HERITAGE IMPACT ASSESSMENT: PROPOSED LOERIESFONTEIN PHOTO-VOLTAIC SOLAR POWER PLANT ON PORTION 5 OF THE FARM KLEIN ROOIBERG 227, NORTHERN CAPE PROVINCE

(Assessment conducted under Section 38 (8) of the
National Heritage Resources Act 25 of 1999)

Prepared for:
Digby Wells Environmental
Private Bag X10046
Randburg, 2125.
Johan Nel
Tel: 011 789 9495
Cell: 072 288 5496
Email: johan.nel@digbywells.com

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Prepared by:

Lita Webley & David Halkett
ACO Associates
8 Jacobs Ladder
St James
7945

Phone (021) 650 2357
Fax (021) 650 2352

acoassociates@gmail.com
Lita@webleyonline.com

EXECUTIVE SUMMARY

ACO Associates cc was appointed by Digby Wells Environmental, on behalf of the client Orlight SA (Pty) Ltd, to undertake a Heritage Impact Assessment for the construction of a 70MW solar facility on 350ha of land Portion 5 of the farm Kleine Rooiberg 227, Northern Cape Province. The proposed facility will be located approximately 40 km to the north of Loeriesfontein, within the Hantam Local Municipality of the Namakwa District Municipality.

This assessment forms part of the EIA process. The Notice of Intent to Develop and Scoping phase was undertaken by Digby Wells Environmental. The NID was submitted to SAHRA (SAHRA file number: 9/2/017/0020) and they have requested a palaeontological and archaeological impact assessment. Further, they have asked that the archaeological impact assessment should also assess "whether the cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance".

The following heritage indicators were identified, assessed and mitigation recommended:

- The PIA (written by specialist Mr John Pether) describes fossil potential of the site as moderate and recommends that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil material be included in the Construction Phase EMP for the project;

The Middle Stone Age Archaeological Scatters:

- Stone artefacts scatters from the MSA are sparsely distributed across the study area;
- Thousands of square kilometres of Bushmanland are covered by these low density artefacts scatters;
- The absence of associated archaeological material and lack of discrete individual sites reduces the significance of the material overall and they are therefore ungraded;
- A permit will be required for the destruction of archaeological material.

The Later Stone Age Archaeological sites:

- Are concentrated on little koppies in the study area as well as along the stream which runs along the gravel road;
- They consist of discrete sites with a formal stone assemblage that includes scrapers and backed pieces, grooved stones as well as pottery and ostrich eggshell fragments;
- These sites are considered to have Grade 11 (Provincial) and Grade 111 (Local) significance;
- The sites are unique and offer the potential to inform on a regional archaeological pattern not recorded previously for this part of Bushmanland;
- For this reason, mitigation should take the form of avoidance of these sensitive sites. If avoidance is not possible, then archaeological intervention in the form of excavations or systematic collections will be required.

The Built Environment:

- There are no buildings of heritage significance on the site.

Graves:

- A single cairn which could represent a burial was identified. Due care should be taken during construction of the site and if human remains are uncovered, work should stop in that area and SAHRA should be notified.

Cultural Landscape:

- The proposed solar plant is positioned on a gravel road to the north of Loeriesfontein;
- The cultural landscape of the surrounding area a flat arid landscape, with occasional low koppies, utilised for the grazing of livestock;
- It is unlikely that the development will have a significant impact on the Cultural Landscape.

Two options for the layout of the facility have been proposed. This report does not favour one layout above the other.

The “no-go” alternative would mean that the status quo is retained and that the heritage resources of the area are maintained in their current condition.

The potential impacts resulting from the installation of a solar power plant on the heritage resources of the sites are considered to be of minor significance with the exception of the LSA sites for which mitigation is recommended.

SPECIALIST TEAM AND DECLARATION OF INDEPENDENCE

David Halkett (BA, BA Hons, MA (UCT)) is an Archaeologist and Member of the Association of Professional Archaeologists of Southern Africa (ASAPA) accredited with Principal Investigator status. He has been working in heritage management for 23 years and has considerable experience in impact assessment with respect to a broad range of archaeological and heritage sites including those in the Northern Cape. He is a member of the Archaeology, Palaeontology and Meteorites Committee and the Impact Assessment Committee of the Heritage Western Cape (HWC), the Provincial Heritage Resources Authority.

Lita Webley (BA, BA Hons, MA (Stellenbosch), PhD (UCT)) is an Archaeologist and member of ASAPA accredited with Principal Investigator status. She has been involved with heritage and archaeological impact assessments on a part-time basis since 1996 and full time since 2008. Her PhD thesis was concerned with the archaeology of the Namaqualand region of the Northern Cape and she is familiar with the heritage of the region.

John Pether (MSc. Pr. Sci. Nat. (Earth Sci)) is an independent consultant/researcher and authority on coastal-plain and continental-shelf palaeo-environments.

Mr David Halkett, Dr Lita Webley and Mr John Pether are independent specialist consultants who are in no way connected, financially or otherwise, with the proponent, other than in the delivery of consulting services on the project.

Terminology

Archaeology: *Remains resulting from human activity which is in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.*

Crypto-crystalline silica (CCS): *Cryptocrystalline silicates include lithic materials such as chert or flint and were widely used by prehistoric peoples to manufacture stone tools*.

Early Stone Age: *The archaeology of the Stone Age between 200 000 and 2 500 000 years ago***.**

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals.*

Heritage: *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).*

Holocene: *The most recent geological time period which commenced 10 000 years ago.*

Late Stone Age: *The archaeology of the last 20 000 years associated with fully modern people.*

Middle Stone Age: *The archaeology of the Stone Age between 20 000- 120 000 years ago associated with early modern humans.*

National Estate: *The collective heritage assets of the Nation.*

Palaeontology: *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 or trace.*

SAHRA: *South African Heritage Resources Agency – the compliance authority which protects national heritage.*

Structure (historic): *Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.*

Trace fossil: *The track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*

Acronyms

BP	Before the Present
DEA	Department of Environmental Affairs
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LSA	Late Stone Age
MSA	Middle Stone Age
NHRA	National Heritage Resources Act, No 25 of 1999
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency

CONTENTS

1. INTRODUCTION

ACO Associates cc appointed by Digby Wells Environmental, on behalf of the client Orlight SA (Pty) Ltd, to undertake an Impact Assessment for the construction of a 70MW solar facility on 350ha of land Portion 5 of the farm Kleine Rooiberg 227, Northern Cape Province. The proposed facility will be located approximately 40 km to the north of Loeriesfontein, within the Hantam Local Municipality of the Namakwa District Municipality. This is to meet the growing demand for electricity generation and cleaner energy production in South Africa.

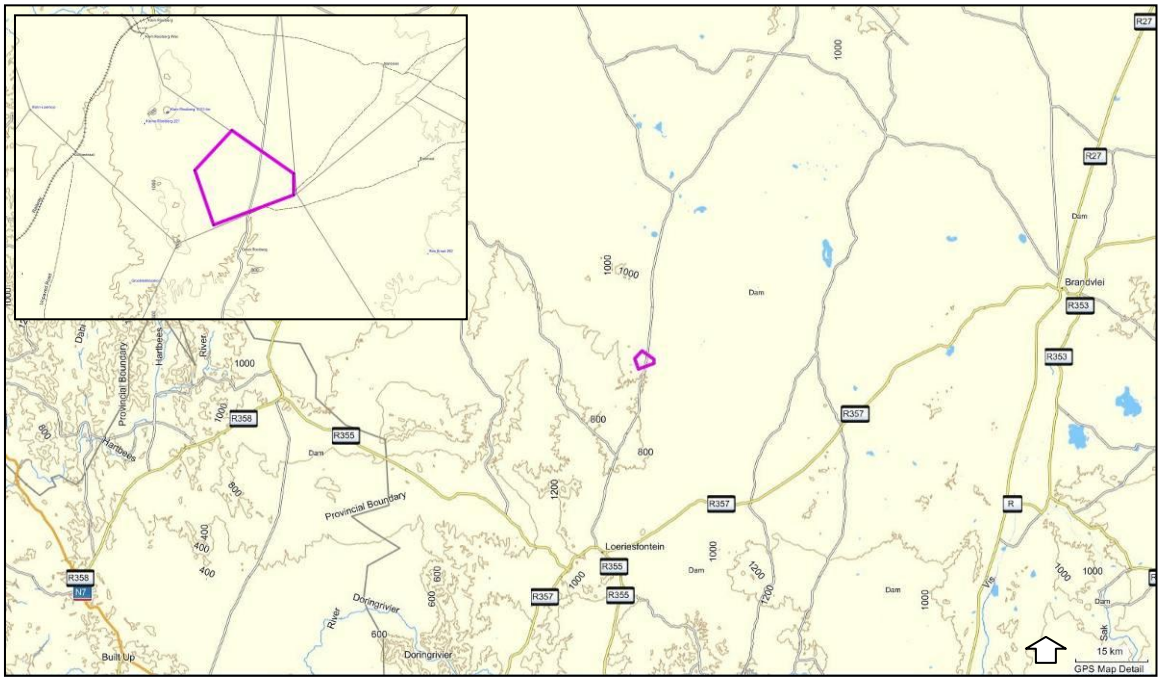

Figure 1: The location of the proposed facility on the farm Kleine Rooiberg, situated to the north of Loeriesfontein and to the west of Brandvlei.

2. DEVELOPMENT PROPOSALS

The Loeriesfontein project will have a generation capacity of 70MW resulting in the physical alteration of approximately 350ha of range land. Two alternative layout designs (Options A & B) have been suggested (Figure 2). They differ only marginally from each other in the position of the laydown areas and the substation. The facility will connect to the Helios substation (if required) via an overhead powerline. Where possible the transmission route will be situated within, or parallel to, an existing servitude. There are two transmission lines near the site, including a 66 kV transmission line that runs along the district road towards the substation and a 400 kV transmission line that runs towards the north of site in the direction of the Klein Rooiberg.

The project will require the establishment of a ground mounting system, solar PV panels, inverters, switchboard and transformers. Access roads to the facility from the nearest public road onto the site will be required. Internal site roads will also be required to access the solar panels for maintenance purposes. The solar panel plant will be fenced off from the surrounding farms. The site will need to be cleared of vegetation.

The following associated infrastructure will be required:

- Temporary container homes during the construction phase
- Office and technical service buildings
- Electricity distribution lines (from substation to Eskom power line)
- A perimeter high security fence

- Roads within the development footprint

The “no go” option (no development of the site) will also be considered.

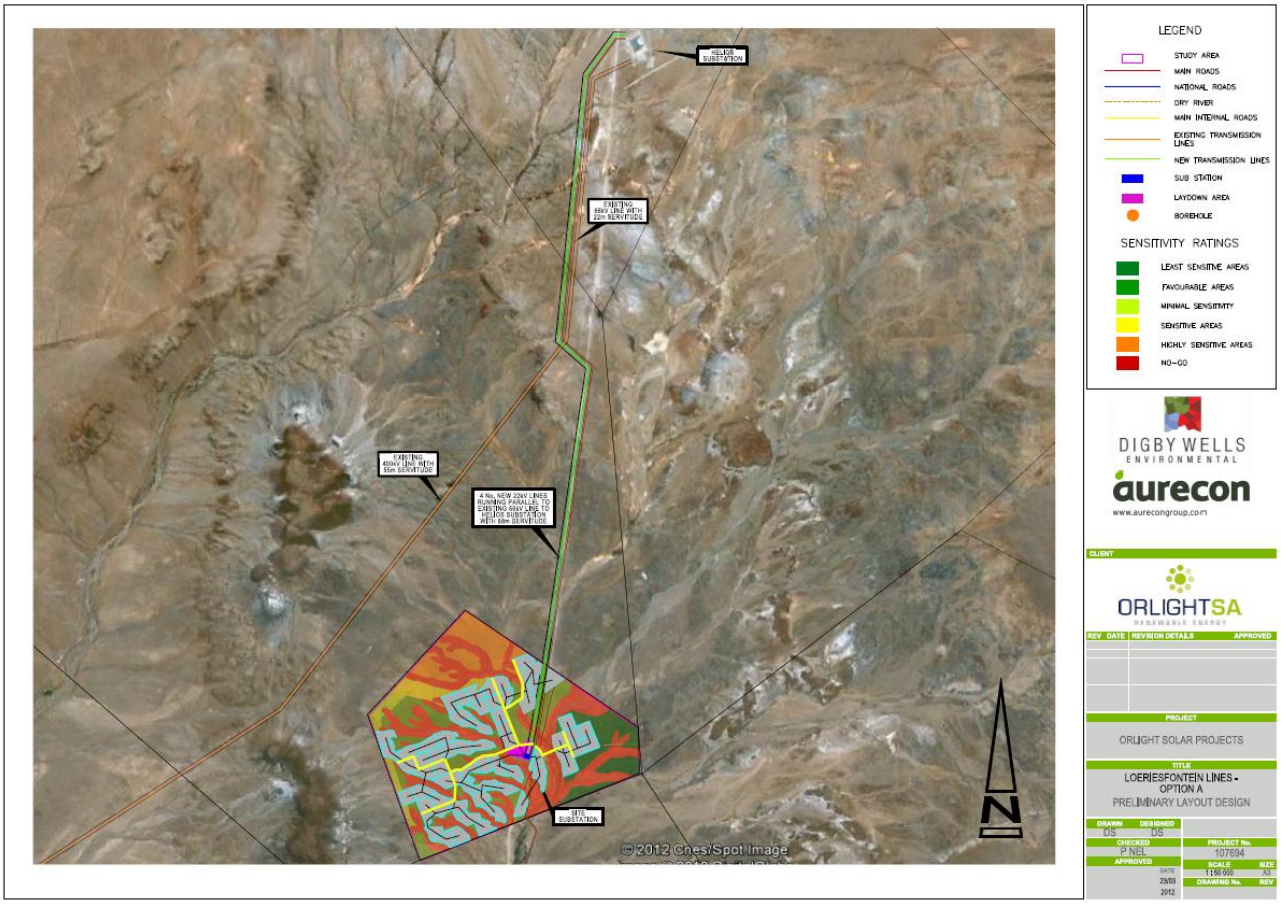

Figure 2: Proposed Layout Option A. Note that the proposed facility is bisected by a gravel road with the largest portion of the facility to the west of the road.

3. TERMS OF REFERENCE

This assessment includes:

- A site visit and desk top study to determine the pre-history and history of the property;
- The rating of significance of heritage resources on the property;
- An assessment of whether the development of the property will result in a loss of significant heritage resources;
- Recommendations for mitigation if necessary.

4. LEGISLATION

The National Heritage Resources Act, No 25 of 1999 (Section 38 (1)) makes provision for a compulsory notification of the intent to development when any development exceeding 5000 m² in extent, or any road or linear development exceeding 300m in length is proposed.

The NHRA provides protection for the following categories of heritage resources:

- Cultural landscapes (Section 3(3))
- Buildings and structures greater than 60 years of age(Section 34)
- Archaeological sites greater than 100 years of age(Section 35)
- Palaeontological sites and specimens
- Shipwrecks and aircraft wrecks
- Graves and grave yards (Section 36).

Only the Western Cape and Kwa-Zulu Natal have functioning Provincial Heritage Authorities, and consequently SAHRA administers heritage in the remaining provinces particularly where archaeology and palaeontology are the dominant concerns. Heritage Northern Cape (Ngwao Boswa Kapa Bokoni) deals largely with built environment issues at this stage. Amongst other things the latter administers:

- World Heritage Sites
- Provincial Heritage Sites
- Heritage Areas
- Register Sites
- 60 year old structures
- Public monuments & memorials

Archaeology, including rock art, graves of victims of conflict and other graves not in formal cemeteries are administered by the national heritage authority, SAHRA. Digby Wells Environmental submitted a cultural resources pre-assessment report or Notice of Intent to Develop to SAHRA in January 2012.

SAHRA (SAHRA file number: 9/2/017/0020) have requested a palaeontological and archaeological impact assessment. Further, they have asked that the archaeological impact assessment should also assess whether the cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance.

The Palaeontological Impact Assessment was conducted by Mr John Pether and is attached at the end of this report at Appendix 2. Select sections are summarised in this Heritage Impact Assessment.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The Loeriesfontein study area is located at 815 to 840 mamsl. The landscape is flat for the most part and north facing. The farm is named “Klein Rooiberg” because the northern border of the study area is dominated by outcropping regions (“koppies”) which are reddish in colour.

Plate 1: View from the koppie to the east of the local district road, looking in a westerly direction across the study area with the dry river bed in the foreground and the 66 kV power line running parallel to the road. The facility does not extend to the mountains in the background.

The southern border of the study area also exhibits these koppies that are elevated above the plains (Plate 2). The site is covered by low lying vegetation of the Succulent Karoo Biome. A number of drainage lines were identified crossing the study area; the widest of them being about 50 m (within the eastern region of the study area). The general flow direction of the smaller drainage lines is easterly, until they meet at the major drainage line within the study area which has a southerly flow direction. The drainage systems are associated with the Volstruisnesholte River catchment. The Scoping Report (Digby Wells Environmental 2012) has recommended a buffer zone of 100 m along the drainage lines (Figure 2). The study area is considered to be fairly natural succulent Karoo shrubland with low intensity sheep grazing on the site. There is a small concrete farm dam located on the property next to a windmill. Farms fences have been erected.

There are two transmission lines near the site, including a 66kV transmission line that runs along the district road towards the substation and a 400kV transmission line that runs to the west of the site in the direction of Klein Rooiberg. There is a district road which runs through the project site.

Plate 2: View of one of the numerous low koppies which occur in the study area. They all have gravel roads which run over the summit.

The Scoping Report points out that there are hardly any visual receptors that will be affected by the potential Loeriesfontein solar power plant, as it will be located some 40km north of the town on a gravel road which is seldom used by tourists. There is also a “koppie” on “the right hand side of the road (when driving in a northerly direction) in the study area that could provide screening if the plant were to be placed behind it” (Draft Scoping Report: Digby Wells Environmental).

6. METHODOLOGY

A literature survey was conducted prior to the fieldwork. Very little information is available on the archaeology of the Loeriesfontein area and, apart from the suggestion that we would find scatters of MSA stone implements, little could be predicted. Previous work on adjoining property of Sous for a wind farm and solar facility (Van Schalkwyk 2011) provided the only source of local data.

The property was visited by Lita Webley and David Halkett on the 19-20 April 2012. The proposed PV arrays were loaded onto handheld GPS receivers (set to the WGS84 datum) to facilitate the identification of the search area. Walk paths (Figure 3) and site locations were recorded with GPS and finds were photographed and described. The assessment was primarily concerned with palaeontology and archaeology (as per the recommendations of SAHRA), but consideration was also given to the built environment where appropriate.

Based on the low sensitivity of the site determined by its geological context, the palaeontological study (conducted by specialist Mr John Pether) was limited to a desktop study. In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*)

represented within the study area were determined from geological maps. The known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience.

An independent Visual Assessment forms part of the EIA.

6.1 Limitations

There were no significant physical limitations encountered when undertaking the field study and surface visibility was excellent. Although there are few roads across the property, the low shrub and the level topography meant that were able to access all areas of the proposed facility.

As with all archaeological surveys, it is not possible to be completely confident that all archaeological sites were identified during the fieldwork. Surface distributions give only a general indication of sub-surface remains. It is always possible that sub-surface archaeological sites may be present which were not identified during the survey

From a palaeontological point of view, the lack of any natural exposures of bedrock on the site have meant that conclusions are broad, based on existing literature and observations elsewhere.

7. BACKGROUND TO THE AREA

7.1 Palaeontological Background

The Palaeontological Impact Assessment was conducted by Mr John Pether and his report is attached as Appendix 2. His findings are only briefly summarised here. The study area is underlain by the Prince Albert Formation of the Ecca Group, Karoo Supergroup. The Prince Albert Formation overlies the Dwyka Group tillites (C-Pd) and is overlain by the Whitehill Formation of the Ecca. Trace fossils such as arthropod tracks and fish trails are common in the Prince Albert Formation. Rare fish remains have been found in nodules and marine invertebrates and fossil wood and leaves also occur. The ephemeral drainages of the Rooiberg hills could well incorporate fossils eroded from the more abundantly fossiliferous Whitehill Formation that is exposed as the "White Band" on the hill slopes. However, these drainages are likely to be avoided for PV panel installations. The draft Scoping Report (Digby & Wells Environmental 2012) also report on a possible fossilised fish-imprint (S30.57302; E19.54537) found just below the top of an outcrop.

7.2 Archaeological Background

There is very little published literature on the archaeology of the area around Loeriesfontein. Webley & Halkett (2010) undertook a study for a new substation between Aries and Helios, to the west of Brandvlei near to the Katkop Hills. They reported on weathered MSA artefacts on indurated shale scattered over a wide area. None of these appear to be *in situ.* They found no Later Stone Age artefactual scatters in the area, despite suggestions in the literature (Deacon 1996) that some of the Bleek and Lloyd informants may have originated in this area.

Van Schalkwyk (2011) undertook an HIA for a wind farm to the north of Loeriesfontein, very close to the proposed area. He reported on a number of open sites with surface scatters of MSA and LSA artefacts. However, there is no description or photographs of the LSA artefacts so that it is not possible to compare them with the findings from this assessment. He observed that they are mostly on top of small hills or at the foot of the hills. He also recorded an early 20th century farmhouse and family cemetery.

Morris (2007) looked at the area around Loeriesfontein with respect to the upgrading of the Sishen-Saldanha railway line. He reported on MSA artefact scatters.

The draft Scoping Report (Digby Wells Environmental 2012) reported on the presence of engravings on boulders between Loeriesfontein and Brandvlei. They refer to an article on the rock

art of the Thirstland by Rudner & Rudner (1968) which described both scratched and pecked engravings and the presence of stone hut circles between the boulders associated with quartz microliths (probably Wilton), possible herder potsherds and ostrich eggshell beads (Rudner and Rudner, 1968).

7.3 Historical Background

Historical literature confirms that this part of Bushmanland was occupied by San hunter-gatherers during the early part of the 19th century. However, from approximately 1850 onwards, Dutch Trekboers started making seasonal use of the summer grazing around the large pans in the area. Many contemporary farmers in Namaqualand still own two farms, one in the Bushmanland and the other in Namaqualand. The livestock is transported between their farms by truck. The Basters, of mixed descent, also lived around the salt pans in Bushmanland during the 19th century but were eventually forced off the land as the farms were surveyed and made available to European farmers. Some of these Basters travelled north and settled in the southern Richtersveld. Many of the farms were only allocated after the introduction of the wind pump to South Africa in the 1870s made the more arid lands accessible and suitable for grazing.

Kleine Rooiberg 227 was surveyed in 1880 (SG 1679/1880).

8. FINDINGS

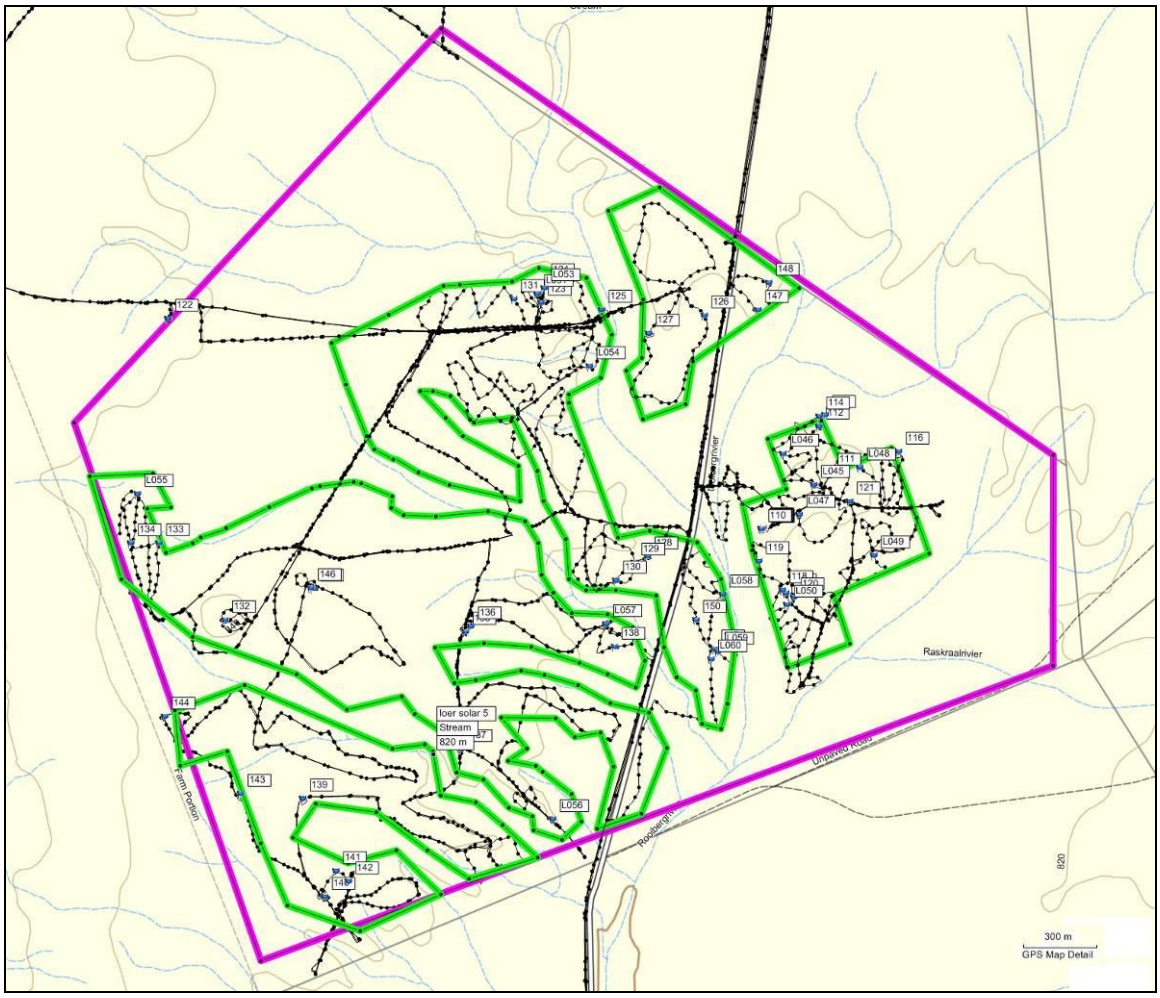

Figure 3: Map of tracks and location of sites recorded during the survey. The green lines indicate the approximate layout of the facility.

The field survey involved a combination of driving and walking. It was soon apparent that the most significant archaeological sites were situated on the top of small koppies, and so all these locations were examined in some detail.

8.1 Archaeology

No clearly identifiable artefacts from the Early Stone Age were found during the survey.

Scatters of very weathered Middle Stone Age artefacts were found randomly scattered across the landscape. The MSA artefacts were not concentrated near the dry stream beds or associated with the koppies which dot the landscape.

Plate 3 & 4: A very weathered flake and core from the study area.

The most significant discovery was that of a number of Later Stone Age archaeological sites, the majority located on the top of the seven little koppies (Sites 086, 124, 132, 135, 137, 139 & 140) which dot the landscape.

Plate 5: Collection of hornfels and CCS (opaline?) flakes and bladelets, with two potsherds on the extreme left.

The most impressive of these LSA koppie sites is Site 86 which is located on the highest koppie, to the east of the gravel road and adjacent the dry stream bed. It consists of a surface scatter of archaeological material over about 20m². It includes freshly flaked hornfels artefacts many

retaining their cortex, and with a significant blade element (Plate 5). These sites are easy to identify by the presence of white crypto-crystalline silica (CCS) flakes and blades. The CCS component is a fine-grained raw material which includes cherts and flints frequently utilised by stone-age hunter gatherers. This particular CCS material appears to be a kind of opaline. Some of the sites have backed CC bladelets, there is also a CC segment and a CCS scraper but these are on other koppies. All the koppie sites are also characterised by large numbers of broken ostrich eggshell (OES) fragments, but only Site 086 has a single, unfinished OES bead. Site 086 also has two potsherds. They are both relatively thin walled (4-5mm in thickness), with a fine quartz temper and the one has a brown slip. Neither is burnished.

Site L051/3 (124): is also on top of a koppie and it exhibits the same variety of LSA material, but in lower densities. Apart from the hornfels bladelet element, it contains an opaline backed piece as well as a small scraper.

Plate 6: A backed CCS piece and a CCS scraper from Site L052. **Plate 7:** CCS cores and chunks.

There are only two exceptions to this pattern of LSA sites on koppies. Site 149 is located on a slight rise, on the banks of the stream which flows parallel to the gravel road. It exhibits the same range of material as Site 086. Nearby is Site 150 which is characterised by a number of portable grooved stones. These two sites are of high significance.

Plate 8 & 9: Two grooved stones from Site 150.

There is also some historical archaeological material, which points to some European contact. Two fragments of ceramics with spongeware decoration were found on the lower slopes of the highest koppie (Site 086). These pieces match another sherd of ceramic from the river bank. A number of metal lids, wire, tins (some with wire handles), fencing posts and white bottle glass were found on the banks of the river suggesting that the river may have formed an focus for seasonal settlement by farm workers during the early 20th century.

8.2 Built Environment

There is a single semi-circular stone shelter (or “skerm”) on the western edge of the river, overlooking the stream bed. It is clearly the remnants of a little stockpost, with some shale blocks arranged in a semi-circle. It is some 2m in diameter and the entrance faces north. It is associated with an old enamel bowl, a tin, a wire hook and two rusted sardine cans.

Plate 10: A semi-circle of packed stone, probably a stockpost.

8.3 Graves

While there is considerable evidence for Stone Age use of the area, formal burials have never been found in South Africa that date to the MSA. Graves from the LSA tend to be located in softer soils, such as the river banks. A few cairns were recorded on the top of low koppies but these may be elevation markers. No typical surface grave markers were observed with the exception of a single cairn in the open (Site 121).

8.4 Cultural Landscape

The landscape is featureless except for the occasional low koppie and the river which flows through it. It is covered with scrubby low vegetation and bare patches of gravel pavement. The farm continues to be used for small stock farming. Man-made features in the form of an overhead powerline, two windmills and a gravel road. There is very little evidence of the built environment on the proposed lands. The cultural landscape of the solar plant site is therefore considered to be of low significance.

9. IMPACT IDENTIFICATION AND ASSESSMENT

9.1 Palaeontology

According to the palaeontological specialist, the scale of subsurface disturbance and exposure is quite limited, comprising mainly “post holes” to support the PV panel frames. These holes will mainly affect the stony regolith and variously weathered Prince Albert shales. However, it is conceivable that eroded-out fossils could be found in places on the surface of the property. In view of the moderate fossil potential it is proposed that only a basic degree of mitigation is required (Appendix 2).

9.2 Archaeology

The MSA artefact scatters recorded during the survey are widespread in the western part of Bushmanland and are of low significance. They are therefore given an ungraded status. However, this study also identified a number of Later Stone Age sites on low koppies and near the river. These sites exhibit a pattern of formal stone artefacts and raw material, as well as pottery and ostrich eggshell, which have not been recorded in combination in Western Bushmanland before. These sites have the potential to inform us on a regional pattern of Later Stone Age settlement and the sites are therefore considered to be of medium to high significance. They have been graded as Grade 111 and Grade 11 sites (Appendix 1).

Table 1: Summary of impacts to archaeological material

Nature of Impact: Impacts to archaeological material could involve destruction of material at solar panel footings, underground cabling, access roads, etc.		
	Pre- Mitigation	**Post- Mitigation**
Extent	Regional	Local
Magnitude	On-site	On-site
Duration	Permanent	Permanent
Intensity	Medium	Negligible
Probability	Definite	Definite
Significance	Low - Medium	Low - Medium
Mitigation: The best method to ensure the conservation of the Later Stone Age sites identified in this report is to avoid the sites on the koppies and next to the river (Sites graded as Grade 11 and Grade 111 in Appendix 1). If this is not possible, then mitigation in the form of an archaeological intervention will be required. This would involve the systematic excavation and/or collection of archaeological material.		
Cumulative Impacts: The cumulative impact of several such facilities will result in the potential destruction of significant archaeological material and may result in the loss of archaeological information.		
Operational Phase: n/a		
Decommissioning Phase: n/a		

* Once archaeological material is destroyed, it cannot be renewed or replaced.

9.3 Built Environment

There are no buildings or structures, with the exception of the stone “skerm” on Portion 5 of the property identified for the development of the facility. The impacts to the Built Environment are considered to be negligible.

9.4 Graves

No cemeteries or graves were recorded with the possible exception of one cairn which may represent a human burial. It is possible that human remains may be found in the softer soils close to the river.

9.5 Cultural Landscape

The proposed facility will result in the “industrialization” of the landscape. However, the landscape is considered to have low cultural significance as it comprises a flat arid environment interspersed with small koppies. This type of landscape stretched for hundreds of kilometres to the north and south. This area is not visited by tourists and the potential visual impact is considered to be low.

Nature of Impact: The proposed facility may have a limited visual impact on the cultural landscape and its archaeological significance		
	Pre- Mitigation	**Post- Mitigation**
Extent	Local	Local
Magnitude	Local	Local
Duration	Long term	Long term
Intensity	Medium	Medium

Probability	Definite	Definite
Significance	Low	Low
Mitigation: A Visual Impact Assessment by a specialist which considers the proposed impact of the development on the Cultural Landscape.		
Cumulative Impacts: The cumulative impact of several such facilities will result in "industrialization" of the landscape.		
Operational Phase: n/a		
Decommissioning Phase: n/a		

No preference is expressed for either of the two options for the layout of the facility (Options A and B).

The "no-go" alternative would mean that the status quo is retained and that the heritage resources of the area are maintained in their current condition.

10. MITIGATION AND ASSESSMENT OF ALTERNATIVES

10.1 Palaeontology

In view of the moderate fossil potential it is proposed that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil material be included in the Construction Phase EMP for the project. Appendix 1 outlines monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

10.2 Archaeology

Two types of archaeological "sites" were identified, namely a background MSA scatter and discrete LSA sites predominantly on koppies and along dry river beds. The report recommends that they are considered separately.

No archaeological mitigation is proposed for the MSA archaeological scatters since:

- There are scatters of MSA artefacts across thousands of square kilometres of Bushmanland;
- The lack of *in situ* MSA open sites or indications of stratified archaeological deposits means that the archaeological material on site has limited scientific value;
- We have photographed and recorded small collections of material across the solar plant site and believe that these are representative of the material as a whole;
- Further mitigation is unlikely to result in a greater understanding of the material and as a result we do not believe further intervention from an archaeological point of view is necessary.

It is important to remember that a permit for the destruction of archaeological remains will have to be obtained from SAHRA. A single permit for the entire area would probably be the most logical.

With regard the LSA sites which are found on koppies and along dry river beds, this report recommends that those sites which have been given a Grade 11 and Grade 111 rating (Appendix 1) should be avoided to ensure they are conserved. This would mean avoiding the summit of the koppies and the sites along the river. If this is not possible, then a systematic sampling of surface material may be the most expedient way of recording the sites and making the area available for development. It is not anticipated that the sites will have much deposit and a surface scrape of material may be sufficient. The only exception are Site 149 and 150 (along the river), where some depth of archaeological deposit may occur. The excavation of archaeological material will require a permit issued by SAHRA and must be undertaken by a suitable qualified archaeologist.

10.3 Graves

It is possible that human remains may occur in the softer soils along the river channels. In the event that human remains are uncovered beneath the soil surface during the construction of the facility, work in that location should stop, and the heritage authorities (SAHRA) should be notified. They may recommend exhumation.

10.4 Built Environment

There are no issues relating to the Built Environment (e.g. buildings or structures older than 60 years which are protected by the NHRA).

10.5 Cultural Landscape

SAHRA have requested that the assessment should whether the "cumulative impact of the solar energy facilities proposed on the same property may compromise the cultural landscape and its archaeological significance". There are no significant issues relating to the Cultural Landscape. The landscape comprises typical Bushmanland scrub. The occupation of the small koppies by Later Stone Age peoples suggests that they had a specific world view which incorporated the koppies as living sites. The koppies could be considered as part of an archaeological landscape. If the koppies are avoided (thereby conserving the LSA sites) then the long term impact of the proposed facility on the landscape will be limited.

The Visual Impact Specialist should consider the cumulative visual impact of the proposed Loeriesfontein wind farm and solar facility on the adjoining property. The construction of several such facilities in this area will have a visual impact on the landscape, but this is likely to be low.

Two options for the layout of the facility have been proposed. This report does not favour one layout above the other.

The "no-go" alternative would mean that the status quo is retained and that the heritage resources of the area are maintained in their current condition.

11. CONCLUSIONS

In conclusion, the following heritage indicators were considered:

Palaeontology:

- The PIA describes fossil potential of the site as moderate and recommends that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil material be included in the Construction Phase EMP for the project;

The MSA Archaeological Scatters:

- Stone artefacts scatters from the Middle Stone Age are sparsely distributed across the study area;
- Thousands of square kilometres of Bushmanland are covered by these low density artefacts scatters;
- The absence of associated archaeological material, and lack of discrete individual sites reduces the significance of the material overall and they are therefore ungraded;
- A permit will be required for the destruction of archaeological material.

The LSA Archaeological sites:

- Are concentrated on little koppies in the study area as well as along the stream which runs along the gravel road;

- They consist of discrete sites with a formal assemblage that includes scrapers and backed pieces, grooved stones as well as pottery and ostrich eggshell fragments;
- These sites are considered to have Grade 11 (Provincial) and Grade 111 (Local) significance;
- The sites are unique and offer the potential to inform on a regional archaeological pattern not recorded previously for this part of Bushmanland;
- For this reason, mitigation should take the form of avoidance of these sensitive sites. If avoidance is not possible, then archaeological intervention in the form of excavations or collections will be required.

The Built Environment:

- There are no buildings of heritage significance on the site.

Graves:

- A single cairn which could represent a burial was identified. Due care should be taken during construction of the site and if human remains are uncovered, work should stop in that area and SAHRA should be notified.

Cultural Landscape:

- The proposed solar plant is positioned on a gravel road to the north of Loeriesfontein;
- The cultural landscape of the surrounding area a flat arid landscape, with occasional low koppies, utilised for the grazing of livestock;
- It is unlikely that the development will have a significant impact on the Cultural Landscape.

The potential impacts resulting from the installation of a solar power plant on the heritage resources of the sites are considered to be of minor significance with the exception of the LSA sites for which mitigation is recommended.

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Appendix 1: Location of archaeological sites.

SITE	LATITUDE (S) (dec deg)	LONGITUDE (E) (dec deg)	DESCRIPTION	GRADE	MITIGATION
086	-30.59736300	19.54711300	Dense LSA scatter on top of a prominent koppie. Large amounts of ostrich eggshell fragments and stone artefacts concentrated on the hilltop. The material includes bladelets, flakes, irregular and single platform cores, 1x miscellaneous retouch piece. No formal artefacts observed. Pottery is present (4-6mm thick; fine temper, no burnish). I x unfinished oes bead suggesting outer diameter of ~6mm. Some bone was also noted (possibly recent). Raw materials include Quartz and quartz crystal, hornfels and CCS (opaline?). No/minimal deposit but rather a single surface scatter. Sites 087-110 are points representing the outer boundary point of 086.	Grade II	Mitigation: avoidance or excavation
087	-30.59734600	19.54705200	artefact scatter approximate boundary point		
088	-30.59735600	19.54705100	artefact scatter approximate boundary point		
089	-30.59735400	19.54705100	artefact scatter approximate boundary point		
090	-30.59737400	19.54710400	artefact scatter approximate boundary point		
091	-30.59737800	19.54712700	artefact scatter approximate boundary point		
092	-30.59737700	19.54712800	artefact scatter approximate boundary point		
093	-30.59737100	19.54712300	artefact scatter approximate boundary point		
094	-30.59738000	19.54713200	artefact scatter approximate boundary point		
095	-30.59737800	19.54713000	artefact scatter approximate boundary point		
096	-30.59738000	19.54713100	artefact scatter approximate boundary point		
097	-30.59736300	19.54712900	artefact scatter approximate boundary point		
098	-30.59735300	19.54714100	artefact scatter approximate boundary point		
099	-30.59735400	19.54714300	artefact scatter approximate boundary point		
100	-30.59735100	19.54713800	artefact scatter approximate boundary point		
101	-30.59734100	19.54713100	artefact scatter approximate boundary point		
102	-30.59730600	19.54711500	artefact scatter approximate boundary point		
103	-30.59730700	19.54711200	artefact scatter approximate boundary point		
104	-30.59730700	19.54711100	artefact scatter approximate boundary point		
105	-30.59730600	19.54711400	artefact scatter approximate boundary point		
106	-30.59730800	19.54711400	artefact scatter approximate boundary point		
107	-30.59731900	19.54708800	artefact scatter approximate boundary point		
108	-30.59733100	19.54705800	artefact scatter approximate boundary point		
109	-30.59733900	19.54703000	artefact scatter approximate boundary point		
110	-30.59735800	19.54702500	artefact scatter approximate boundary point		
111	-30.59530400	19.55010100	Isolated fresh-looking quartzite flake		
112	-30.59362000	19.54958600	Small scatter of highly weathered hornfels (MSA?) flakes	Ungraded	No
113	-30.59320100	19.54986600	Small scatter of highly weathered hornfels (MSA?) flakes. One convergent retouched flake is clearly of MSA age.	Ungraded	No
114	-30.59325300	19.54960300	Patchy occurrences of chunky looking weathered hornfels material	Ungraded	No
115	-30.59461400	19.54799000	Small scatter of LSA (and MSA?) flakes on quartzite, ccs and hornfels	Ungraded	No
L046	-30.59461330	19.54799240	Same as site 115		No
116	-30.59453400	19.55313200	Weathered hornfels core and a few flakes. 1x retouched blade	Ungraded	No
117	-30.59969900	19.54812100	A few weathered hornfels flakes	Ungraded	No
118	-30.59958600	19.54796800	Old spring with evidence of it having been dug out, with debris piled to one side. In the immediate vicinity are signs of LSA artefacts including numerous CCS (opaline) and hornfels flakes. Fragments of 19th c refined earthenware ceramics are also noted here and elsewhere suggesting later colonial period use. A number of ostrich eggshell fragments were also observed.	Ungraded	No
119	-30.59852900	19.54691500	2 isolated fragments of refined earthenware ceramic	Ungraded	No
120	-30.59984600	19.54847400	2 isolated ccs flakes	Ungraded	No
121	-30.59635100	19.55096100	Isolated stone “cairn”. Roughly packed but grave-like in shape	Ungraded	No
122	-30.58969300	19.52065500	LSA and MSA artefact scatter on top of a low koppie. Big hornfels flakes as well as smaller debitage. Most fresh-looking while some display weathering. 1 piece of white ccs	Grade 111	Mitigation: avoidance or excavation

			(opaline) observed. A cairn of dolerite rocks (beacon/marker) is present on the hill.		
123	-30.58910800	19.53723500	A small number of large, fresh-looking hornfels flakes.	Ungraded	
124	-30.58840200	19.53737600	Extensive LSA artefact scatter on top of a low koppie. Some MSA elements are present. Most of the LSA material consists of bladelets, flakes and cores on hornfels, while 3 backed blades and a scraper are on the white ccs material. A small amount of ostrich eggshell fragments was observed. A small cairn of the local dolerite rocks (beacon/marker) was noted on the hill (L052). Also some recent glass.	Grade II	Mitigation: avoidance or excavation
L053	-30.58857790	19.53737650	Also a part of site 124		
125	-30.58936800	19.53992400	A dispersed and somewhat disturbed hornfels MSA scatter near a windmill and dam. Weathered flakes and cores covering a broad area.	Ungraded	No
126	-30.58957300	19.54449600	Isolated quartzite core	Ungraded	No
127	-30.59023300	19.54202100	A small localised scatter of white ccs cores and flakes of undetermined age, and a small weathered hornfels MSA component.	Ungraded	No
128	-30.59835600	19.54196800	Small LSA artefact scatter consisting of mostly hornfels flakes, bladelets and cores. No organic materials noted. Flat area not far from the river.	Ungraded	No
129	-30.59858000	19.54138500	Weathered hornfels radial core	Ungraded	No
130	-30.59923500	19.54056800	Isolated LSA irregular core made on banded agate	Ungraded	No
131	-30.58897700	19.53602700	Isolated LSA white ccs side scraper	Ungraded	No
132	-30.60067500	19.52319100	Ephemeral MSA artefact scatter on top of a low koppie, consisting of patinated flakes and chunks. Both fresh-looking and weathered specimens were noted. Some distinctive convergent MSA flakes are present.	Grade 111	Mitigation: avoidance or excavation
133	-30.59787200	19.52025000	Area of extensive natural unmodified hornfels covering flat plain. Extensive low density, very patinated hornfels artefactual material is present throughout the area, consisting of flakes, chunks and cores.	Ungraded	No
134	-30.59787400	19.51899700	Localised denser patch of artefactual material both weathered and fresher-looking.	Ungraded	No
135	-30.60110500	19.53387800	Ephemeral artefact LSA and MSA scatter on top of a low koppie. Mostly hornfels, with a few white ccs pieces noted including a bladelet core.	Grade 111	Mitigation: avoidance or excavation
136	-30.60090300	19.53411900	An arrangement of stone slabs to form a “cairn” on the east down slope of a low koppie. The purpose of this feature is unclear.	Ungraded	No
137	-30.60537300	19.53370800	Ephemeral artefact LSA and MSA scatter on top of a low koppie. Hornfels, white CCS and 1 piece of chalcedony. A few OES fragments were observed. I fragment of bottle glass with a pinkish hue from solar radiation was noted.	Grade 111	Mitigation: avoidance or excavation
138	-30.60164600	19.54050800	Extensive ephemeral MSA hornfels artefact scatter amongst natural surface hornfels chunks.	Ungraded	No
139	-30.60718000	19.52664400	Ephemeral artefact LSA and MSA scatter on top of a low koppie. Weathered and fresh looking hornfels and some white CCS. I metal item (possibly a mouth organ fragment)	Grade 111	Mitigation: avoidance or excavation
140	-30.61076000	19.52761700	LSA and MSA artefact scatter on top of a low koppie. Greater number of hornfels pieces than on some of the other koppies, and a handful of white CCS. Cores, flakes and chunks. Several pieces of bottle glass fragments (dark colour suggests some may be 19th century).	Grade 111	Mitigation: avoidance or excavation
141	-30.60982300	19.52812400	Big natural, smoothed dolerite boulder, and a few smaller outcroppings in the vicinity. None of these are engraved.	Ungraded	No
142	-30.61019800	19.52867000	An arrangement of flat slabs, and a few associated metal fragments probably representing an old borehole.	Ungraded	No
143	-30.60700300	19.52388000	LSA and MSA artefact scatter on top of a low koppie. Fresh looking hornfels predominant and starting to patinate. Cores and blades, 1x	Grade 111	Mitigation: avoidance or excavation

			retouch.		
144	-30.60419200	19.52050500	Extensive ephemeral patinated chunky MSA hornfels artefact scatter. Chunks, flakes and cores. Fresh scars breaking the patina are noted from time to time.	Ungraded	No
145	-30.59953000	19.52710200	As for 144		
146	-30.59950900	19.52700700	1 small "Fauresmith" type biface and 1 large convergent flake	Ungraded	No
147	-30.58937200	19.54688200	Isolated artefacts, 1 quartzite and 1 on white ccs	Ungraded	No
148	-30.58837900	19.54736300	A number of sherds of 19th c white refined earthenware ceramics, probably part of a plate. Somewhat isolated and not associated with any obvious buildings or structures. There are a few similar occurrences noted on the site.	Ungraded	No
149	-30.60174100	19.54493900	Dense LSA artefact scatter on a low koppie immediately overlooking the river. Abundant ostrich eggshell fragments and hornfels and CCS. Chunks, flakes and cores predominate but a formal element is present in the form of side scrapers (2x white ccs), a large segment (white ccs), a backed blade (1x hf) and an mrp (silcrete?)	Grade II	Mitigation: avoidance or excavation
L059	-30.60182770	19.54510090	Additional point on site 149		
L060	-30.60210220	19.54479880	Additional point on site 149		
150	-30.60067300	19.54412500	A LSA artefact scatter on a flat area close to the existing powerline, above and adjacent to the river. Hornfels, CCS and a small amount of quartz. Flakes and cores, thumbnail scraper (x1 white CCS), side scraper (x1 white CCS). Small amount of OES fragments. Quite unique in terms of this survey, are a number of lower grindstones found on this site (at least 4). One has a deep single groove, another is moderately shallower. The other 2 are flat slabs showing polish without any groove having developed. Grindstones often mark the position of a campsite. It is entirely possible that buried material will be present in the vicinity give the loose sediments along the old river terrace.	Grade II	Mitigation: avoidance or excavation
L045	-30.59574870	19.54936510	Weathered hornfels flakes, possibly MSA. These isolated flakes occur widely in the veld.	Ungraded	No
L046	S30 35 40.6	E19 32 52.8	Scatter of white opaline flakes, probably LSA. At least 6 photographed and there are probably a total of 10. In the veld, in the open. Scattered over an area of 2-3m²	Grade 111	Mitigation: avoidance or excavation
L047	-30.59683720	19.54871550	Two fragments of European ceramic with spongeware design, from the same vessel. Possibly mid to late 19th C.	Ungraded	No
L048	-30.59511720	19.55140300	One very large weathered hornfels flake/blade, MSA	Ungraded	No
L049	-30.59831880	19.55202940	One large weathered hornfels core	Ungraded	No
L050	-30.60011310	19.54816730	Some recent material on the eastern bank of the river, including glass, wire, tin cans, piece of spongeware ceramic that matches L047.	Ungraded	No
L051	-30.58879380	19.53706260	Two black quartzite flakes on the slopes of a little koppie.	Ungraded	No
L054	-30.59142240	19.53938990	Recent stockpost 'skerm'. Semi-circle of packed shale slabs, 2 blocks high, forming a semi-circle 2m in diameter, with an entrance to the north. Associated with wire, tin can and enamel basin.	Ungraded	No
L055	-30.59607570	19.51929320	Single very weathered flake with retouch	Ungraded	No
L056	-30.60792900	19.53775280	On a slight rise, a scatter of 10 artefacts consisting of 3 hornfels and some CCS chips.	Ungraded	No
L057	-30.60082170	19.54012240	Near stream. Flat area – deflated. Four opaline flakes, some hornfels. One core with flakes chipped off. Two bladelet elements. Many ostrich eggshell fragments over a 5m² area.	Grade 111	Mitigation: avoidance or excavation
L058	-30.59974360	19.54530880	Overlooking the stream, between stream and road. Opaline and hornfels flakes and ostrich eggshell.	Ungraded	No

Appendix 2: Palaeontological Impact Assessment.

BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED ORLIGHT SA DEVELOPMENT OF A SOLAR PHOTOVOLTAIC POWER PLANT NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE
Portion 5 of Kleine Rooiberg 227 RD

By

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)
Geological and Palaeontological Consultant
P. O. Box 48318, Kommetjie, 7976
Tel./Fax (021) 7833023
Cellphone 083 744 6295
jpether@iafrica.com

Prepared at the Request of

Digby Wells & Associates (Pty) Ltd.
Fern Isle, Section 10, 359 Pretoria Ave, Randburg
Private Bag X10046, Randburg, 2125
Co. Reg. No. 1999/05985/07
Tel: 011 789 9495, Fax: 011 789 9498
johan.nel@digbywells.com, www.digbywells.com

For

ORLIGHT SA (PTY) LTD

24 April 2012

DEA REF. NO. 12/12/20/2632
NEAS REF. NO. DEA/EIA/0000825/2011

CONTENTS

SUMMARY

Orlight SA (Pty) Ltd (Orlight SA) proposes to construct five new Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces. Three proposed sites for development of the Orlight SA Solar PV Power Plants are located in the Northern Cape Province near the towns of Aggeneys, Kenhardt and Loeriesfontein. Two proposed sites are in the Western Cape Province adjacent to the towns of Vanrhynsdorp and Graafwater. Digby Wells Environmental (Digby Wells) is appointed as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) processes for the proposed projects.

This desktop palaeontological assessment pertains to the Solar PV Plant near Loeriesfontein in the Namakwa District Municipality of the Northern Cape Province, viz. on Portion 5 of the farm Kleine Rooiberg 227 RD (Figure 1).

The solar PV panels will be mounted on metal frames (Figure 2) which are anchored to the ground with either concrete or screw pile foundations. These footings will be either hammered into the earth or anchored in a 1.5 m deep concrete foundation.

The study area is underlain by the Prince Albert Formation of the Ecca Group, Karoo Supergroup (Ppr, Figure 4). The Prince Albert Formation overlies the Dwyka Group tillites (C-Pd) and is overlain by the Whitehill Formation of the Ecca. Trace fossils such as arthropod tracks and fish trails are common in the Prince Albert Formation. Rare fish remains have been found in nodules and marine invertebrates and fossil wood and leaves also occur. The ephemeral drainages of the Rooiberg hills could well incorporate fossils eroded from the more abundantly fossiliferous Whitehill Formation (Pw, Figure 4) that is exposed as the “White Band” on the hill slopes (Figure 3). However, these drainages are likely to be avoided for PV panel installations.

The scale of subsurface disturbance and exposure is quite limited, comprising mainly “post holes” to support the PV panel frames. These holes will mainly affect the stony regolith and variously weathered Prince Albert shales. However, it is conceivable that eroded-out fossils could be found in places on the surface of the property.

In view of the moderate fossil potential it is proposed that only a basic degree of mitigation is required. It is recommended that an alert for the uncovering of fossil material be included in the Construction Phase EMP for the project. Appendix 1 outlines monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

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The author, John Pether, is an independent consultant/researcher and is a recognized authority in the field of coastal-plain and continental-shelf palaeoenvironments and is consulted by exploration and mining companies, by the Council for Geoscience, the Geological Survey of Namibia and by colleagues/students in academia pursuing coastal-plain/shelf projects.

Expertise

- Shallow marine sedimentology.
- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures and on/offshore cores).
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods).
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).
- Analysis of the shelly macrofauna of modern samples e.g. for environmental surveys.

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Heritage Western Cape. Member, Permit Committee for Archaeology, Palaeontology and Meteorites.
- Accredited member, Association of Professional Heritage Practitioners, Western Cape.

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1 INTRODUCTION

Orlight SA (Pty) Ltd (Orlight SA) proposes to construct five new Solar Photovoltaic (PV) Power Plants in the Western Cape and Northern Cape Provinces. Orlight SA is the local company established by BSG Resources Limited (BSGR), an international natural resources company that operates in the fields of mining, energy and engineering services.

Three proposed sites for development of the Orlight SA Solar PV Power Plants are located in the Northern Cape Province near the towns of Aggeneys, Kenhardt and Loeriesfontein. Two proposed sites are in the Western Cape Province adjacent to the towns of Vanrhynsdorp and Graafwater. Digby Wells Environmental (Digby Wells) is appointed as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) processes for the proposed projects

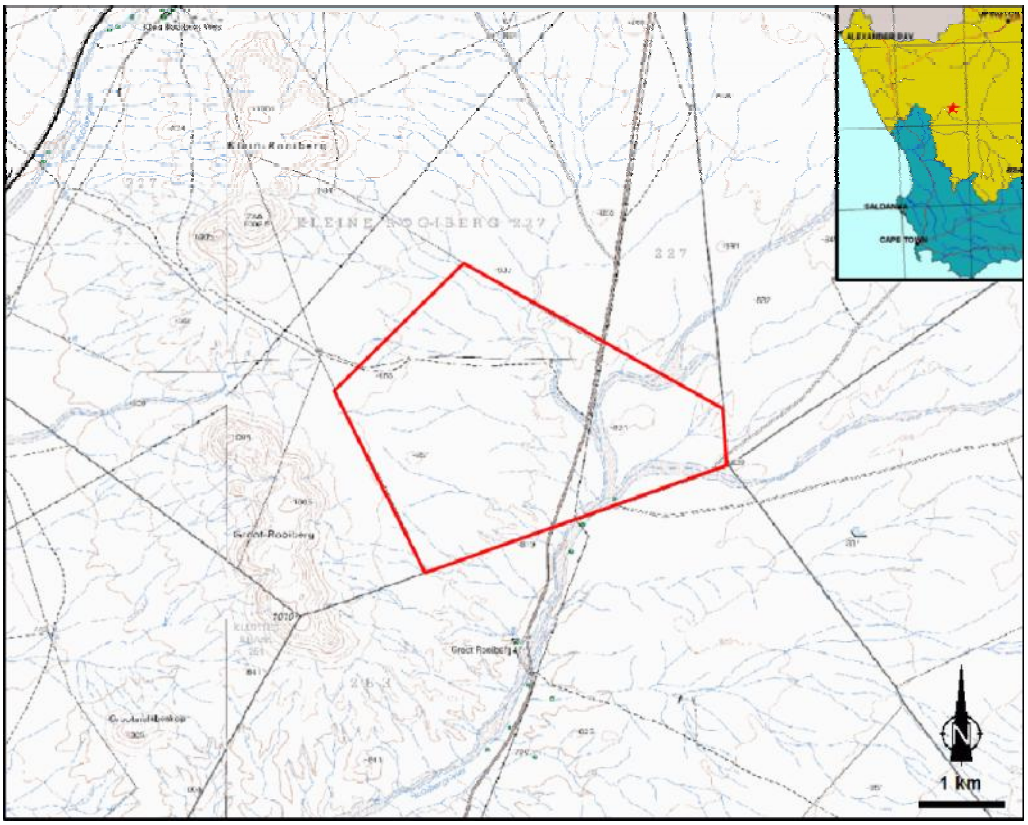

Figure 1. Location of the proposed Loeriesfontein Solar PV Plant. Extracts from 3019CB_2003_ED2_GEO.TIF and 3019DA_2003_ED2_GEO.TIF 1:50000 topo-cadastral maps. Chief Directorate: Surveys & Mapping.

This desktop palaeontological assessment pertains to the Solar PV Plant near Loeriesfontein in the Namakwa District Municipality of the Northern Cape Province, viz. on Portion 5 of the farm Kleine Rooiberg 227 RD (Figure 1). The preliminary generation capacity of the proposed Kenhardt Solar PV Power Plant is ~40 MW, but may be up to 150 MW. During the EIA Phase, studies will be undertaken to determine the optimal generation capacity that can be

accommodated in the study area based on ecological, cultural and socio-economic characteristics and other technical factors.

The power plant infrastructure will consist of a ground mounting system, solar PV panels, cabling, inverters, switchboards and transformer/s and transmission lines to connect the proposed Solar PV Power Plant to an existing Eskom transmission line. Also involved are access roads and temporary construction-related laydown areas, temporary site offices and a workshop.

The solar PV panels will be mounted into metal frames (Figure 2) which are anchored to the ground with either concrete or screw pile foundations. These footings will be either hammered into the earth or anchored in a 1.5 m deep concrete foundation.

Figure 2. Example of a Solar PV installation (supplied by Digby Wells).

Figure 3. Simulated oblique view of the project area, looking north. From Google Earth.

2 GEOLOGICAL SETTING

The project area is situated on a gently sloping sandy plain (Figures1 & 3) that descends from ~850 m asl. near the inselbergs of the Groot and Klein Rooiberge in the west, down to the Rooibergrivier drainage that traverses the eastern part of the project area. Where the Rooibergrivier exits the area the elevation is ~800 m asl. Minor drainages cross the area, linking to the Rooibergrivier.

The study area is underlain by the Prince Albert Formation of the Ecca Group, Karoo Supergroup (Ppr, Figure 4). The Prince Albert Formation overlies the Dwyka Group tillites (C-Pd) and is overlain by the Whitehill Formation of the Ecca. It is of early Permian age ~290-280 Ma. It is composed of grey to greenish shales in which calcareous concretions are common and was deposited in a marine deeper-deltaic environment (Johnson *et al*., 2006). Secondary iron and manganese mineralization imparts a dark hue to exposures.

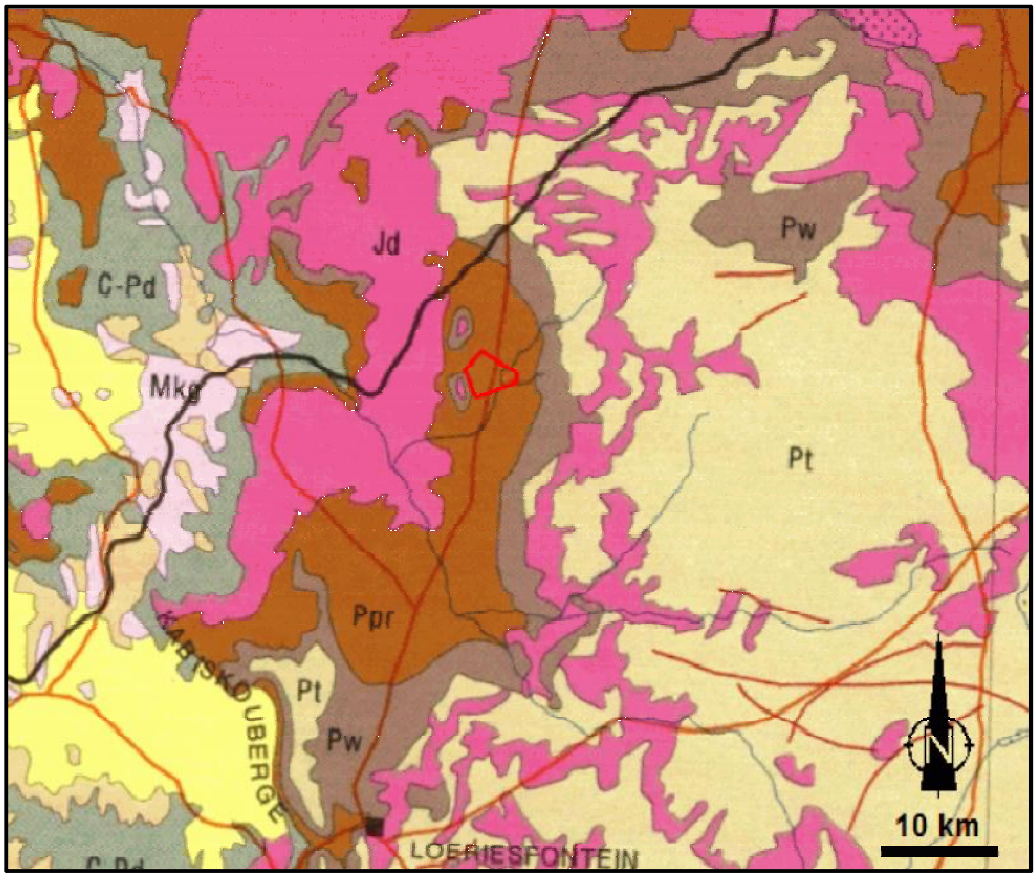

Figure 4. Geology of the study area. 1:1000000 Geological Map (CGS, 1997).

Jd – Karoo dolerites.
Pt – Tierberg Formation, Ecca Group.
Pw – Whitehill Formation, Ecca Group.
Ppr – Prince Albert Formation, Ecca Group.
C-Pd – Dwyka Group.

3 EXPECTED PALAEONTOLOGY

Trace fossils such as arthropod tracks and fish trails are common in the Prince Albert Formation. Rare fish remains (sharks, palaeoniscoids) have been found in nodules. Marine invertebrates and fossil wood and leaves also occur. Most of the fossils are found in the lowermost part of the formation (Cole, 2005).

Outcrops of rock are prevalent in the area (Figure 3) and the soil cover is evidently relatively thin and stony. The rock outcrops are a potential source of fossil-bearing rock pieces, such as the find of a probable lycopod stem (Figure 5)

Thicker sediments occur in the ephemeral drainages and those draining the Rooiberg hills in the west could well incorporate fossils eroded from the more abundantly fossiliferous Whitehill Formation (Pw, Figure 4) that is exposed as the "White Band" on the hill slopes (Figure 3). However, these drainages are likely to be avoided for PV panel installations.

Figure 5. Probable lycopod plant fragment (FSR for the project, Digby Wells, 2012).

The scale of subsurface disturbance and exposure is quite limited, comprising mainly "post holes" to support the PV panel frames. These holes will mainly affect the stony regolith and variously weathered Prince Albert shales. However, it is conceivable that eroded-out fossils could be found in places on the surface of the property.

4 RECOMMENDATIONS

In view of the moderate fossil potential it is proposed that only a basic degree of mitigation is required.

It is recommended that an alert for the discovery of fossils be included in the construction EMP for the project. Appendices 1 and 2 outline monitoring by construction personnel and general Fossil Find Procedures. This is a general guideline, to be adapted to circumstances.

In the event of possible fossil and/or archaeological finds, the contracted archaeologist or palaeontologist must be contacted. For possible fossil finds, the palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

5 APPLICATION FOR A PALAEONTOLOGICAL PERMIT

A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit must be made to SAHRA immediately.

The application requires details of the registered owners of the sites, their permission and a site-plan map. All samples of fossils must be deposited at a SAHRA-approved institution.

6 REPORTING

Should fossils be found a detailed report on the occurrence/s must be submitted. This report is in the public domain and copies of the report must be deposited at SAHRA. The report must fulfil the reporting standards and data requirements of SAHRA.

7 REFERENCES

Cole, D.I. 2005. Prince Albert Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 33-36.

Johnson, M.R., Van Vuuren, C.J., Visser, J.N.J., Cole, D.I., De V. Wickens, H., Christie, A.D.M., Roberts, D.L. & Brandl, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

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8 GLOSSARY

~ (tilde): Used herein as “approximately” or “about”.

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

AIA: Archaeological Impact Assessment.

Alluvium: Sediments deposited by a river or other running water.

Archaeology: Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

asl.: above (mean) sea level.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Coversands: Aeolian blanket deposits of sandsheets and dunes.

EIA: Environmental Impact Assessment.

EMP: Environmental Management Plan.

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

HIA: Heritage Impact Assessment.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil whose composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol or pedocrete, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by bulk earth works.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus *etc.*).

Pedocrete: A duricrust formed by pedogenic processes.

PIA: Palaeontological Impact Assessment.

SAHRA: South African Heritage Resources Agency – the compliance authority, which protects national heritage.

8.1 GEOLOGICAL TIME SCALE TERMS

ka: Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e*. duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present. Sometimes "kyr" is used instead.

Ma: Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present.

Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka. Late Pleistocene 11.7–135 ka. Middle Pleistocene 135–781 ka. Early Pleistocene 781–2588 ka (0.78-2.6.Ma).

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era. The Quaternary includes both the Pleistocene and Holocene epochs.

Pliocene: Epoch from 5.3-2.6 Ma.

Miocene: Epoch from 23-5 Ma.

Oligocene: Epoch from 34-23 Ma.

Eocene: Epoch from 56-34 Ma.

Paleocene: Epoch from 65-56 Ma.

Cenozoic: Era from 65 Ma to the present. Includes Paleocene to Holocene epochs.

For more details, see www.stratigraphy.org.

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9 APPENDIX 1 - FOSSIL FIND PROCEDURES

A regular monitoring presence over the period during which excavations are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

In the context under consideration, it is improbable that fossil finds will require declarations of permanent “no go” zones. At most a temporary pause in activity at a limited locale may be required. The strategy is to rescue the material as quickly as possible.

The procedures suggested below are in general terms, to be adapted as befits a context. They are couched in terms of finds of fossil bones that usually occur sparsely. However, they may also serve as a guideline for other fossil material that may occur.

Bone finds can be classified as two types: isolated bone finds and bone cluster finds.

9.1 ISOLATED BONE FINDS

In the process of digging the excavations, isolated bones may be spotted in the hole sides or bottom, or as they appear on the spoil heap. By this is meant bones that occur singly, in different parts of the excavation. If the number of distinct bones exceeds 6 pieces, the finds must be treated as a bone cluster (below).

Response by personnel in the event of isolated bone finds

- **Action 1:** An isolated bone exposed in an excavation or spoil heap must be retrieved before it is covered by further spoil from the excavation and set aside.
- **Action 2:** The site foreman and ECO must be informed.
- **Action 3:** The responsible field person (site foreman or ECO) must take custody of the fossil. The following information to be recorded:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital image of fossil.
- **Action 4:** The fossil should be placed in a bag (*e.g.* a Ziplock bag), along with any detached fragments. A label must be included with the date of the find, position info., depth.
- **Action 5:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of isolated bone finds
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established.

9.2 BONE CLUSTER FINDS

A bone cluster is a major find of bones, *i.e*. several bones in close proximity or bones resembling part of a skeleton. These bones will likely be seen in broken sections of the sides of the hole and as bones appearing in the bottom of the hole and on the spoil heap.

Response by personnel in the event of a bone cluster find

- **Action 1:** Immediately stop excavation in the vicinity of the potential material. Mark (flag) the position and also spoil that may contain fossils.
- **Action 2:** Inform the site foreman and the ECO.
- **Action 3:** ECO to inform the developer, the developer contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of a bone cluster find
The palaeontologist will assess the information and liaise with the developer and the ECO and a suitable response will be established. It is likely that a Field Assessment by the palaeontologist will be carried out asap.

It will probably be feasible to "leapfrog" the find and continue the excavation farther along, or proceed to the next excavation, so that the work schedule is minimally disrupted. The response time/scheduling of the Field Assessment is to be decided in consultation with developer/owner and the environmental consultant.

The field assessment could have the following outcomes:

- If a human burial, the appropriate authority is to be contacted (see AIA). The find must be evaluated by a human burial specialist to decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an archaeological context, an archaeologist must be contacted to evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an palaeontological context, the palaeontologist must evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

9.3 RESCUE EXCAVATION

Rescue Excavation refers to the removal of the material from the just the "design" excavation. This would apply if the amount or significance of the exposed material appears to be relatively circumscribed and it is feasible to remove it without compromising contextual data. The time span for Rescue Excavation should be reasonably rapid to avoid any or undue delays, *e.g*. 1-3 days and definitely less than 1 week.

In principle, the strategy during mitigation is to “rescue” the fossil material as quickly as possible. The strategy to be adopted depends on the nature of the occurrence, particularly the density of the fossils. The methods of collection would depend on the preservation or fragility of the fossils and whether in loose or in lithified sediment. These could include:

- On-site selection and sieving in the case of robust material in sand.
- Fragile material in loose/crumbly sediment would be encased in blocks using Plaster-of Paris or reinforced mortar.

If the fossil occurrence is dense and is assessed to be a “Major Find”, then carefully controlled excavation is required.

9.4 MAJOR FINDS

A Major Find is the occurrence of material that, by virtue of quantity, importance and time constraints, cannot be feasibly rescued without compromise of detailed material recovery and contextual observations.
A Major Find is not expected.

Management Options for Major Finds
In consultation with developer/owner and the environmental consultant, the following options should be considered when deciding on how to proceed in the event of a Major Find.

Option 1: Avoidance

Avoidance of the major find through project redesign or relocation. This ensures minimal impact to the site and is the preferred option from a heritage resource management perspective. When feasible, it can also be the least expensive option from a construction perspective.

The find site will require site protection measures, such as erecting fencing or barricades. Alternatively, the exposed finds can be stabilized and the site refilled or capped. The latter is preferred if excavation of the find will be delayed substantially or indefinitely. Appropriate protection measures should be identified on a site-specific basis and in wider consultation with the heritage and scientific communities.

This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.

Option 2: Emergency Excavation

Emergency excavation refers to the “no option” situation wherein avoidance is not feasible due to design, financial and time constraints. It can delay construction and emergency excavation itself will take place under tight time constraints, with the potential for irrevocable compromise of scientific quality. It could involve the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for “stockpiling”. This material could then be processed later. Consequently, emergency excavation is not the preferred option for a Major Find.

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Appendix 3: Visual Impact Assessment (Refer to EIA Report)