HERITAGE IMPACT ASSESSMENT: PROPOSED AGGENEYS 2 - 100 MW SOLAR PV FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR AGGENEYS, NAMAKWALAND MAGISTERIAL DISTRICT, NORTHERN CAPE

Required under Section 38(8) of the National Heritage Resources Act (No. 25 of 1999).

HWC SAHRA Case No.: 13729

Report for:

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EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur with the proposed development of the 100 MW Aggeneys 2 photo-voltaic (PV) solar energy facility and associated infrastructure to be located on the farm Bloemhoek 61/rem (12 378.97 ha in extent), some 12 km southeast of Aggeneys, Namakwaland Magisterial District, Northern Cape. The study area is centred on S29° 17' 15" E18° 57' 11". The project falls within the Springbok 8 Renewable Energy Development Zone.

The project will include:

» Arrays of PV panels up to 3.5 m high (fixed-tilt PV, single-axis tracking PV or double-axis tracking PV) on up to a maximum 233 ha and with a contracted capacity of up to 100MW;
» Mounting structures to support the PV panels;
» Cabling between the project components (to be lain underground where applicable);
» On-site substation (c. 0.625 ha);
» On-site inverters to convert the power from a direct current (DC) to alternating current (AC);
» On-site step-up transformers;
» Site Offices and Maintenance Buildings (c. 1 ha), including workshop areas for maintenance and storage, canteen, visitor's centre;
» Gatehouse and security office;
» Laydown area (c. 5 ha);
» Main site access road (c. 200-400 m long and 6 m wide, tarred if necessary);
» Internal access roads (c. 18-20 km total length and 4-5 m wide); and
» Fencing.

The 250 ha site is relatively flat and sandy with a light gravel coating and minimal vegetation. Ground visibility was excellent.

No heritage resources were identified within the proposed footprint, although several isolated stone artefacts attributable to background scatter were noted.

Because no significant impacts to heritage resources are expected it is recommended that the proposed Aggeneys 2 PV development be authorised. The following should be included as conditions of authorisation:

- If any change in the footprint occurs, then an archaeologist should be consulted for an opinion on whether a survey is required; and
- If any archaeological or palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency.

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BA: Basic Assessment

CCS: crypto-crystalline silica

CRM: Cultural Resources Management

ECO: Environmental Control Officer

EMPr: Environmental Management Programme

ESA: Early Stone Age

GP: General Protection

GPS: global positioning system

HIA: Heritage Impact Assessment

HWC: Heritage Western Cape

LSA: Later Stone Age

MSA: Middle Stone Age

NBKB: Ngwao-Boswa Ya Kapa Bokoni

NCW: Not Conservation Worthy

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

NID: Notification of Intent to Develop

PPP: Public Participation Process

PV: Photo-voltaic

REDZ: Renewable Energy Development Zone

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

SEF: Solar Energy Facility

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1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of the Aggneys 1 - 100 MW solar photo-voltaic (PV) energy facility to be located on the farm Bloemhoek 61/rem (12 378.97 ha in extent), some 12 km southeast of Aggeneys, Namakwaland Magisterial District, Northern Cape (Figures 1 & 2). The study area is centred on S29° 17' 15" E18° 57' 11". The project falls within the Springbok 8 Renewable Energy Development Zone (REDZ).

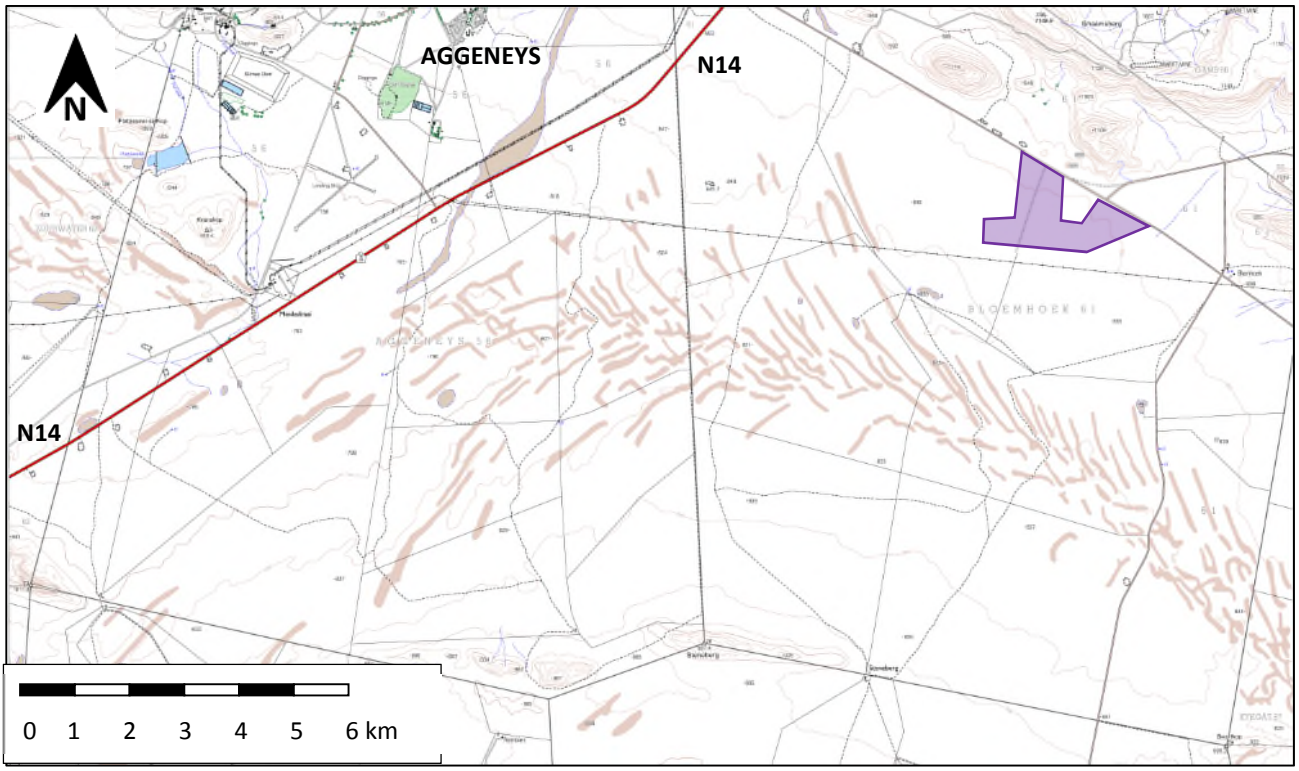

Figure 1: *Extract from 1:50 000 topographic mapsheet 2918BD showing the location of the site (purple polygon) relative to Aggeneys and the N14. Source of basemap: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

1.1. Project description

ABO Wind Aggeneys 1 PV (Pty) Ltd are proposing the development of a 100MW Solar Energy Facility (SEF) on a ~250 ha site southeast of Aggeneys. The project will include:

» Arrays of PV panels up to 3.5 m high (fixed-tilt PV, single-axis tracking PV or double-axis tracking PV) on up to a maximum of 233 ha and with a contracted capacity of up to 100MW;
» Mounting structures to support the PV panels;
» Cabling between the project components (to be lain underground where applicable);
» On-site substation (~0.625 ha);
» On-site inverters to convert the power from a direct current (DC) to alternating current (AC);
» On-site step-up transformers;

» Site Offices and Maintenance Buildings (~1 ha), including workshop areas for maintenance and storage, canteen, visitor's centre;
» Gatehouse and security office;
» Laydown area (~5 ha);
» Main site access road (~200 m long and 6 m wide, tarred if necessary);
» Internal access roads (~18-20 km total length and 4-5 m wide); and
» Fencing.

The facility would be connected to the proposed on-site collector substation via an up to a 220kV power line. The collector substation will be connected via the proposed powerline to the nearby Eskom Aggeneis Main Transmission Substation (MTS) near Aggeneys. It must be noted that the proposed collector substation and powerline will form part of a separate environmental authorisation application, and is assessed in a separate report.

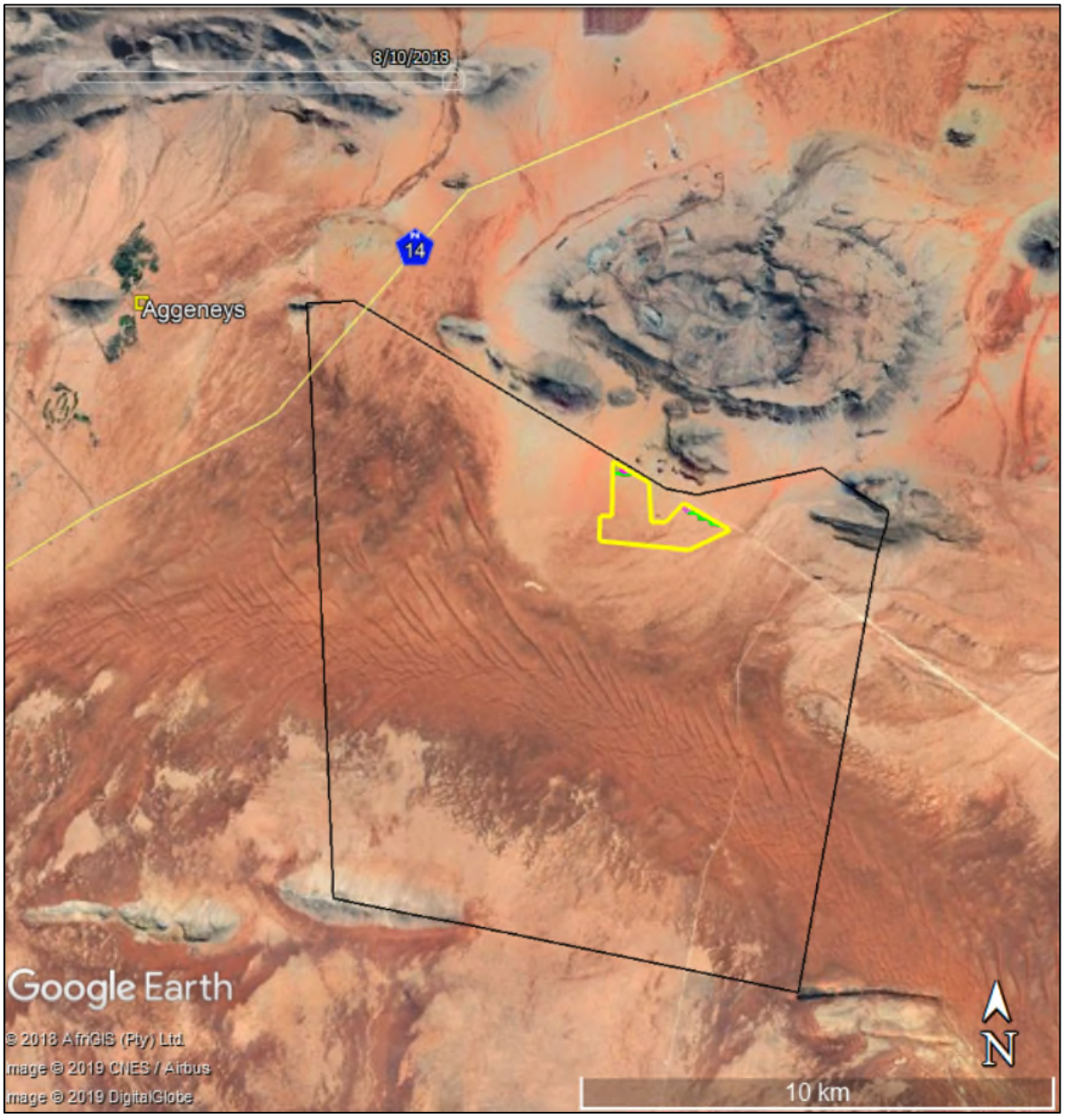

Figure 2: *Aerial view of the farm Bloemhoek 61/rem (black polygon) showing the location of the study area (yellow polygon) relative to Aggeneys and the N14.*

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations and/or services may impact on archaeological and/or palaeontological remains, while all above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA Consulting was asked to compile a heritage impact assessment (HIA) for the project. The report was to be based on both desktop research and field observations.

It should also be noted, however, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, all heritage resources should be identified and assessed.

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the national Department of Environmental Affairs (DEA) who will review the Basic Assessment Report (BAR) and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

» Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
» Field Director: Colonial Period & Rock Art.

1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old as well as military remains more than 75 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: "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";
- Palaeontological material: "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";
- Archaeological material: a) "material 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"; b) "rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation"; c) "wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";
- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

Section 3(3) describes the types of cultural significance that a place or object might have in order to be considered part of the national estate. These are as follows:

a) its importance in the community, or pattern of South Africa's history;
b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
i) sites of significance relating to the history of slavery in South Africa.

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to a Basic Assessment process because it is located within a REDZ in accordance with Government Notice 114 of February 2018. The present report provides the heritage component for the proposed development. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by DEA.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map was sourced from the Chief Directorate: National Geo-Spatial Information.

3.2. Field survey

The site was subjected to a detailed foot survey on 22 and 23 October 2018, with a return visit to examine the nearby open borrow pit on 29 November 2018. The survey was during late spring but in this dry area seasonality makes no meaningful difference to the vegetation cover and hence ground visibility. During the survey the positions of finds and survey tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at

times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

3.3. Specialist studies

A specialist palaeontological study was conducted by Dr John Almond of Natura Viva cc. Due to the generally low sensitivity of the study area this was only a desktop study (see Appendix 4).

3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by Savannah Environmental.

3.5. Grading

S.7(1) of the NHRA provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[1] for use in provinces where it has commenting authority. In this system, sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated as GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

3.6. Consultation

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of a Basic Assessment (BA) which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

3.7. Assumptions and limitations

The field study was carried out at the surface only and hence any completely buried archaeological sites would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. However, desktop work and prior experience in the area suggests that the chances of buried archaeology are very low and this is assumed to be true of the present study area as well.

[1] The system is intended for use on archaeological and palaeontological sites only.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The study area lies just southeast of the N14 highway that links Springbok, to Aggeneys and Pofadder. A gravel road forms the north-eastern edge of the study area, and an existing 400kV power line lies just south of the study area. The site is 12 km from the mining town of Aggeneys and the Gamsberg Mine lies across the gravel road to the north. The non-mining areas tend to be used for game and small stock grazing and are very poorly developed. Fences and occasional tracks tend to be the main anthropogenic features, with structures being rare. A small farm complex lies on the eastern part of the farm, some 2.5 km east of the study area.

4.2. Site description

The site is very flat (Figure 3) but slopes very gently downhill towards the southwest with several ephemeral water courses that emanate from the culverts under the gravel road alongside the site (Figure 4). The surface is coated in sand and fine gravel with rock outcrops being absent. Vegetation is minimal, but where the sand is slightly deeper there are more plants (Figure 5). Patches are quite deflated, largely close to the gravel road (Figure 6). These gravel patches are largely igneous and metamorphic rock fragments but many pieces of quartz also occur. A single small rocky hill lies within an area excluded from the development footprint (Figure 7) and other rocky hills and mountains occur to the north and northeast (Figure 2).

Figure 3: *Panoramic view towards the south (left side) and southwest (right side) showing the nature of the study area. The centre of the site considered here is marked by the circle.*

Figure 4: *View towards the southwest showing an ephemeral water course.*

Figure 5: *View towards the south showing a sandy patch with slightly denser vegetation.*

Figure 6: *View towards the northwest showing one of the deflated gravel patches where larger clasts have accumulated.*

Figure 7: *View towards the southwest showing the light gravel substrate. The rock outcrop in the excluded area is visible on the skyline.*

5. ARCHAEOLOGICAL AND HISTORICAL CONTEXT

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What was found during the field survey as presented below may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources.

5.1. Archaeological aspects

Morris (2013) surveyed areas on the same farm and located bedrock grinding hollows with associated scatters of stone artefacts, pottery and ostrich eggshell located around water sources. These are bedrock exposures with fissures in them that trap water after rain. Webley and Halkett (2012) examined an area to the north of the N14 and recorded many isolated artefacts and a few occurrences of light quartz and quartzite artefact scatters. Orton (2015) worked in the same area and located a heavily used, grooved double-sided lower grindstone. Morris's (2011b) nearby survey found much sand cover and only a small number of isolated quartz artefacts. He does, however, note the presence of a rock painting on a boulder nearby. The painting is a finger painting likely associated with the Khoekhoen. Similar art is found on granite outcrops throughout Namaqualand but in very low densities (Orton 2013). Within the Gamsberg Inselberg to the east of the study area there are a variety of archaeological traces preserved. Scatters of Early Stone Age (ESA) artefacts occur in open, often eroding areas, while a small rock shelter preserves a ~30 cm deep Later Stone Age (LSA) deposit and rock art is found in the kloof that drains the mountain (Orton 2014).

More generally, it can be noted that archaeological sites in the area tend to be more commonly encountered around the fringes of rocky hills, on sand dunes or around pans (Beaumont *et al.* 1995). Other surveys in the region support this contention (Halkett 2010; Morris 2011a, 2013).

5.2. Historical aspects and the built environment

Because it lies so far from the original Cape Colony (i.e. Cape Town), this area was colonised quite late with most farms only surveyed and granted in the very late 19th or even early 20th centuries. As a result, very few historical structures and features exist on the landscape. The majority of buildings date to the early-mid-20th century and tend to be of low or no heritage significance. A number of surveys in the Bushmanland area have recorded possible isolated graves represented by unusual rocks (either isolated standing rocks or unnatural clusters). These could be related to early '*trekboers'* passing through the area. Because they lived a very nomadic lifestyle, their physical traces are extremely ephemeral. The ruins of small stone structures that are occasionally found alongside rock outcrops in Bushmanland are likely to represent huts and small livestock enclosures built either by 19th century '*trekboers*' or by early 20th century shepherds. Rare isolated stones or clusters of stones found in areas where stones are otherwise absent may represent graves but, to the author's knowledge, none have ever been tested. Examples have been found to the northwest of the present study area, north of the N14, and might date from either the historical or Stone Age periods (Orton 2016).

Some of the place names in the region reflect the living heritage of the Khoekhoen. Gamsberg (also Ghaamsberg), for example, derives from the Khoekhoen word meaning 'grassy spring' (Raper n.d.). There are unconfirmed historical reports that a massacre of Bushmen may have occurred in a kloof of the Gamsberg (Robinson 1978) but surveys have failed to yield any evidence of this. Morris (2013) seems confident of this event, however, and suggests that the kloof at the south-eastern edge of the inselberg was the location where the killing occurred.

6. FINDINGS OF THE HERITAGE STUDY

A list of finds recorded during the ground survey is provided in Appendix 2.

6.1. Palaeontology

Almond (2018) finds that the study area is underlain by Late Caenozoic superficial sediments that are generally of low to very low palaeontological sensitivity. These sediments include wind-blown sands and alluvial and sheetwash gravels. The sands are red Kalahari sands of the Gordonia Formation (to the south of the project footprint), while the gravels that underlie the PV site are derived from the local igneous and metamorphic basement rocks. Examination of a borrow pit alongside the Loop 10 gravel road showed that these gravels continue to at least 2 m depth in this area (Figure 8), although they would very likely thin towards the southwest, away from the hills.

Figure 8: *View of the section in the borrow pit that lies alongside the Loop 10 gravel road near the site.* The inset shows the sub-angular clasts that dominate the profile.

6.2. Archaeology

Archaeological remains were found to be very rare. Isolated flaked stone artefacts made in quartz, quartzite and crypto-crystalline silica (CCS) were noted from time to time (perhaps less than 10 artefacts in the entire survey), but are of no consequence and are attributed to background scatter. They are likely a mix of Pleistocene and Holocene-aged materials.

A few small stone-walled features were noted at a rocky hill located just outside the study area (the study area lies around the west, south and east sides of this hill). Although away from the proposed development footprint, they are briefly noted here for the record. They probably relate to shepherds, either historical or precolonial, although far more likely the former. There were three sections of walling on top of the hill (waypoint 194; Figure 9) and one very small section at the base of the hill to the north (waypoint 192). Further stone walling was noted alongside a small hill to the northeast of the Loop 10 road (visited only to obtain the photograph in Figure 3) and is not described here. It is worth noting, however, that in this landscape the rocky hills acted as landscape foci with the majority of archaeological finds being close to the hills.

Figure 9: *View of the stone walling on top of the rocky hill to the east of the study area at waypoint 194. Sections of walling are arrowed.*

About 1.2 km south of the proposed project footprint an ephemeral artefact scatter was found along the edge of a pan at waypoint 188. The scatter included a small grindstone, two quartz flakes and two ostrich eggshell fragments. It was located on very loose wind-blown sand so there are very likely further artefacts buried beneath the surface. An isolated lower grindstone (found upside down) was also seen at waypoint 187 some 500 m west of the study area.

6.3. Graves

No sign of any graves was seen in the proposed project footprint during the survey. However, two likely graves were found alongside the small rocky hill located just outside the study area and described above (Section 6.2). They lie at waypoints 191 (Figure 10) and 193 (Figure 11). Both were oriented in an east-west direction. Their age is unknown but they may well relate to the early colonial period.

Figure 10: *The likely grave found at waypoint 191.*

Figure 11: *The likely grave found at waypoint 193.*

6.4. Built environment

No built heritage resources occur in the study area. The nearest building of any sort is a labourer's cottage of unknown age some 2.5 km to the east of the proposed project footprint.

6.5. Cultural landscape

The area around the study area is very minimally developed with few traces of anthropogenic interventions. The most visually dominant anthropogenic activity, however, is the mining occurring at Gamsberg, just to the north. Several power lines and a substation occur in the area. These together result in a modern cultural landscape that is far more dominant than the ephemeral traces of historical or prehistoric occupation of the landscape. This does not take away from the potential historical importance of the area to the east, especially if the massacre mentioned above is indeed proven to have occurred at Gamsberg. This part of the landscape may thus be associated with living heritage.

6.6. Summary of heritage indicators

It is possible that isolated fossils may occur within the sediments on site. While archaeological resources and graves do occur in the area, they are not within the proposed project footprint. If the massacre was shown to be true then the proposed PV facility would not significantly impact on that landscape in terms of contextual impacts.

6.7. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The reasons that a place may have cultural significance are outlined Section 3(3) of the NHRA (see Section 2 above).

If isolated fossils were present beneath the surface then they may have high cultural significance for their scientific value. There are no other significant heritage resources in the study area, but the

massacre site, if true, would be considered to have high significance for its historical and social values.

7. ASSESSMENT OF IMPACTS

Note that because the areas for the laydown area, substation and operations and maintenance building alternatives have no specific impacts associated with them, they are all included within the assessments that follow. In each case neither alternative is preferred and impacts are regarded as identical.

7.1. Potential impacts to palaeontological resources

No significant impacts to palaeontological resources are expected, primarily because of the very low probability of fossils actually occurring. If impacts did occur, they would be during the construction phase with no impacts possible during later phases. Table 1 summarises the potential impacts. Rescue of fossils discovered during construction through the implementation of a chance finds procedure (see palaeontological specialist study) would slightly reduce the potential magnitude of impacts, but this makes little difference to the overall assessment. It should be noted that, although impacts with mitigation may still be negative, the possibility of positive impacts occurring does exist if workers are vigilant and protect fossils *in situ* so that the maximum amount of contextual information can be recorded when the fossil is rescued.

Table 1: *Assessment of palaeontological impacts for Aggeneys 2 – 100MW Solar PV facility and associated infrastructure.*

Nature: Fossils may be impacted during any excavation work for foundations or electrical cabling.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (1)
Probability	Very improbable (1)	Very improbable (1)
Significance	**8 (Low)**	**7 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Implementation of a chance fossil find procedure to ensure recovery of isolated fossils found during construction.		
Cumulative impacts: Cumulative impacts are expected to be minimal because of the very low incidence of fossils recorded from this area.		
Residual Impacts: It is never possible to spot and rescue all isolated fossils, especially when they are likely to be extremely sparse. Even with some fossils rescued there will always be some lost.		

Measures for inclusion in the Environmental Management Programme (EMPr) are as follows:

OBJECTIVE: To locate and rescue fossils exposed in excavations	
Project component/s	All buildings and infrastructure.
Potential Impact	Fossils may be damaged or destroyed during earthworks.
Activity/risk source	All bulk earthworks.
Mitigation: Target/Objective	Successful location, evaluation and sampling of palaeontological materials as required.

Mitigation: Action/control	Responsibility	Timeframe
Inform staff of the need to watch for potential fossil occurrences.	ECO	Pre-construction
Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences.	ECO	Pre-construction
Monitor for presence of fossils.	Workers and ECO.	During construction
Report to SAHRA or a palaeontologist any fossils noted during construction in order to determine if further actions are required.	ECO	As necessary

Performance Indicator	• Fossils are seen and rescued. • Scientific record of fossil contexts and temporary exposures in earthworks.
Monitoring	• Ensure staff are aware of fossils and the procedure to follow when found. • ECO to conduct inspections of open excavations whenever on site.

7.2. Impacts to archaeological resources and graves

No significant impacts to archaeological resources are expected, primarily because of the very low probability of impacts to culturally significant sites actually occurring. None were located within the proposed development footprint. Table 2 summarises the potential impacts. The only possible impact of minor significance would be if people visited the rocky hills of the area and disturbed the archaeological features (including graves). The chance of this happening is rated as improbable but with awareness training provided by the ECO this would become very improbable.

Table 2: *Assessment of archaeological impacts for Aggeneys 2 – 100MW solar PV facility and associated infrastructure.*

Nature: Archaeological stone artefacts and/or graves may be impacted during any excavation work for foundations or electrical cabling.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (1)
Probability	Probable (3)	Very improbable (1)
Significance	**30 (Medium)**	**7 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» Ensure that the rocky hills in the area with their archaeological features (including graves) are not disturbed.

» Report any dense concentrations of artefacts seen during construction activities (although the chances of such material being present are virtually zero).

Cumulative impacts: » Cumulative impacts are expected to be minimal because of the very low incidence of culturally significant archaeological material recorded from the open plains favoured for development in this area.
Residual Impacts: » *No sampling of archaeological resources has been suggested because they have insufficient cultural value. As such, the few isolated artefacts present in the study area would be lost. This is of no consequence.*

Measures for inclusion in the EMPr are as follows:

OBJECTIVE: To ensure that impacts to archaeological sites and materials are minimised during construction of the solar facility and associated infrastructure.	
Project component/s	All buildings and infrastructure.
Potential Impact	Archaeological sites and materials may be damaged and/or destroyed during earthworks.
Activity/risk source	All earthworks and surface clearing.
Mitigation: Target/Objective	Successful location, evaluation and sampling of archaeological materials as required.

Mitigation: Action/control	**Responsibility**	**Timeframe**
Inform staff of the need to watch for potential archaeological sites.	ECO	Pre-construction
Watch for archaeological materials during earthworks	Workers and ECO	During construction
Report to SAHRA or an archaeologist any dense concentrations of artefacts noted during construction in order to determine if further actions are required	Workers and ECO	As necessary
Declare rocky hills no-go areas and keep workers/vehicles away from them	ECO and site manager/foreman	Throughout project duration

Performance Indicator	• Negligible loss of known significant archaeological resources and/or graves. • Newly discovered archaeological material is evaluated and sampled if required.
Monitoring	Ensure no damage to sites and/or graves at rocky hills.

7.3. Impacts to the cultural landscape

Impacts to the cultural landscape will occur but because of existing impacts (power lines, a substation and mining) in the area this impact is not considered to be of great significance and is certainly not a fatal flaw. Importantly, the gravel road past the site is not considered to be a scenic route and the site is quite far from the N14. The landscape is largely natural with anthropogenic features, aside from the modern ones, being poorly represented. Clustering of landscape impacts is generally preferred which means that this location, quite close to a large substation and mining area, is appropriate for electrical development. Only one potential issue has been identified and this relates to a possible San massacre site located some 3.5 km to the east-northeast of the site. Impacts to this cultural landscape element are unlikely to be significant due to distance. Table 3 summarises the potential impacts. There are no practical mitigation measures to screen the proposed development and the significance thus remains the same before and after mitigation.

Table 3: *Assessment of cultural landscape impacts for Aggeneys 2 – 100MW solar PV facility and associated infrastructure.*

Nature: The cultural landscape would be impacted through the addition of electrical/industrial infrastructure to a landscape that is generally natural and rural in character.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**50 (Medium)**	**50 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » Ensure that best practice measures such as minimising the area of disturbance and rehabilitating timeously (where appropriate) are implemented.		
Cumulative impacts: » Cumulative impacts are not expected to be of great concern since the area is currently being impacted by a visually prominent mining project and the large existing substation. The project would be located along a minor gravel road and thus reasonably far from most travellers (generally those using the N14) who would appreciate the cultural/natural landscape.		
Residual Impacts: » *Because it is not possible to screen the facility, there will always be a residual impact but, due to the existing visual impacts in the area, this is not considered at all significant.*		

Measures for inclusion in the EMPr should be as specified by the visual assessment practitioner and should aim to reduce visual scarring of the landscape.

7.4. Existing impacts to heritage resources

There are currently no obvious threats to heritage resources on the site aside from the natural degradation, weathering and erosion that will affect archaeological materials and, over a very long period, graves. Trampling damage from grazing animals and/or vehicles passing through the area may also occur.

7.5. Cumulative impacts

Archaeological resources are the most common heritage resources on this landscape but, even so, are rare. They tend to occur in conjunction with water sources and rocky hills which are usually protected from impacts for other reasons (i.e. ecology, fresh water). This means that impacts tend to be minimal. The only significant archaeological sites known to have been destroyed in the area are through mining within the Gamsberg Inselberg. In that case mitigation was conducted but significant resources remain under threat (Orton 2014). Other heritage resources, aside from the landscape itself, are sparse and significant cumulative impacts are not expected to occur. Clustering of renewable energy facilities close to the mining area and Aggeneis Substation will reduce the impacts to the broader landscape. Figure 12 shows the other facilities considered in the cumulative assessment, while Table 4 assesses the cumulative impacts for all heritage resources. Although the significance calculates to medium, this can be offset to a degree by the fact that the site lies within a REDZ which has been earmarked for renewable energy development. The indirect result is that heritage resources in other areas will have a far greater chance of being protected.

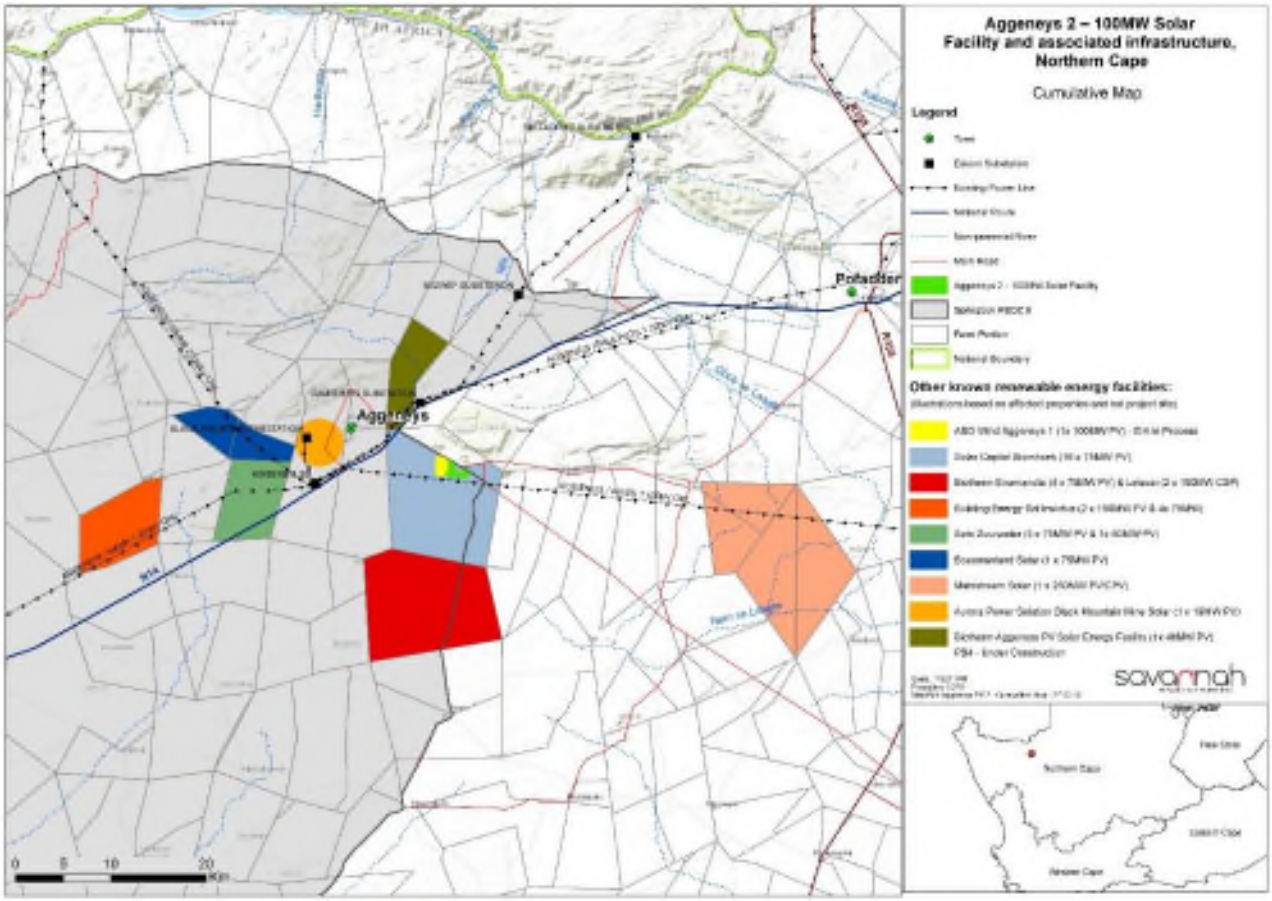

Figure 12: *Map of other renewable energy facilities considered in the cumulative impact assessment.*

Table 4: *Assessment of cumulative impacts for Aggeneys 2 – 100MW solar PV facility and associated infrastructure.*

Nature: *The addition of multiple solar energy facilities and related infrastructure can result in widespread destruction of heritage resources and increased visual clutter in the natural and cultural landscape.*		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**40 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » Ensure that best practice measures such as minimising the area of disturbance and rehabilitating timeously (where appropriate) are implemented.		

7.6. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable. Because of the height of the majority of the proposed development, such an impact is not envisaged.

8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

The only monitoring that would be required is to ensure that the small rocky hill and associated no-go area partially enclosed by the project footprint remains undisturbed throughout the duration of the project. The environmental control officer (ECO) would need to ensure that this happens.

9. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

This project would result in an increased electricity supply for South Africa. This is needed in order to promote economic development. Short-term (construction period) employment would be provided, while a small number of long term employment opportunities would be created during the operation phase. Due to the very low significance of heritage resources on and associated with the site, the social and economic benefits outweigh any potential impacts.

10. CONCLUSIONS

No significant impacts to heritage resources have been identified and there are no fatal flaws for the proposed development. Both alternative locations for the laydown area, on-site substation, buildings for the operations and maintenance area and security office are acceptable. As such, the site is seen as an appropriate place for the proposed PV development. The only no-go area identified is outside of the development site and can be easily managed. This area has been demarcated through the addition of a minimum 30 m buffer around the various finds associated with the hill (Figure 11).

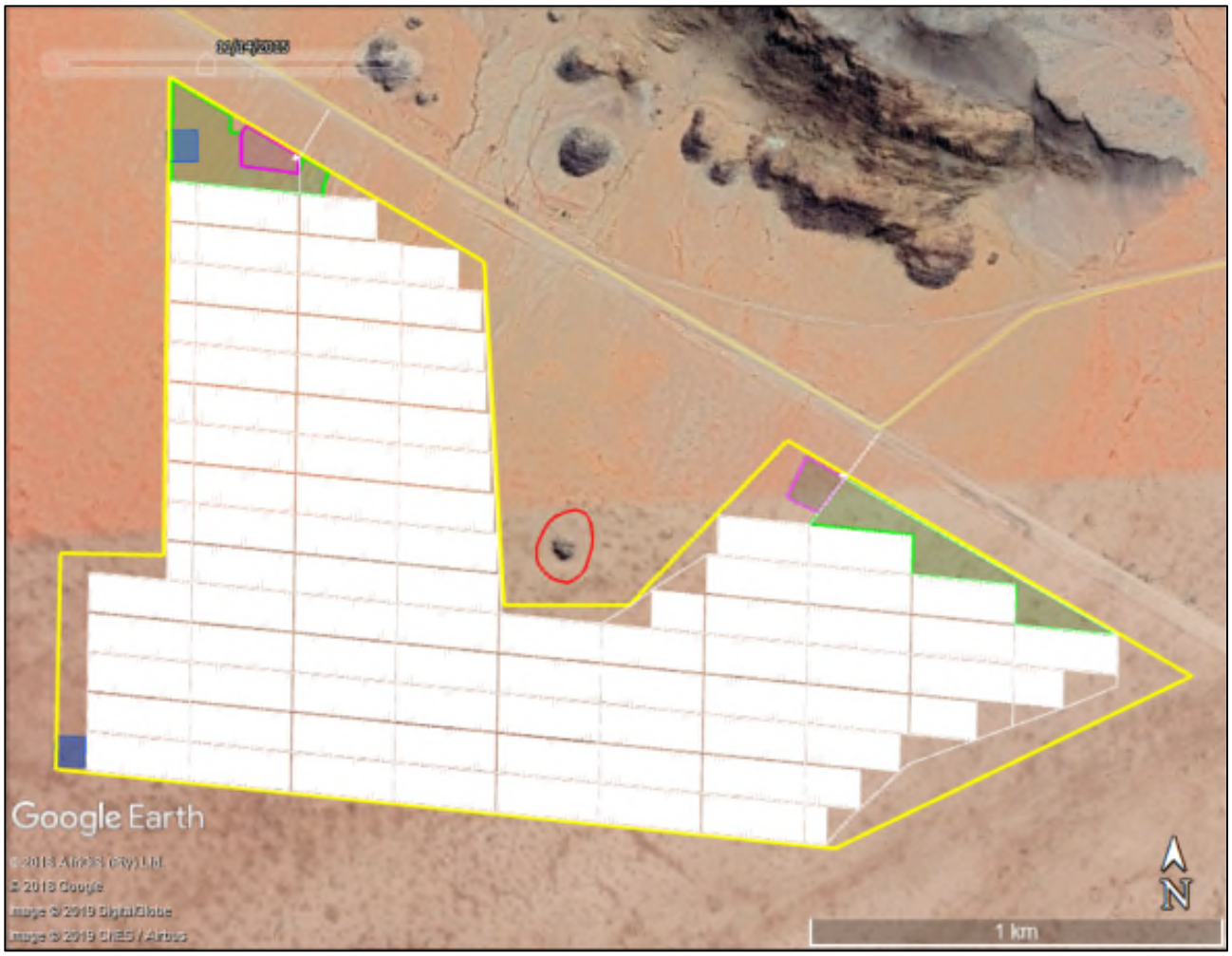

Figure 11: *Aerial view of the study area showing the proposed development footprint (yellow polygon with PV panels in white, laydown area alternatives in green, substation alternatives in blue, building alternatives in pink) and the single heritage no-go area identified during the assessment (red circle).*

11. RECOMMENDATIONS

Because no significant impacts to heritage resources are expected, it is recommended that the proposed Aggeneys 2 PV development and associated infrastructure (either alternative) be authorised. The following should be included as conditions of authorisation:

- If any change in the footprint occurs, then an archaeologist should be consulted for an opinion on whether a survey is required; and
- If any archaeological or palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

12. REFERENCES

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 789 0327
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ *Memberships and affiliations:*

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 – List of finds

Waypoint	Location	Description	Significance
187	S29 17 21.1 E18 56 17.5	Isolated lower grindstone found face down.	Very Low
188	S29 17 52.2 E18 55 39.3	A small artefact scatter comprising of a small grindstone, two quartz flakes and two ostrich eggshell fragments. There are very likely further artefacts buried beneath the surface. The site lies on the north side of a large pan.	Low
191	S29 17 08.5 E18 57 19.8	Elongated, east-west oriented rock cairn to the southwest of a small rocky hill that very likely represents a grave.	High
192	S29 17 07.0 E18 57 20.9	Short section of stone walling at the base and on the north side of the same small rocky hill.	Low
193	S29 17 06.0 E18 57 22.0	Elongated, east-west oriented rock cairn (now somewhat dispersed) that very likely represents a grave. It lies some 40 m north of the same rocky hill.	High
194	S29 17 07.9 E18 57 21.3	A set of stone walls on top of the same small rocky hill. There at least three walls visible, largely very tumbled.	Low
195	S29 17 09.5 E18 57 21.2	A light scatter of quartz flaked artefacts located to the south of the same rocky hill.	Low

APPENDIX 3 – Mapping

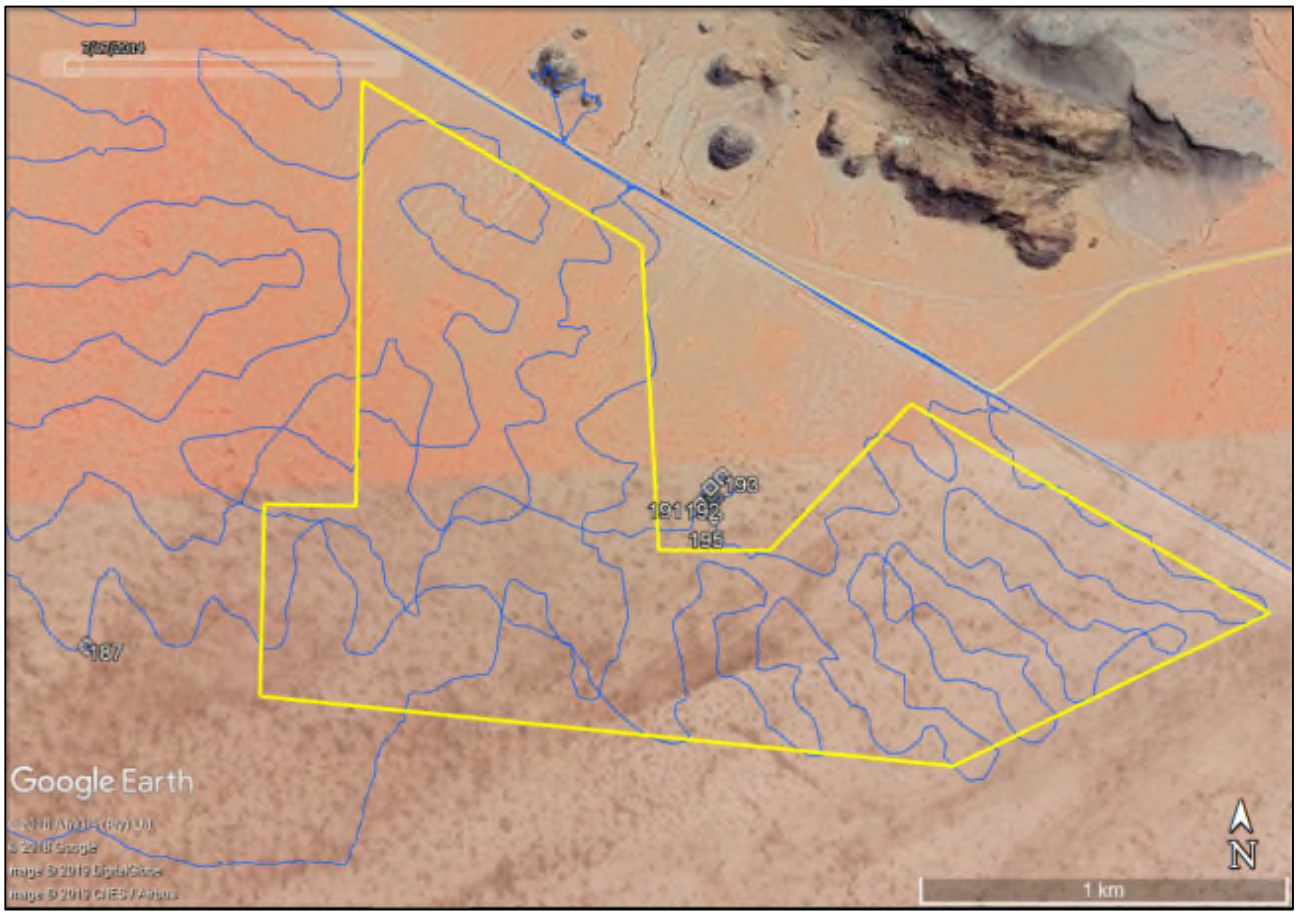

Figure A3.1: *Map of the study area showing the proposed project footprint (yellow polygon encloses all associated infrastructure), the survey tracks (blue lines) and the recorded finds (numbered white symbols). The hill in the centre is enlarged in Figure A3.2.*

Figure A3.2: Map of the area around the rocky hill showing the survey tracks (blue lines), the recorded finds (numbered white symbols) and a no-go buffer of 30 m (red outline).

APPENDIX 4 – Palaeontological Study

PALAEONTOLOGICAL HERITAGE ASSESSMENT: DESKTOP STUDY

AGGENEYS PROPOSED PV SOLAR ENERGY FACILITIES ON THE REMAINING EXTENT OF THE FARM BLOEMHOEK 61 AND ASSOCIATED POWER LINE CORRIDORS NEAR AGGENEYS, NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE

John E. Almond PhD (Cantab.)
***Natura Viva* cc, PO Box 12410 Mill Street,**
Cape Town 8010, RSA
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April 2019

Executive Summary

The project areas of two proposed 100 MW photovoltaic (PV) solar energy facilities on the Remaining Extent of the Farm Bloemhoek 61, as well as the associated power line corridors to Aggeneis Main Transformer Substation (MTS) (2 route options), are underlain by Late Caenozoic superficial sediments such as wind-blown sands as well as alluvial and sheetwash gravels. These surface sediments are generally of low to very low palaeontological sensitivity. Significant impacts on fossils within the study areas for the PV solar energy facilities and associated power lines - where deep excavations are not involved - are therefore not anticipated.

The overall impact significance of the proposed Aggeneys solar PV facilities and the associated grid connection solutions is rated as VERY LOW in terms of palaeontological heritage resources. Cumulative impacts inferred for the various renewable energy developments in the Aggeneys region of the Northern Cape are likewise assessed as LOW. Given their very similar geological context, there is no preference for either of the power line connections to the Aggeneis MTS under consideration. There are no objections on palaeontological heritage grounds to the authorisation of the proposed solar PV projects, and the grid connection solutions to connect the solar PV facilities to the Aggeneis MTS.

Pending the potential discovery of significant fossil remains during the construction phase, in which case the Chance Fossil Finds Protocol appended here should be implemented, no further specialist palaeontological studies or mitigation are recommended for the PV solar projects and the associated grid connection. Ancient alluvial gravels (possibly calcretised) associated with Pleistocene or older fossil remains (*e.g.* mammalian bones and teeth) might be exposed in the existing borrow pit in the Koa River Palaeovalley area in the south-eastern portion of the Remaining Extent of the Farm Bloemhoek 61 (yellow circle in Fig. 2). If it is proposed to exploit alluvial gravel material from this pit as part of the PV solar facilities, a site inspection by a professional palaeontologist before excavations commence is recommended. These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed solar PV facilities and associated grid connection solutions.

1. Project outline and brief

It is proposed to develop two PV solar energy facilities on the Remaining Extent of the Farm Bloemhoek 61, situated on the south-eastern side of the N14 near Aggeneys and *c*. 47 km WSW of Pofadder, Namaqua District Municipality, Northern Cape (Figure 1). Each project will have a generation capacity of up to100 MW. The main infrastructure associated with the two solar PV facilities (see Fig. 2) includes:

- Arrays of PV panels (static and tracking PV system);
- Mounting structures to support the PV panels;

- Cabling between the project components (to be lain underground where applicable);
- On-site substation;
- On-site inverters to convert the power from a direct current (DC) to alternating current (AC);
- On-site step-up transformers;
- Battery storage mechanism;
- Site offices and maintenance buildings, including workshop areas for maintenance and storage;
- Temporary laydown areas; and
- Internal access roads and fencing.

Two route options for the proposed power lines connecting the PV facilities with the existing Aggeneis MTS near Aggeneys are under consideration (Option 1 and Option 2 shown in Fig. 2). Each has an associated collector substation location. The power lines concerned would be up to 220 kV (single circuit).

The proposed solar PV developments and the grid connection solutions fall on the eastern margins of the Springbok Renewable Energy Development Zone 8 (REDZ) and are therefore subject to a Basic Assessment process.

The present desktop palaeontological heritage study has been commissioned as part of a broader heritage assessment study by ASHA Consulting (Pty) Ltd, Lakeside (Contact details: Dr Jayson Orton. ASHA. 40 Brassie Street, Lakeside, 7945. E-mail: jayson@asha-consulting.co.za. Tel: 021 783 0557. Cell: 083 272 3225).

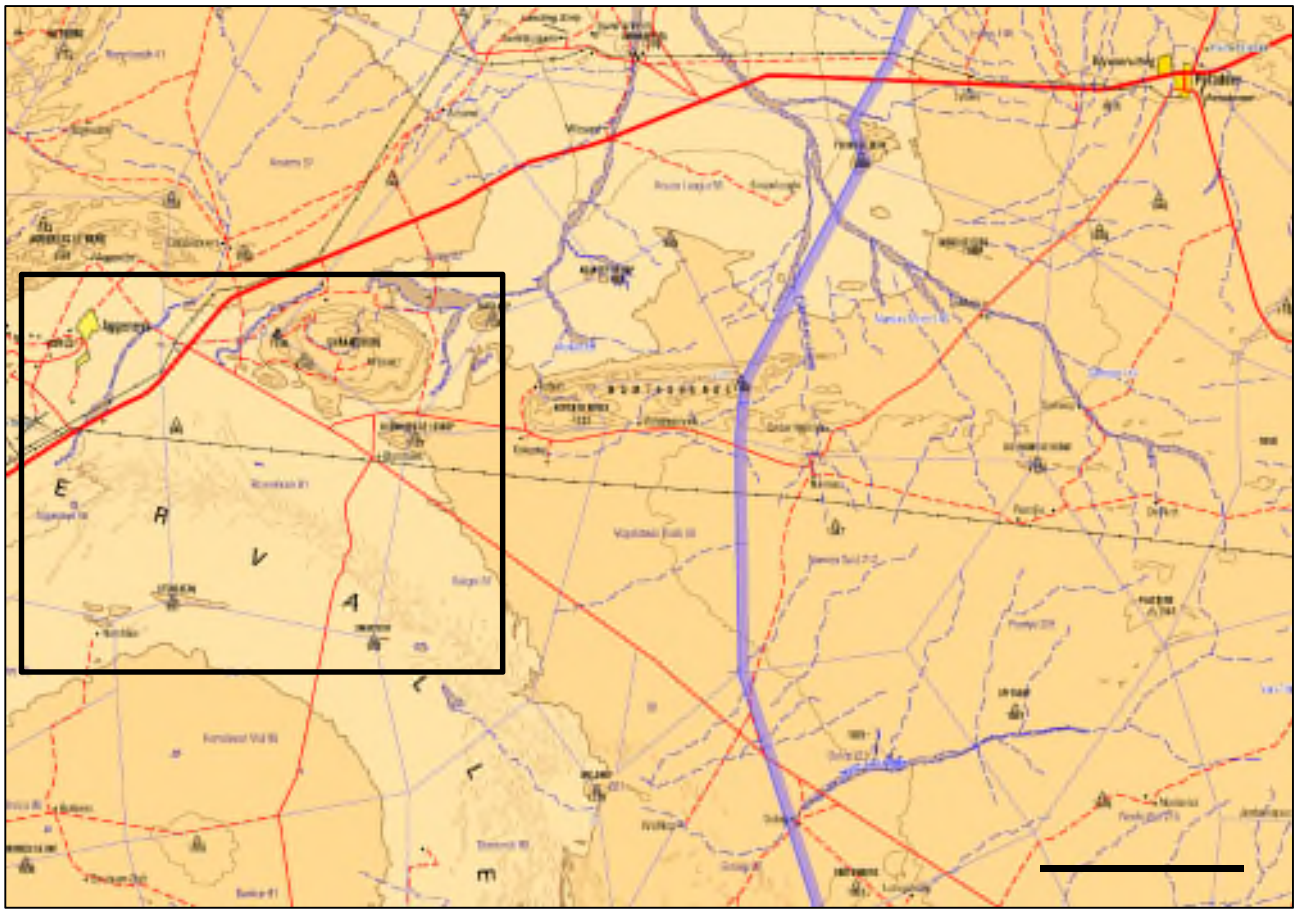

Figure 1. Extract from 1: 250 000 topographical sheet 2918 Pofadder (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location (black rectangle) of the PV solar facilities and associated power lines near Aggeneys and c.

47 km WSW of Pofadder, Namakwa District Municipality, Northern Cape. Scale bar = *c*. 10 km. N towards the top of the image.

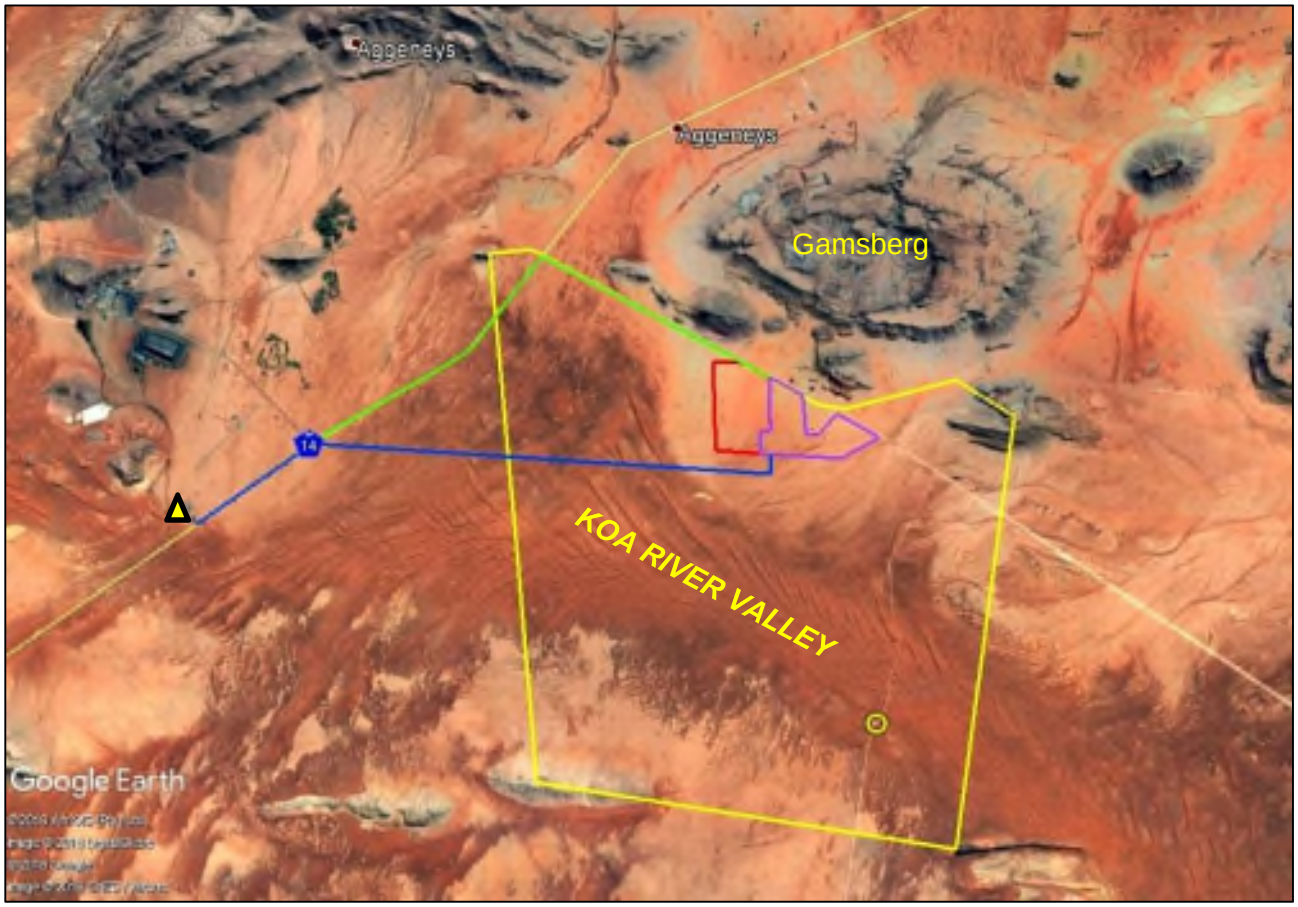

Figure 2. Google Earth© satellite image showing the Remaining Extent of the Farm Bloemhoek 61 on the SE side of the N14 tar road near Aggeneys (yellow polygon), the project areas for the two PV projects (Site 1 - red and Site 2 - purple) and the two power line corridor route alternatives (Alternative 1 – blue; Alternative 2 – green). The small yellow circle marks an existing borrow pit and the yellow triangle marks the existing Aggeneis Main Transmission Substation. Please note that the routing of the power line is subject to change and will be located within the assessed corridor which has been considered fully within the present report.

2.2. Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major

influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the present study area near Aggeneys in the Northern Cape levels of natural bedrock exposure are limited by extensive superficial deposits, especially alluvium, sandy soils and surface gravels. The palaeontology of the region is comparatively poorly known since few academic or impact-related field studies have been carried out here.

2. Geological Context

The proposed PV solar energy facilities on the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys are to be constructed in a fairly flat-lying to very gently-sloping (*c*. 840 to 870 m amsl), arid area of Bushmanland, situated on the southern side of the Gamsberg inselberg and on the northern margins of the sandy Koa River Palaeovalley (Figs. 1 & 2). The surface terrain in this region is predominantly sandy to gravelly and traversed by a number of very shallow, intermittently-flowing drainage lines. No substantial bedrock exposures are apparent on satellite images. Both power line route corridor options to the Aggeneis MTS - located besides the N14 *c*. 14 km WSW of the solar PV project areas - traverse the Koa Palaeo-valley.

The geology of the Aggeneys region is shown on 1: 250 000 geological map 2918 Pofadder (Council for Geoscience, Pretoria) (Fig. 3) (Agenbacht 2007). Scattered basement inliers on the southern margins of the Ghaamberg are composed of a variety of resistant-weathering igneous and high grade metamorphic rocks - mainly gneisses, schists, quartzites and amphibolites - of Late Precambrian (Mokolian / Mid-Proterozoic) age. These ancient basement rocks, which underlie the PV project areas at depth, are assigned to the **Namaqua-Natal Province** and are approximately one to two billion years old (Cornell *et al.* 2006, Moen 2007, Agenbacht 2007). The flatter portions of the study area – including those that will be directly affected by the proposed solar PV facility developments - are underlain by a spectrum of mostly unconsolidated superficial sediments of Late

Caenozoic age. These include **Quaternary to Recent sands and gravels** of probable braided fluvial (alluvial fan) or sheet wash origin (**Q-s$_2$** in Fig. 3), as well as a veneer of downwasted suface gravels and colluval (rocky scree) deposits that are not indicated separately on the geological map. The alluvial and colluvial sediments are locally overlain, and perhaps also underlain, by unconsolidated aeolian (*i.e.* wind-blown) sands of the **Gordonia Formation** (**Kalahari Group**) that are Pleistocene to Holocene in age (**Q-s$_1$** in Fig. 3). Orange-hued linear sand dunes with NW-SE trending crests are well seen in the Koa River Palaeovalley area on satellite images (Fig. 2). All these superficial sediments can be broadly subsumed into the Late Cretaceous to Recent **Kalahari Group**, the geology of which is reviewed by Partridge *et al.* (2006).

The **Koa River Palaeovalley** is an important Caenozoic geological feature in the Aggeneys area. It represents a defunct south bank tributary of the River Orange of Neogene / Late Tertiary (Miocene – Pliocene) age that fed into the palaeo-Orange River near Henkries (Malherbe *et al*. 1986, De Wit 1990, 1993, 1999, De Wit *et al*. 2000, Partridge *et al.* 2006). The palaeovalley runs across Remaining Extent of the Farm Bloemhoek 61 along an ESE-WNW line just to the south of the PV project areas and underlies parts of the power line project areas. It can be readily seen on satellite images where it is marked by intermittent pans and a veneer of orange-brown Kalahari wind-blown sands (Fig. 2. See also arcuate band of yellow Q-s$_1$ on the geological map Fig. 3).

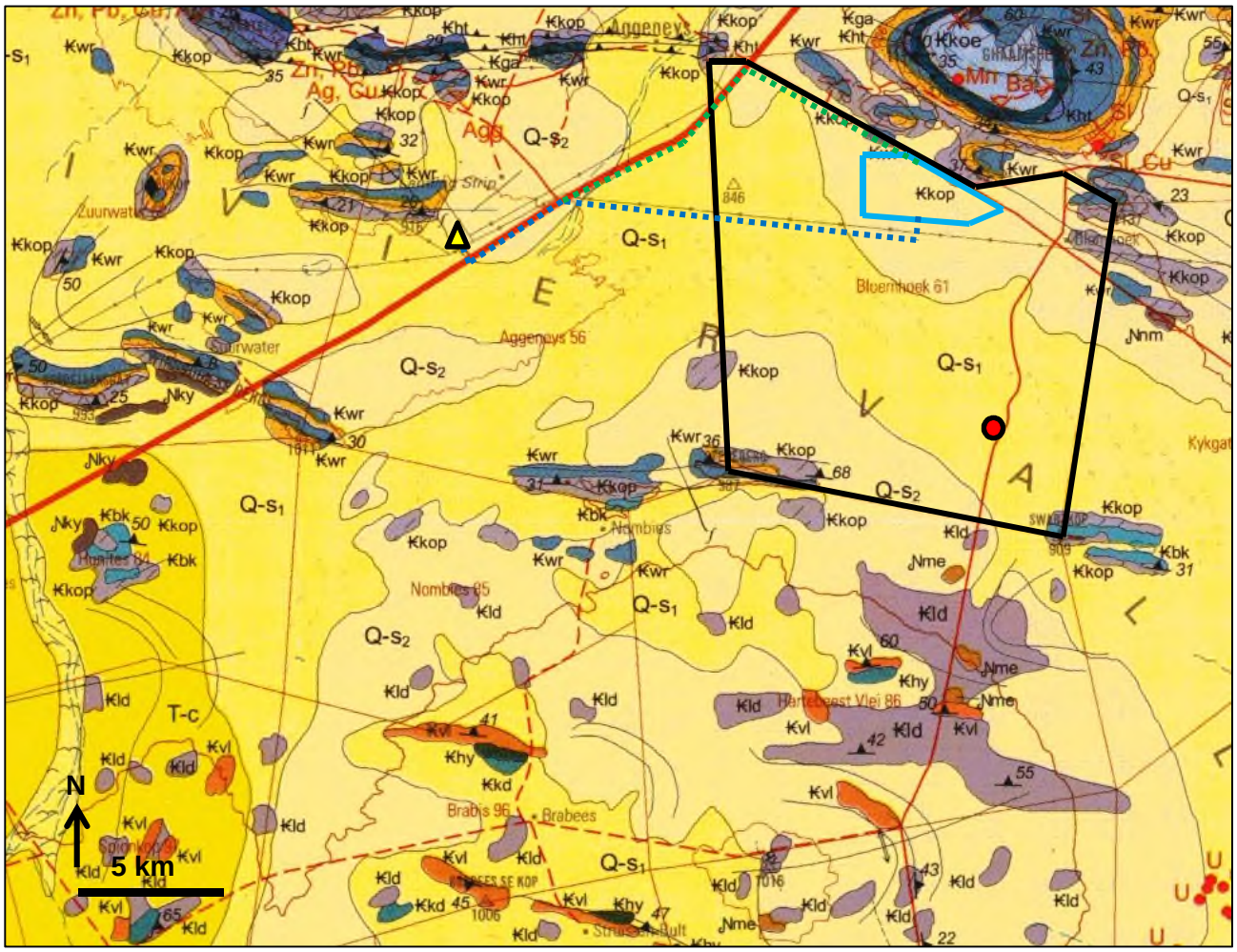

Figure 3. Extract from 1: 250 000 geological map 2918 Pofadder (Council for Geoscience, Pretoria) showing the Remaining Extent of the Farm Bloemhoek 61 near Aggeneys (black polygon), the combined project area for the two PV projects (pale blue) and the two power line corridor route alternatives (Option 1 – blue; Option 2 – green). The red circle marks an existing borrow pit and the yellow triangle marks the existing Aggeneis Substation. Please note that the routing of the power line is subject to change and will be located within the assessed corridor which has been considered fully within the present report.
Geological units mapped in Figure 3 include:
(a) Several Precambrian (Mid Proterozoic) igneous and metamorphic basement rocks of the Namaqua-Natal Province: small purple, orange, blue-green, grey outcrop areas whose symbols start with K or N.
(b) Late Caenozoic superficial sediments: Q-s_1 (medium yellow) = red aeolian sands of the GORDONIA FORMATION (Kalahari Group); Q-s_2 (pale yellow) = sand, scree, rubble and sandy soil. Note the arcuate Koa River Valley (medium yellow) running to the south of the solar facility project area that is traversed by both the power line corridors.

3. Palaeontological Heritage

Mid Proterozoic basement rocks of the **Namaqua-Natal Province** are entirely unfossiliferous (Almond & Pether 2008). Fossil biotas recorded from each of the main sedimentary rock units mapped in the Aggeneys region and along the Orange River to the north have been reviewed in several previous palaeontological heritage assessments by the author Almond (*e.g.* 2011, 2012, 2013a, 2013b, 2014, 2015, 2016, 2017, 2018; see also Almond & Pether 2008, Almond 2009, Almond *in* Macey *et al.* 2011 and extensive references therein).

The various younger superficial deposits of the **Kalahari Group** in Bushmanland, including aeolian sands, alluvium, colluvium, sheetwash and other surface gravels, calcretes and pan deposits, are poorly known in palaeontological terms. The fossil record of the Kalahari Group as a whole is generally very sparse and low in diversity; no fossils are recorded here in the Pofadder and adjoining Onseepkans geology sheet explanations by Agenbacht (2007) and Moen and Toogood (2007) respectively. The Kalahari beds may very occasionally contain important Late Caenozoic fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises, non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites), plant remains such as peats or palynomorphs (pollens, spores) in organic-rich alluvial horizons as well as siliceous diatoms in pan sediments. Calcrete hardpans might also contain trace fossils such as rhizoliths, termite nests and other insect burrows, or even mammalian trackways.

An important Early to Middle Miocene vertebrate faunule has been recorded from alluvial deposits (gravels, grits and lenses of sand, clay) of the **Koa River Palaeo-valley** system at Bosluis Pan, some 50 km SSW of Aggeneys. The fossil fauna has been dated to 15-16 Ma and is reviewed by Senut *et al*. (1996; see also Malherbe *et al*. 1986, De Wit 1999, Partridge *et al*. 2006, Agenbacht 2007, Almond *in* Macey *et al.* 2011). It includes rare bones, tusks, molars and numerous tooth fragments of *Gomphotherium*, a four-tusked, browsing proboscidean with characteristic rounded (mastodont) tooth cusps. There are also crocodile teeth and tortoise shell fragments, as well as remains of grazing elephant shrews, giraffids, bovids, a rhinocerotid and air-breathing catfish. However, fossiliferous fluvial sediments have not yet been recorded from the northern sector of the Koa River Valley near Aggeneys; if present, they are likely to be deeply buried beneath superficial sediments (*e.g.* younger alluvium, aeolian sands).

It is unclear whether or not the existing small borrow pit located adjacent to a farm track in the south-eastern portion of Bloemhoek 61 (yellow circle in Fig. 2) exposes potentially-fossiliferous calcretes and alluvial gravels of the Koa River Palaeovalley. If so, these may be of considerable palaeontological heritage interest.

4. Conclusions and Recommendations

In terms of palaeontological sensitivity outcrop areas of basement rocks in Bushmanland are zero to very low while the overlying Late Caenozoic superficial deposits (alluvium, gravels, aeolian sands *etc*) are generally of low sensitivity. No sensitive palaeontological sites or no-go areas have been identified within the PV solar facility project areas on the Remaining Extent of the Farm Bloemhoek 61 or within the associated power line corridor options. Impacts on unique or irreplaceable fossil heritage resources here are unlikely and their severity is anticipated to be very low since (1) significant fossil sites are unlikely to be affected and (2) in many cases these impacts can be mitigated.

The overall impact significance of the proposed PV facilities and associated grid connection is rated as VERY LOW in terms of palaeontological heritage resources. Cumulative impacts inferred for the various renewable energy developments in the Aggeneys region of the Northern Cape are likewise assessed as low. Given their very similar geological context, there is no preference for either of the power line connections to Aggeneis MTS under consideration. There are no objections on palaeontological heritage grounds to authorisation of the proposed renewable energy projects.

Pending the potential, albeit unlikely, discovery of significant fossil remains (*e.g.* mammalian bones or teeth) during the construction phase, no further specialist palaeontological studies or mitigation are recommended for the PV solar projects and the associated grid connection on the Remaining Extent of the Farm Bloemhoek 61. If alluvial gravels (possibly calcretised) are exposed in the existing borrow pit in the Koa River Palaeovalley area in the south-eastern portion of the Remaining Extent of the Farm Bloemhoek 61 (yellow circle in Fig. 2), they might be associated with Pleistocene or older fossil remains (*e.g.* mammalian bones and teeth). If it is proposed to exploit alluvial gravel material from this pit as part of the PV solar facility development, a site inspection by a professional palaeontologist before excavations commence is recommended.

Chance fossil finds such as vertebrate bones and teeth or shells should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to the South African Heritage Resources Agency, SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented (Please refer to the tabulated Chance Fossil Finds Procedure appended to this report). The palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection) (SAHRA 2013). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed renewable energy developments.

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6. Qualifications & experience of the author

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA. Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Mpumalanga, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has previously served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development 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 the objectivity of my performing such work.

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: PV SOLAR ENERGY FACILITIES ON FARM BLOEMHOEK 61 AND ASSOCIATED POWER LINES NEAR AGGENEYS</td></tr>
<tr><td>Province & region:</td><td colspan="2">NORTHERN CAPE, Namaqua District Municipality</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Late Caenozoic superficial deposits esp. aeolian sands, surface gravels & alluvium. Possible calcretised ancient alluvial gravels.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Bones, teeth & horncores of mammals, reptiles & fish, terrestrial gastropods, calcretised burrows</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.</td></tr>
</table>