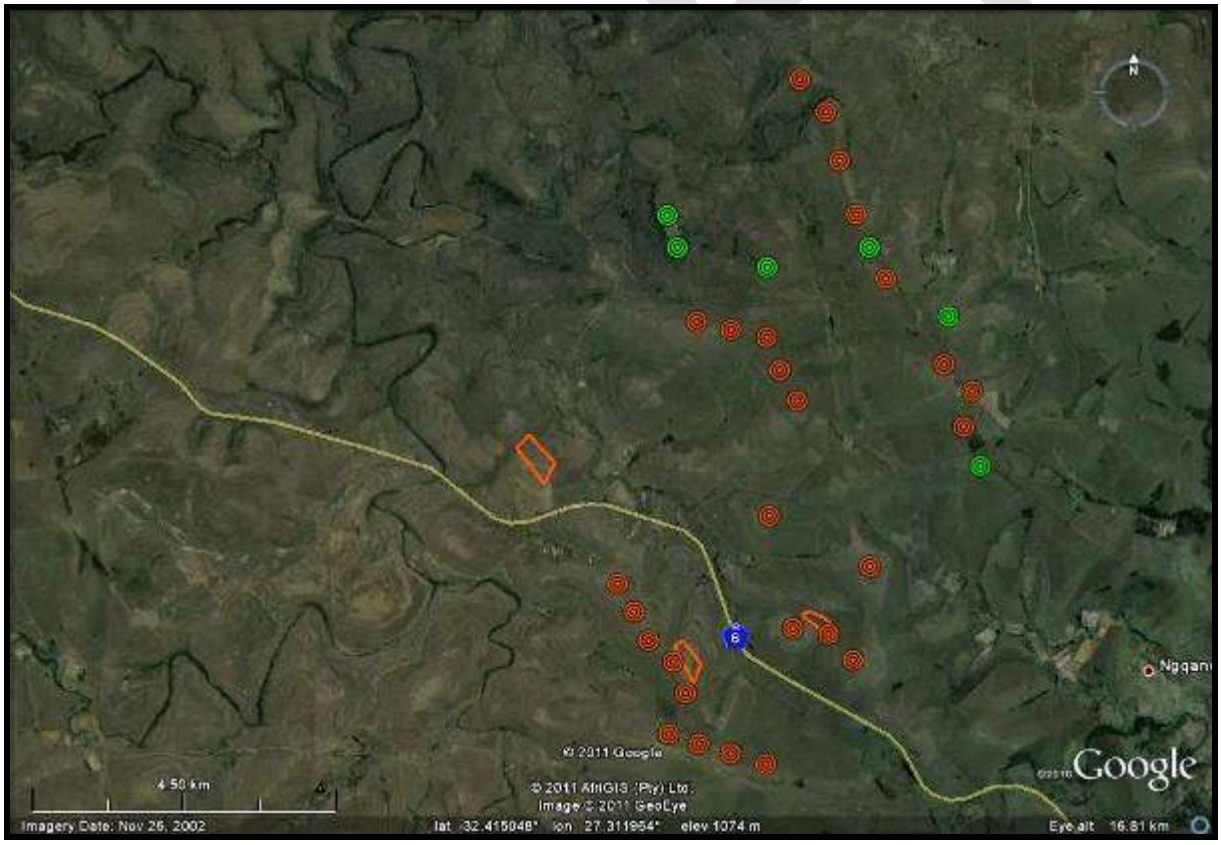

Figure 8.1 Palaeontological Impact of the Proposed Thomas River Wind Energy Facility

The following colour coding method is used to classify a development area's palaeontological impact as illustrated in Figure 8.1:

- Red colouration indicates a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops on the site/route and the chances of finding fossils during the construction phase are very high.

- Orange colouration indicates a possibility of finding fossils of a specific assemblage zone either in outcrops or in bedrock on the site/route.
- Green colouration indicates that there is no possibility of finding fossils in that section of the site/route development.

The proposed development involves the installation of wind turbines and infrastructure such as roads and buildings. The construction phase will require excavation of bedrock and has the potential to impact directly on fossil heritage if the Katberg Formation's mudstone is exposed. From Figure 8.1 the following mitigation measures are recommended:

Table 8.1 Site Specific Mitigation Measures

Colour Coding (Figure 8.1)	Mitigation Recommended
Green Sites	Igneous or metamorphic rocks underlie these zones, with no potential for fossils.
Orange Sites	The project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase, and the excavated bedrock during the construction phase. If fossil material is observed, a palaeontologist must be contracted to recover the material as per SAHRA legislation.

9. CONCLUSION

The Thomas River Energy Facility site is dominated by rolling hill topography with poor outcrops of the Katberg Formation. These outcrops consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations.

The Katberg Formation areas in the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations, the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) will be a beneficial palaeontological impact.

It is recommended that the project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase and the excavated bedrock during the construction phase. If fossil material is discovered it must be properly protected and the discovery reported to a palaeontologist for the removal thereof as per SAHRA's legislation.

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11. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma in Nature Conservation from the University of South Africa (1990). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

Declaration of Independence

I, Gideon Groenewald, 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 palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist