# PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED WOODHOUSE SOLAR 2 PV FACILITY AND ASSOCIATED INFRASTRUCTURE ON THE REMAINING EXTENT OF FARM WOODHOUSE 729, NEAR VRYBURG, NORTH WEST PROVINCE

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## EXECUTIVE SUMMARY

Genesis Woodhouse Solar 2 (Pty) Ltd propose the development of a commercial photovoltaic (PV) solar energy facility as well as associated infrastructure on the Remaining Extent of the farm Woodhouse 729 (Fig. 1), located south east of Vryburg, and within the Naledi Local Municipality and the greater Dr Ruth Segomotsi Mompati District Municipality, North West Province. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is required to detect the presence of fossil material within the proposed development site and to assess the impact of the construction and operation of the Woodhouse solar 2 PV Facility on the palaeontological resources.

The development site (i.e. the Remaining Extent of the farm Woodhouse 729) is underlain by the Ghaap Group (Schmidtsdrif Subgroup and Vryburg Formation), and the Dwyka Group of the Karoo Supergroup. The geologically older Vryburg Formation (2.6 billion year-old) consists of fluvial and shallow marine quartzites, mudrocks and conglomerates, while the Dwyka Group [317 Million years (Ma)] consists of Permo-carboniferous glacial sediments. Small outcrops on the north-western and south-eastern borders consist of Permo-Carboniferous glacial rocks of the Dwyka Group (Karoo Supergroup). Although trace fossils and plants could be present in the Dwyka the likelihood of significant fossil heritage in the Vryburg area is considered to be low. The central area of the development area consists of the Vryburg Formation, while a small outcrop of the Schmidtsdrif Subgroup is present in the south western margin of the development area. Stromatolite assemblages are recorded within the Schmidtsdrif Subgroup and Vryburg Formation. The Boomplaas Formation stromatolites represent some of the oldest examples of these microbial fossils in South Africa. Detailed descriptions of these fossils have yet to be documented while their stratigraphic and geographical distributions are poorly understood.

The development site near Vryburg consists of characteristic flat-lying terrain and vegetation cover of grassy thornveld. Poorly- to fairly well-preserved, stromatolite assemblages were recorded within the Boomplaas Formation on the south western portion of Woodhouse RE/729, which includes the proposed Woodhouse Solar 2 Alternative 1 development area. Mapping of the stromatolites was very difficult due to the vegetation and gravelly soil. The overall impact of the proposed solar plant development on the remainder of Woodhouse 729 is provisionally rated as of **negative medium significance**.

Mitigation is recommended which usually involves the sampling, collection and recording of fossils as well as obtaining relevant data concerning the surrounding sedimentary matrix within the proposed development footprint by a palaeontologist. This should take place after the initial vegetation removal has taken place but *before* the ground is levelled for construction. Excavation of this fossil heritage will require a permit from

SAHRA and the material must be housed in a permitted institution. All fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. These recommendations should be incorporated into the Environmental Management Plan for the Woodhouse Solar 2 Solar PV Facility project.

**Contents**

## 1. INTRODUCTION

**Savannah Environmental (Pty) Ltd** has been appointed as the independent Environmental Assessment Practitioners (EAP) by Genesis Eco-energy Developments for the undertaking of the Environmental Impact Assessment process for the proposed Woodhouse 2 Solar Facility. The construction of a commercial photovoltaic (PV) solar energy facility as well as associated infrastructure on the Remaining Extent of Farm Woodhouse 729, south east of Vryburg and within the Dr Ruth Segomotsi Mompati District Municipality is proposed (Fig. 1).

Two PV facilities are to be developed as stand-alone projects (known as Woodhouse Solar 1 and Woodhouse solar 2 PV facilities) by Genesis Eco-energy Developments, under two separate Special Purpose Vehicles, namely Genesis Woodhouse Solar 1 (Pty) Ltd and Genesis Woodhouse Solar 2 (Pty) Ltd (Fig. 2)**.** Both facilities will be located within the Remaining Extent of the farm Woodhouse 729. This Palaeontological Impact Assessment focuses on the Woodhouse Solar 2 PV Facility. The development of the Woodhouse Solar 1 PV Facility is being assessed in a separate EIA process.

Individually the PV facilities are proposed to include several arrays of photovoltaic solar panels with a contracted capacity of up to 100MW. The development footprint for each facility is expected to be less than 300 hectares in total.

**Infrastructure associated with the PV facility includes:**

- Arrays of PV panels with a capacity of up to 100MW
- Mounting structures to support the PV panels
- On-site inverters to convert the power from a direct current to an alternating current and a substation to facilitate the connection between the solar energy facility and the Eskom electricity grid
- A new 132kV power line between the on-site substation and the Eskom grid connection point.
- Cabling between the project components, to be laid underground where practical
- Offices and workshop areas for maintenance and storage
- Temporary laydown areas
- Internal access roads and fencing around the development area

The development of the Woodhouse Solar 2 PV Facility will modify the existing topography and may disturb, damage or destroy scientific valuable fossil heritage exposed at the surface or buried below ground. Palaeontological material is unique and non-renewable and is protected by the National Heritage Resources Act (Act No. 25 of 1999, section 38). A Palaeontological Impact Assessment of the proposed development is therefore necessary to certify that palaeontological material is either removed, or is not present.

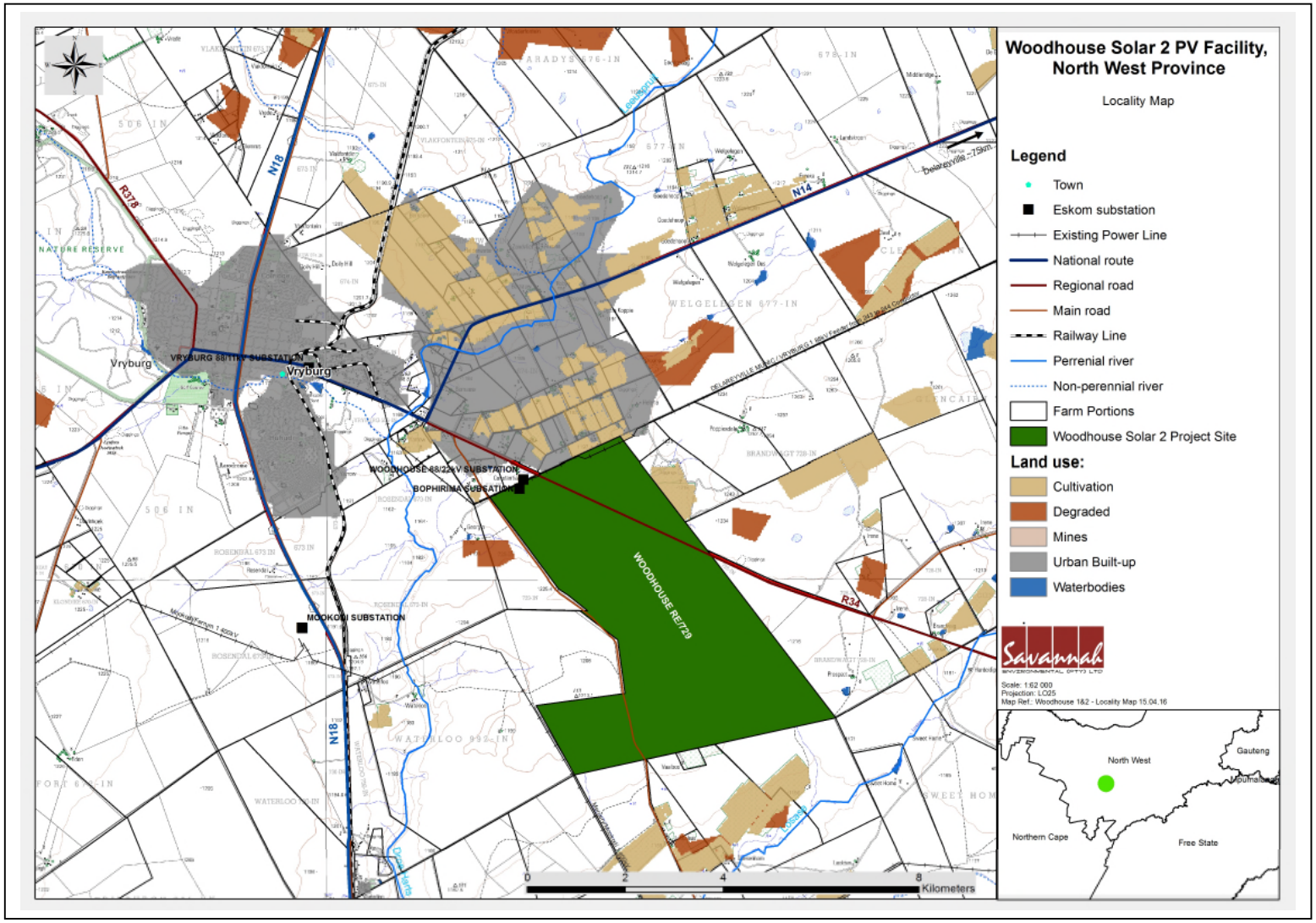


**Figure 1**. Location of the proposed Woodhouse Solar Facility (filled in green) on the remainder of Woodhouse 729, near Vryburg, Dr Ruth Segomotsi Mompati District Municipality, North West Province. Map provided by Savannah Environmental.

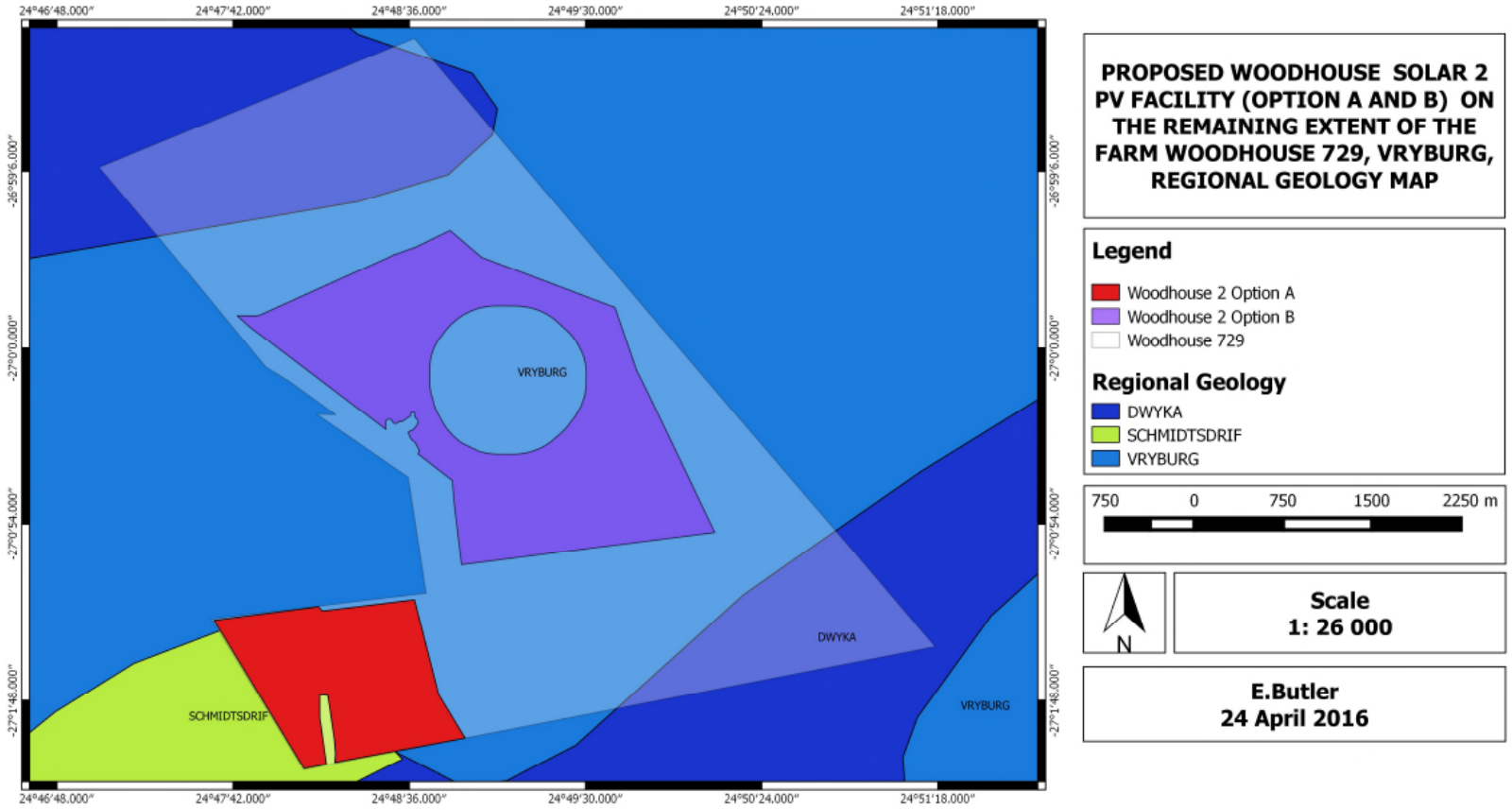


**Figure 2.** The surface geology of the proposed Woodhouse 1 and Woodhouse 2 Alternative 1 and Alternative 2, development localities on the remaining extent of Woodhouse 729, near Vryburg, Dr Ruth Segomotsi Mompati District Municipality. The development area is underlain by the Dwyka Group of the Karoo Supergroup and the Ghaap Group (Schmidtsdrif Subgroup and Vryburg Formation). (Modified from the 1: 250 000 geological map 2724 Christiana (Council for Geoscience, Pretoria).

## 1.1 LEGISLATION

Cultural Heritage in South Africa is governed by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Scoping Study forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

**SECTION 35 OF THE NATIONAL HERITAGE RESOURCES ACT 25 of 1999**

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority
- All archaeological objects, palaeontological material and meteorites are the property of the State
- 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
- No person may, without a permit issued by the responsible heritage resources authority—
    - 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 which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
    - serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order; and/or

- carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.

## 2 OBJECTIVE

According to the SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports the aims of the palaeontological impact assessment are: 1) to identify exposed and subsurface rock formations that are considered to be palaeontologically significant; 2) to assess the level of palaeontological significance of these formations;3) to comment on the impact of the development on these exposed and/or potential fossil resources and 4) to make recommendations as to how the developer should conserve or mitigate damage to these resources.

The objective is thus to conduct a Palaeontological Impact Assessment, which form part of the Heritage Impact Assessment (HIA) and EIA report to determine the impact of the development on potential palaeontological material at the site.

When a palaeontological desktop/scoping study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the study area at a desktop level. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of the palaeontological sensitivity of the rocks and the nature and scale of the development itself (extent of new bedrock excavated).

If rocks of moderate to high palaeontological sensitivity are present within the study area, a Phase 1 field-based assessment by a professional palaeontologist is necessary. Generally, damaging impacts on palaeontological heritage occur during the construction phase. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study. Based on the desktop data as well as a field examination of representative exposures of all major sedimentary rock present, the impact significance of the planned development is considered with recommendations for any further studies or mitigation.

When specialist palaeontological mitigation is suggested, it may take place prior to construction or, even more successfully, during the construction phase when new, potentially fossiliferous bedrock is still exposed and available for study. Mitigation

usually involves the careful sampling, collection and recording of fossils as well as of relevant data concerning the surrounding sedimentary matrix. Excavation of the fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. With appropriate mitigation, many developments involving bedrock excavation will have a positive impact on our understanding of local palaeontological heritage.

## 3 BACKGROUND TO THE GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The development site near Vryburg is underlain by the Ghaap Group (Schmidtsdrif Subgroup, Vryburg Formation), and the Dwyka Group of the Karoo Supergroup. The geologically older Vryburg Formation (2.6 billion year-old) consists of fluvial and shallow marine quartzites, mudrocks and conglomerates, while the Dwyka Group [317 Million years (Ma)] consists of Permo-carboniferous glacial sediments (Fig. 2).

The Dwyka Group, present in the north-western and south-western margins of the development site, represents the lowermost unit of the Karoo Supergroup. It consists almost throughout of gravelly sediments with subordinate vorved shale and mudstone containing scraped and facetted pebbles. These sediments are supposed to be of glacial origin and in places these materials have been deposited on typical glacier floors. In the Vryburg region this succession mainly comprises of glacial tillite or boulder mudstone and interglacial shale. Exposure levels are generally very poor, since the mudrock matrix weathers easily, and therefore the Dwyka outcrop area is represented at the surface only by scattered erratic boulders (Keyser and Du Plessis 1993). The northern outcrops of the Dwyka Group may comprise of a low diversity non-marine trace fossil assemblages (fish and arthropod traces, *Rhizocorallium*) within interglacial mudrocks and dispersed vascular plant remains (*Glossopteris* leaves and petrified wood). Although these trace fossils and plants are considered to be a possibility, the likelihood of significant fossil heritage in the Vryburg area and the development site is considered to be low.

The south-western margin of the development site is underlain by ancient sedimentary rocks of the Schmidtsdrif Subgroup (Fig. 2) and consists of flat terrain. In the Griqualand West Basin, the Schmidtsdrif Subgroup is the basal subdivision of the Late Archaean to Early Proterozoic Ghaap Group (Transvaal Supergroup), Ghaap Plateau Sub-basin (Fig. 3). The Schmidtsdrif Subgroup can be divided into the geological older Boomplaas Formation and younger Clearwater Formation. The Ghaap Group represents 200 Ma of chemical sedimentation of which iron and manganese ores, cherts and carbonates with subordinate silicastic rocks are prominent within the Griqualand West Basin. The central and south-eastern portions of the development site are underlain by shallow marine or lagoon sediments as well as volcanic rocks of the Vryburg Formation. This formation is roughly 140m thick and overlies lavas of the Ventersdorp Supergroup. The lower portion of the Vryburg succession consists of basal conglomerates followed by the 20m thick Kobaga beds which show prominent weathering of cross-bedded feldspathic quartzites. The Kobaga beds are overlain by *c*. 20m andesitic or basaltic lavas of the Rosendal Member and finally by the Waterloo Member which consists of c. 20-50m of amydaloidal and non-amydaloidal basaltic or andesitic lavas and is overlain by 14m of interbedded pyroclastic sediments and thin lenticular limestones. These sediments form the top of the Vryburg Formation and are followed by the overlying

carbonate-rich Boomplaas Formation which is present in the study area. The Boomplaas Formation is known to contain well-preserved stromatolite (microbial dome) assemblages in the Vryburg region. It is very likely that comparable, scientifically important fossil stromatolites also occur on Woodhouse 729.

Microbial stromatolites in the upper Vryburg Formation were described by Smith (1991). The stromatolitic carbonates are interpreted to be intertidal (Altermann and Wotherspoon, 1995). Detailed descriptions of the Vryburg stromatolite occurrences are not present in the literature, although South African Archaean stromatolites have been discussed in detail (Altermann, 2001; Buick, 2001; and Schopf, 2006). Columnar stromatolites from the Schmidtsdrif Subgroup of the Northern Cape have been described by Bertrand-Sarfarti and Eriksson (1977).

The Boomplaas beds are characterised by grey dolomites which weathers reddish-brown with subordinate interbeds of limestone (weathering blue-grey), quartzite, flaggy sandstone and shale. Oolitic and stromatolitic dolomite alternating with intervals of carbonaceous possible lagoonal mudrocks containing interbeds of calcareous sandstone and mudclast breccias is present. The Boomplaas beds are overlain by the grey- to khaki-hued mudrocks and interbedded dolomites, flagstones, tuffites and BIF-like cherts of the Clearwater Formation (= Lokamonna Formation), the topmost unit of the Schmidtsdrif Subgroup. Stromatolites and oolites from the Transvaal Supergroup have been described by various authors (Keyser and Du Plessis, 1993; Truswell and Eriksson, 1973; Eriksson and Altermann, 1998).

The proposed development site near Vryburg consists of characteristic flat-lying terrain of the Ghaap Plateau region. This terrain is currently used for agricultural purposes, primary cattle farming. The climate is semi-arid and the vegetation cover of grassy thornveld is mapped as Ghaap Plateau Vaalbosveld. Small, low and scattered bedrock exposure may be present on the development site, but the literature states that the exposures are rare apart from along river banks and steeper hill slopes (Almond, 2013). Images from Google Earth show a flat relief and bedrock mantled by reddish-brown soils. These sandy soils contain abundant gravel clasts, primarily cherty material down wasted from the underlying Boomplaas Formation (Eriksson, *et al.,* 2006).

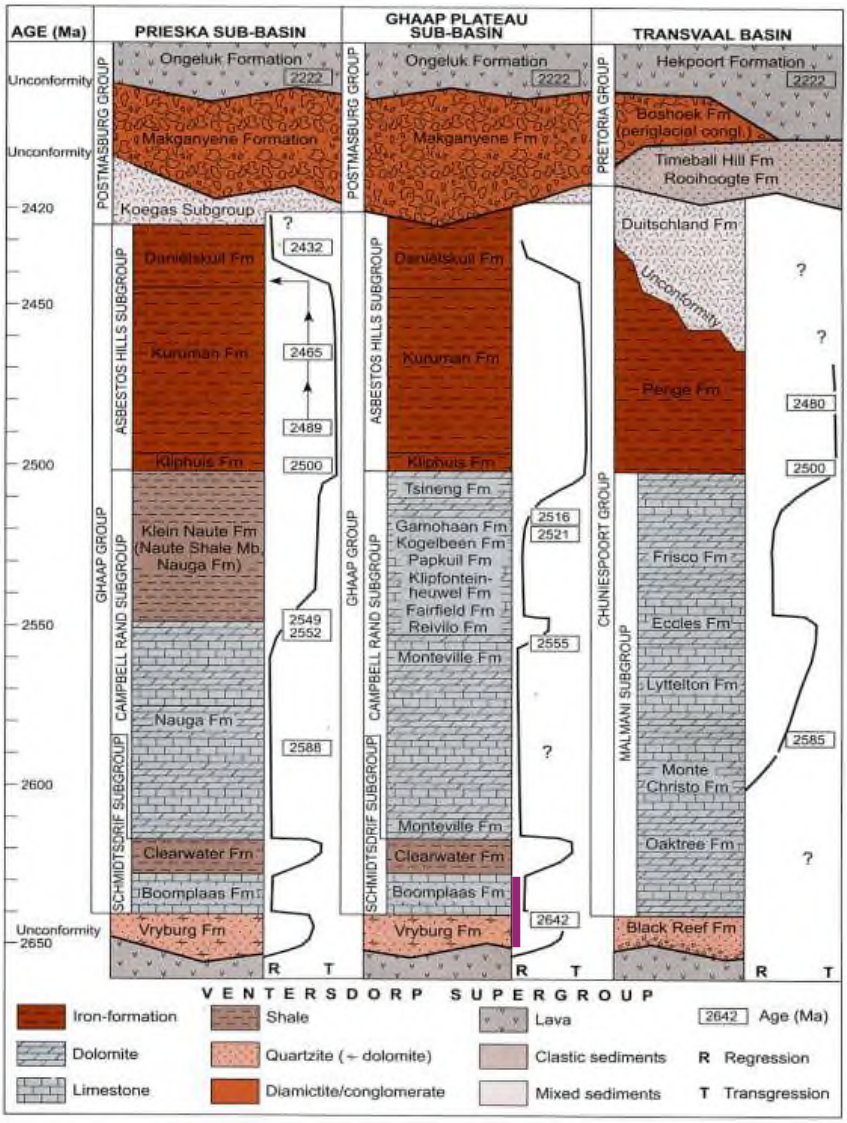


**Figure 3.** Stratigraphy of the Transvaal Supergroup of the Ghaap Plateau Basin. The middle column shows the rock units represented in the proposed study area (purple line) (Eriksson, *et al.* 2006). The Vryburg Formation is incorporated within the base of the Schmidtsdrif Subgroup by some recent authors and is no longer correlated with the Black Reef Formation of the Transvaal Basin as shown here (*e.g.* Altermann and Wotherspoon, 1995, Sumner and Beukes, 2006).

## 4 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development site is located approximately 10 km south east of Vryburg and falls under the jurisdiction of Naledi Local Municipality and the Dr Ruth Segomotsi Mompati District Municipality, North West Province (Fig.1).

## 5 METHODS

As part of the Palaeontological Impact Assessment a field-survey was conducted on the 11 March 2016 to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of the development. A physical field-survey was conducted on foot within the proposed development area. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2015), topographical and geological maps and other reports from the same area were used to assess the palaeontology of the proposed area of the development.

### 5.1.1 Assumptions and Limitations

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist.
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g*. of commercial mining companies) - is not readily available for desktop studies

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on the possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present, the reliability of a Palaeontological Impact Assessment may be significantly improved through field-survey by a professional palaeontologist.

## 6 FIELD OBSERVATIONS

The following photographs were taken on a site visit to Woodhouse RE/729 on 11 March 2016. Several stromatolites were located *in situ* in the Woodhouse 2 Site Alternative 1 development area where they were concentrated on the south-western border.

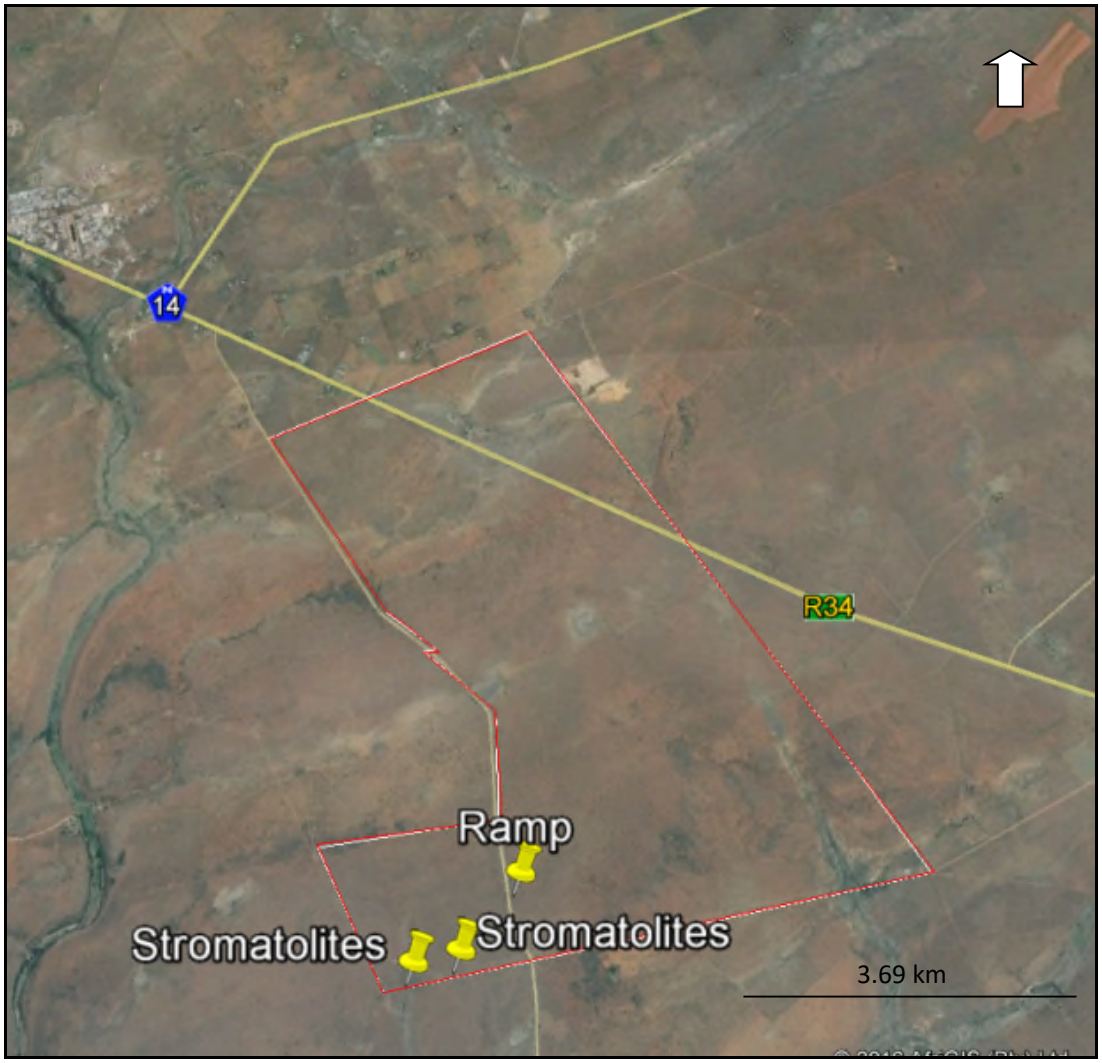


**Figure 5**. Google Earth image of the Remaining Extent of Woodhouse 729 (bordered in red) and locations where stromatolite outcrops were identified. Map modified from Google Earth 2016).

Figure 6. Large stromatolite.

**Figure 7.** Concentration of large weathered stromatolites.

**Figure 8**. Well preserved loose stromatolite.

**Figure 9.** A fragment of a stromatolite.

**Figure 8.** Several stromatolites were used to build a ramp. These stromatolites were most probably collected in the development area. See Figure 5 for the location of the ramp within the Remaining Extent of the farm Woodhouse 729.

## 7 IMPACT ASSESSMENTS

An assessment of the impact significance of the proposed Woodhouse Solar 2 PV Facility on local fossil heritage within the Remaining Extent of the farm Woodhouse 729 is presented here:

### 7.1 Nature of the impact

The excavations and site clearance will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research. According to the Geology of the development site there is a possibility of finding stromatolites (laminated microbial mounds).

### 7.2 Sensitive areas

The development site is underlain by Ghaap Group (Schmidtsdrif Subgroup, and Vryburg Formation), as well as the Dwyka Group of the Karoo Supergroup. Small outcrops of Permo-Carboniferous Dwyka Group, Vryburg Formation, and Schmidtsdrif Subgroup are present (Fig.2). Although trace fossils and plants could be present in the Dwyka the likelihood of significant fossil heritage in the Vryburg area is considered to be low.

**Stromatolite assemblages are recorded within the Schmidtsdrif Subgroup (south western margin of the development site) and Vryburg Formation (central area of the development site). The Boomplaas Formation (Schmidtsdrif Subgroup) stromatolites represent some of the oldest examples of these fossils in South Africa**. Detailed descriptions of these fossils have yet to be documented while their stratigraphic and geographical distributions are poorly understood. The Palaeontological Heritage of the Boomplaas Formation is rated as **very/highly sensitive**.

### 7.3 Geographical extent of impact

The impact on fossil materials and thus palaeontological heritage will be limited to the construction phase when new excavations into fresh potentially fossiliferous bedrock take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as **local**.

### 7.4 Duration of impact

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent.**

### 7.5 Potential significance of the impact

Should the project progress without due care to the possibility of fossils being present at the proposed development site within the Vryburg Formation the resultant damage, destruction or inadvertent relocation of any affected fossils will be **permanent and irreversible**. Thus, any fossils occurring within the development area are potentially scientifically and culturally significant and any negative impact on them would be of **high significance**.

### 7.6 Severity / benefit scale

The development of the proposed Woodhouse Solar 2 PV Facility is **beneficial** on not only a local level, but regional and national levels as well. The facility will provide a long term benefit to the community in terms of the provision of electricity to a progressively stressed national electricity grid.

A potential **secondary advantage** of the construction of the project would be that the excavations may uncover fossils that were hidden beneath the surface exposures and, as such, would have remained unknown to science.

### 7.7 Intensity

Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as medium.

### 7.8 Probability of the impact occurring

Since concentrations of small to large stromatolites are recorded on the margins of, as well as within, the proposed development site, the probability of significant impacts on palaeontological heritage during the construction phase are high (definite).

### 7.9 Assessment of development area alternatives

Two development areas (Site Alternative 1 and Site Alternative 2) have been identified and considered for the development of the Woodhouse Solar 2 PV Facility. These areas were both assessed during the field-survey and are both considered as acceptable for the development of the PV facility from a palaeontological perspective.

## 8 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSIBLE LOSS

### 8.1 Mitigation

Should fossil material exist within the area proposed for the development any negative impact upon it could be mitigated by surveying, recording, describing and sampling of well-preserved fossils by a professional palaeontologist. This should take place after initial vegetation clearance has taken place but *before* the ground is levelled for construction. Excavation of fossil heritage will require a permit from SAHRA and the material must be housed in a 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 and infrastructure moved.

### 8.2 Degree to which the impact can be mitigated

Recommended mitigation of the inevitable damage and destruction of fossil stromatolites within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a professional palaeontologist. This work should take place after initial vegetation clearance has taken place but *before* the ground is levelled for construction.

### 8.3 Degree of irreversible loss

Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.

### 8.4 Degree to which the impact may cause irreplaceable loss of resources

Stratigraphic and geographical distribution of Late Archaean stromatolites within the Schmidtsdrif Subgroup (including the Boomplaas Formation), is not documented in the literature. It is thus **not possible to accurately assess** the exceptional value of the stromatolite assemblages' present on Woodhouse 729. Better preserved specimens could be present on other areas in the Boomplaas Formation. By taking a precautionary approach, a significant loss of fossil resources is expected.

### 8.5 Cumulative impacts

Five known solar projects, other than the proposed development are located within a 10km radius from the Woodhouse Solar 2 PV Facility development site. These include:

- Proposed 60MW Carocraft PV Solar Park and associated infrastructure (a.k.a. the Carocraft Solar Park) on the Remaining Extent and Portion 1 of Farm Weltevrede 681.
- Construction of the 75MW Photovoltaic facility and associated infrastructure in Naledi (a.k.a. the Sediba Solar Energy Facility) on the Remaining Extent of the Farm Rosendal 673.
- Proposed Tiger Kloof Solar Photovoltaic energy facility near Vryburg, North West Province (a.k.a. the Tiger Kloof Solar Energy Facility) on Portion 3 (RE) and Portion 4 of the Farm Waterloo 730.
- Proposed construction of the 75MW Photovoltaic Solar Plant and associated infrastructure on a Portion of the Farm Waterloo 992 in the Naledi Local Municipality of the North West Province (a.k.a. the Waterloo Solar Park) on the Remaining Extent of Farm Waterloo 992.
- Proposed Woodhouse Solar 1 PV Facility, North West Province on the Remaining Extent of the farm Woodhouse729.

The cumulative effect of the development of the Woodhouse Solar 2 PV Facility within the proposed location, and taking into consideration the five other proposed solar energy

facilities located in the surrounding area is considered to be low. This is as a result of the broader Vryburg area not being considered as fossiliferous.

## 9 FINDINGS AND RECOMMENDATIONS

The development area located within the Remaining Extent of the farm Woodhouse 729 is underlain by Ghaap Group (Schmidtsdrif Subgroup and Vryburg Formation), and the Dwyka Group of the Karoo Supergroup. Small outcrops of Permo-Carboniferous Dwyka Group, Vryburg Formation, and Schmidtsdrif Subgroup is present in the development area (Fig.2). Although trace fossils and plants could be present in the Dwyka the likelihood of significant fossil heritage in the Vryburg area is considered to be low.

Stromatolite assemblages are recorded within the Schmidtsdrif Subgroup (south western margin of the development area) and Vryburg Formation (central area of the development area). The Boomplaas Formation (Schmidtsdrif Subgroup) stromatolites represent some of the oldest examples of these fossils in South Africa. Detailed descriptions of these fossils have yet to be documented while their stratigraphic and geographical distributions are poorly understood. A process of mitigation must therefore be undertaken. These recommendations should be incorporated into the Environmental Management Plan for the Woodhouse 2 Solar Plant project.

## 10 ASSESSMENT OF IMPACTS

### 10.1 Assessment Methodology

Direct, indirect and cumulative impacts of the impacts identified above will be assessed according to the following standard methodology:

- The **nature** which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent** wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration** wherein it will be indicated whether:
    - The lifetime of the impact will be of very short duration (0 - 1 years) – assigned a score of 1;
    - The lifetime of the impact will be of short duration (2 - 5 years) – assigned a score of 2;
    - Medium-term (5 - 15 years) – assigned a score of 3;
    - Long-term (> 15 years) – assigned a score of 4; or
    - Permanent – assigned a score of 5.
- The **magnitude** quantified on a scale from 0 - 10 where 0 is small and will have no effect on the environment, 2 is minor and will result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease) and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1 - 5 where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but of low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **significance** which shall be determined through a syntheses of the characteristics described above and can be assessed as low, medium or high; and
- The **status**, which is described as positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

$S = (E + D + M) \times P$

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);
- 30 – 60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated); and
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

***Nature:*** The excavations and site clearance during the construction phase will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research.

This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase.

| | **Without mitigation** | **With mitigation** |
|---|---|---|
| ***Extent*** | Medium (3) | Low (1) |
| ***Duration*** | Long term/permanent (4) | Long term/permanent (4) |
| ***Magnitude*** | Moderate (6) | Low (2) |
| ***Probability*** | Probable (2) | Improbable (2) |
| ***Significance*** | **Low (26)** | **Low (14)** |
| ***Status (positive or negative)*** | Negative | Neutral |
| ***Reversibility*** | Irreversible | Irreversible |
| ***Irreplaceable loss of resources?*** | Yes | No |
| ***Can impacts be mitigated?*** | Yes | Yes |

| |
|---|
| ***Mitigation:***<br><br>Mitigation includes surveying, recording, describing and sampling of well-preserved fossils within the area proposed for the development by a palaeontologist. This should take place after initial vegetation clearance was undertaken but *before* the ground is levelled for construction. Excavation of this fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. |
| ***Residual Risk:***<br><br>Residual Risk will be low after mitigation has been implemented as all relevant fossils will be documented and removed from the site. |

## 11 ASSESSMENT OF CUMULATIVE IMPACTS

| ***Nature:*** Cumulative impacts on fossil remains preserved at or beneath the ground surface | | |
|---|---|---|
| | **Cumulative Contribution of Proposed Project** | **Cumulative Impact without Proposed Project** |
| ***Extent*** | Local (1) | Low (1) |
| ***Duration*** | Long-term (4) | Long-term (4) |
| ***Magnitude*** | Minor (2) | Minor (2) |
| ***Probability*** | Improbable (2) | Improbable (2) |
| ***Significance*** | **Low (14)** | **Low (14)** |
| ***Status (positive/negative)*** | Positive | Positive |
| ***Reversibility*** | Irreversible | Irreversible |
| ***Loss of resources?*** | No | No |
| ***Can impacts be mitigated?*** | Yes | Unknown |
| ***Confidence in findings:***<br>High. | | |
| ***Mitigation: Not necessary***<br>Trace fossils and plants could be present in the Dwyka but the likelihood of significant fossil heritage is considered to be low. The southern area of the development area consists of the Vryburg Formation, which is unfossiliferous in this area.<br>. | | |

## 12 RECOMMENDATIONS CONCERNING FOSSIL HERITAGE MANAGEMENT DURING THE CONSTRUCTION PHASE

| OBJECTIVE: Prevent the loss of Palaeontological Heritage | |
|---|---|
| **Project component/s** | Damaging impacts on palaeontological heritage occur during the **construction** phase which will modify the existing topography. Project components include:<br>- PV Panels;<br>- Underground cabling;<br>- Substation;<br>- Access roads; and<br>- Buildings |
| **Potential Impact** | Disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study t |
| **Activity/risk source** | Surveying, recording, describing and sampling of well-preserved fossils |
| **Mitigation: Target/Objective** | Removal of well-preserved fossil heritage before construction starts. |

| **Mitigation: Action/control** | **Responsibility** | **Timeframe** |
|---|---|---|
| Survey, record and describe fossil heritage<br><br>A permit from SAHRA (South African Heritage Research Agency) must be obtained to sample fossils in the development footprint and fossils must be curated in a approved collection | A qualified Palaeontologist | Before construction of the solar facility commence. |

| | |
|---|---|
| **Performance Indicator** | Basically only a report. |
| **Monitoring** | A Palaeontologist must **apply** for a SAHRA permit, field work entails **surveying, recording** and **describing** fossil heritage, and obtaining relevant data concerning the surrounding sedimentary matrix) and the well preserved fossils must be **excavated** and |

| | |
|---|---|
| | sent to a **permitted institution**. All of the information regarding the process followed must be compiled into a **report** after fossils have been excavated. |

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## 14 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Elize Butler has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working at the National Museum since 1993 and currently holds the position of Collection Manager of the Karoo Vertebrate Collection of the Palaeontology Department at the National Museum in Bloemfontein. Her current research interests comprise of Permo-Triassic vertebrate palaeobiology, with a special focus on gorgonopsians at the End-Permian Mass Extinction.

## 15 DECLARATION OF INDEPENDENCE

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

Sincerely

Mrs. Elize Butler