McGregor Museum
Department of Archaeology

PAARDE VALLEY
ILANGA LETHEMBA PV SOLAR ENERGY FACILITY

SPECIALIST INPUT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PHASE AND ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE PROPOSED ILANGA LETHEMBA SOLAR ENERGY FACILITY, NEAR DE AAR, NORTHERN CAPE PROVINCE

ARCHAEOLOGY

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1. INTRODUCTION

Solar Capital (Pty) Ltd has proposed developing a photovoltaic (PV) solar energy facility with associated infrastructure on Portion 3 of the farm Paarde Valley 145, north east of De Aar in the Northern Cape Province. The project has been named the Ilanga Lethemba PV Solar Energy Facility. A scoping phase report was prepared by J.A. van Schalkwyk (2011). Development footprint estimates relative to identified sensitive areas were subsequently provided and access was granted for on-the-ground survey.

The proposed activities would include the construction and operation of a solar energy facility and associated infrastructure. The proposed facility would have a generating capacity ultimately of approximately 300 MW (It is envisaged that 75 MW will be installed in a first phase and the remaining three phases will be developed at 75 MW each). The following associated infrastructure is anticipated: photovoltaic (PV) panels; an on-site substation and power line to link the facility with the Eskom grid; cabling between solar panels and substation; internal access roads; security infrastructure; and storage areas.

Focus and Content of Specialist Report: Archaeology

The archaeology specialist study is focused on the development footprint options for the proposed solar energy facility and ancillary infrastructure. This specialist study is a stand-alone report (as per the EIA Regulations) and incorporates the following information:

- Introduction (1)
  - Focus and content of report (1.1)
  - Archaeology specialist (1.2)
- Description of the affected environment (2)
  - Heritage features of the area (2.1)
  - Description and evaluation of environmental issues and potential impacts identified in the scoping phase (2.2)
- Methodology (3)
  - Assumptions and limitations (3.1)
  - Potentially significant impacts to be assessed (3.2)
  - Description and evaluation of environmental issues (3.3)
  - Determining archaeological significance (3.4)
- Observations and assessment of impacts (4)
  - Fieldwork observations (4.1)
  - Characterising the archaeological significance (4.2)
  - Characterising the significance of impacts including a summary in tabular format together with Measures for inclusion in the draft EMP (4.3)
- Conclusions (5)
- References (6)

1.1 Archaeology Specialist

The author of this report is an archaeologist accredited as a Principal Investigator by the Association of Southern African Professional Archaeologists, having previously carried out surveys and fieldwork on sites in the Northern Cape including the Karoo (e.g. Morris 1988; Beaumont & Morris 1990; Morris & Beaumont 2004; Parkington *et al*. 2008).

The author works independently of the organisation commissioning this specialist input, and I provide these preliminary observations within the framework of the National Heritage Resources Act (No 25 of 1999).

The National Heritage Resources Act No. 25 of 1999 (NHRA) protects heritage resources which include archaeological and palaeontological objects/sites older than

100 years, graves older than 60 years, structures older than 60 years, as well as intangible values attached to places. The Act requires that anyone intending to disturb, destroy or damage such sites, objects and/or structures may not do so without a permit from the relevant heritage resources authority. This means that a Heritage Impact Assessment should be performed, resulting in a specialist report as required by the relevant heritage resources authority/ies to assess whether authorisation may be granted for the disturbance or alteration, or destruction of heritage resources.

2. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The environment in question is a Karoo landscape north east of De Aar, currently devoted to livestock farming with limited agricultural production. The specific segments of the landscape being investigated comprise of relatively flat terrain with dolerite hills in the surrounding landscape. Relatively shallow soil veneers a combination of calcrete, shale and dolerite substrates, with relatively sparse vegetation of Karoo scrub and grass. Surface archaeological traces are likely to be reasonably to highly visible in such contexts. They should also give a good indication of what lies below the surface in situations where soil cover is shallow.

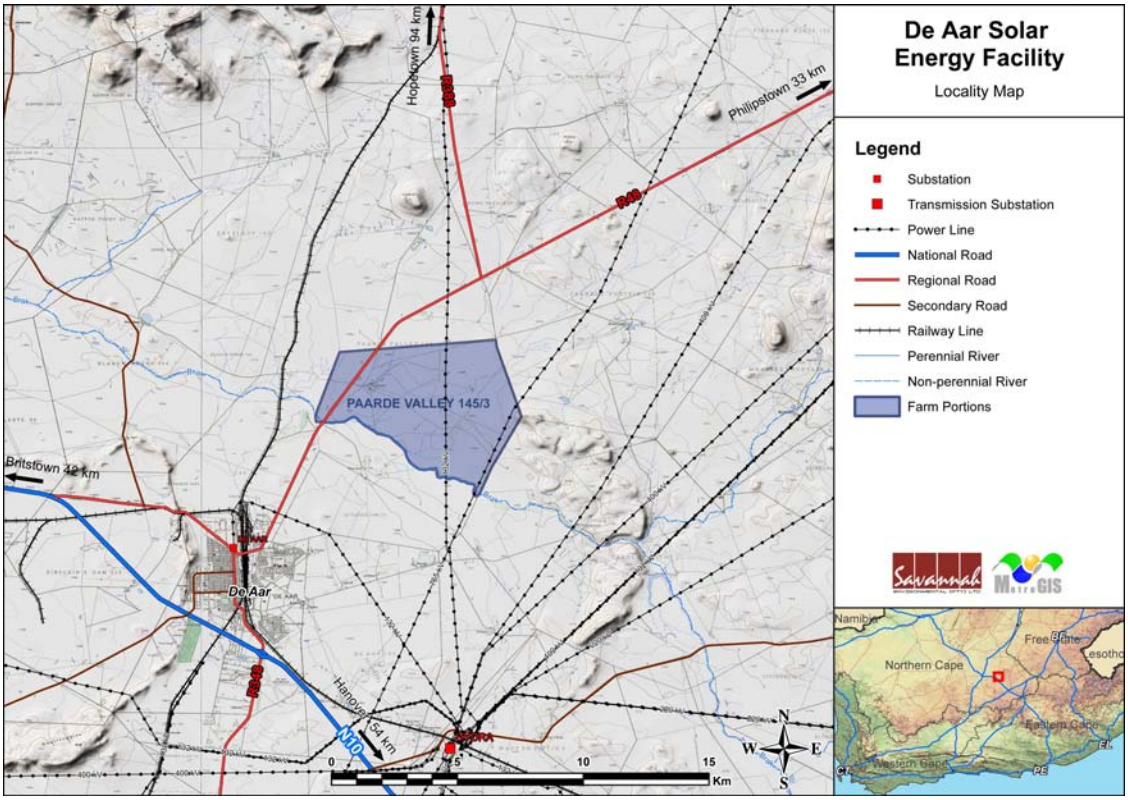

Figure 1: Location of proposed Paarde Valley/Ilanga Lethemba solar energy facility north east of De Aar, Northern Cape.

Topographically, the two principal development footprints and associated infrastructure are situated on relatively flat terrain, with dolerite koppies defining the relief of the surrounding landscape. Where dolerite outcrops occur there is a possibility that rock engravings could be found.

The Brak River defines the southern margin of the property and has been indicated in the scoping report as a potentially higher sensitivity zone in terms of Later Stone Age sites (van Schalkwyk 2011).

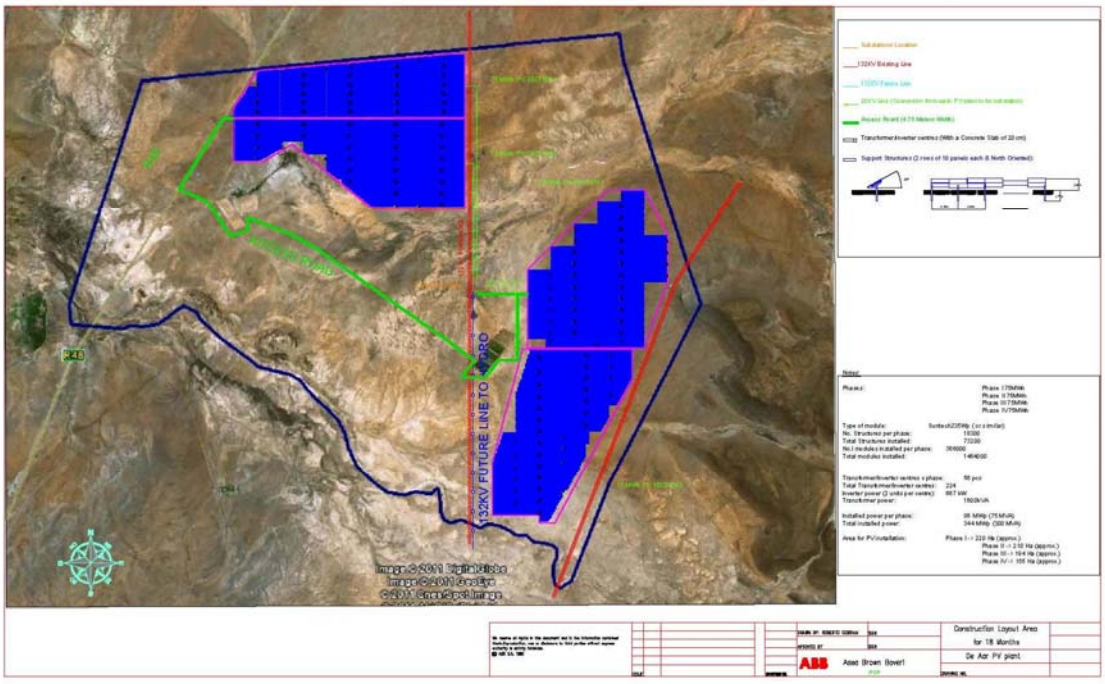

Figure 2: Proposed development footprint relative to the terrain.

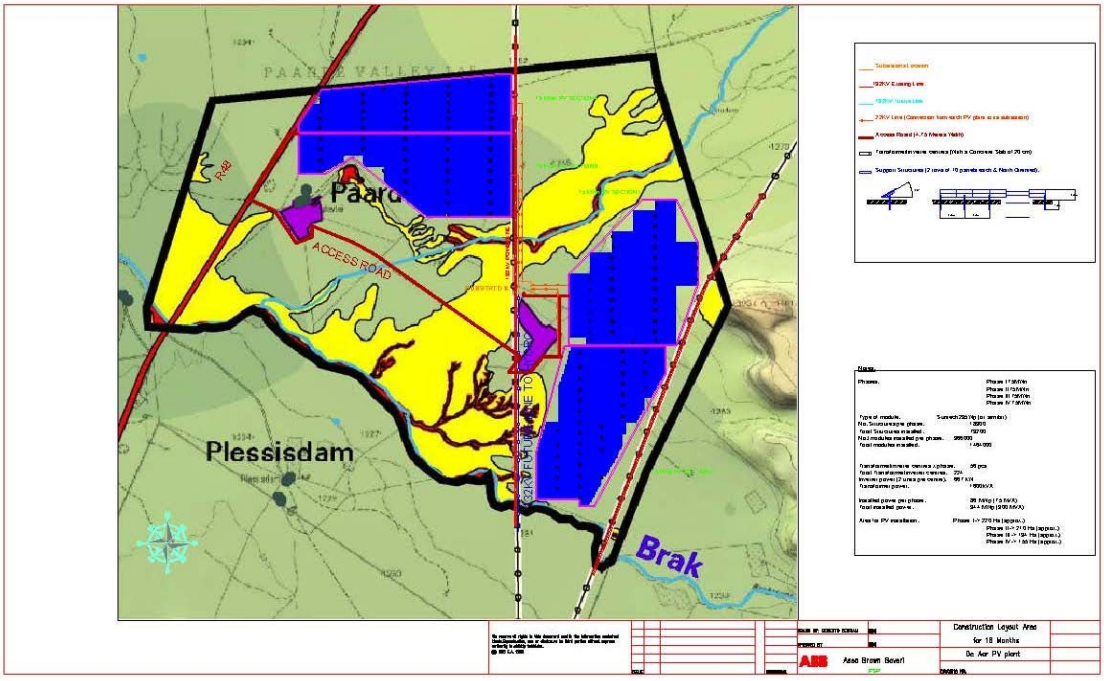

Figure 3: Proposed development footprint relative to sensitive areas identified during the scoping phase.

2.1. Heritage features of the area

No archaeological survey work has been carried out in the immediate vicinity of the proposed solar energy facility. Much of the surrounding region has yet to be examined from an archaeological viewpoint.

However the following observations were made during the Scoping Phase:

» That dolerite koppies in the region are known to have rock engravings (Fock & Fock 1989; Morris 1988; Parkington *et al*. 2008).
» That variable spreads (in terms of typology as well as assemblage density) of Stone Age artefacts might occur in these areas (e.g. Beaumont *et al*. 1995).
» That colonial era material culture may include farm infrastructure and graves. Alongside the nearby railway line there would be remains of the Anglo-Boer War blockhouse line as well as infrastructure relating to railway construction and maintenance such as gangers' huts.

2.2. Description and evaluation of environmental issues and potential impacts identified in the scoping phase

Heritage resources including archaeological sites are in each instance unique and non-renewable resources. Area and linear developments such as those envisaged can have a permanent destructive impact on such resources. The objective of an EIA would be to assess the sensitivity of heritage resources where present to assess the significance of potential impacts on them and to recommend no-go areas and measures to mitigate or manage said impacts.

Area impacts are possible in the case of the Paarde Valley/Ilanga Lethemba Solar Energy Facility. The power line and access roads would represent linear impacts.

2.2.1. Direct, indirect and cumulative impacts (in terms of nature, magnitude and extent)

The destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. In the long term, the proximity of operations in a given area could result in secondary indirect impacts resulting from the movement of people or vehicles in the immediate or surrounding vicinity.

With respect to the magnitude and extent of potential impacts, it has been noted that the erection of power lines would have a relatively small impact on Stone Age sites, in light of Sampson's (1985) observations during surveys beneath power lines in the Karoo (actual modification of the landscape tends to be limited to the footprint of each pylon – tower positions, once known, would need to be assessed for possible mitigation), whereas a road would tend to be far more destructive (modification of the landscape surface would be within a continuous strip), albeit relatively limited in spatial extent, i.e. width (Sampson compares such destruction to the pulling out of a thread from an ancient tapestry).

METHODOLOGY

The EIA phase assessment necessitated a site visit to inspect various parts of the terrain on foot, focusing on areas of expected impact. Heritage traces are evaluated in terms of their archaeological significance (see tables below). A set of scoping phase predictions are tested with observations made in the field.

2.3. Assumptions and limitations

It was assumed that, by and large in this landscape, with its sparse vegetation, some sense of the archaeological traces to be found would be readily apparent from surface observations. Where the landscape is veneered by deeper sediments, as may be possible in places, it is likely that subsurface occurrences, particularly of Pleistocene age stone artefacts, would be masked. In such locales animal burrows and erosion features afford opportunities to evaluate the potential for material below the present surface.

A proviso is routinely given, that should sites or features of significance be encountered during construction (this could include an unmarked burial, an ostrich eggshell water flask cache, or a high density of stone tools, for instance), specified steps are necessary (cease work, report to heritage authority).

This report does not address the palaeontological aspects, if any, at the site.

2.4. Potentially significant impacts to be assessed in the EIA process

During the Scoping phase it was predicted/intimated that:

» Where dolerite koppies occur there is a possibility that rock engravings might be found.
» Stone Age artefact scatters were likely to occur across much or all of the area, with possibly greater densities near the Brak River or adjacent to or on features such as hills.
» Colonial era heritage features of note may exist in the vicinity of farming, railway and past military activities.

Description and evaluation of environmental issues and potential impacts identified in the scoping phase

Any area or linear, primary and secondary, disturbance of surfaces in the development locales could have a destructive impact on heritage resources, where present. In the event that such resources of high significance are found, they are likely to be of a nature that potential impacts could be mitigated by documentation and/or salvage following approval and permitting by the South African Heritage Resources Agency and, in the case of any built environment features, by Ngwao Boŝwa ya Kapa Bokone (the Northern Cape Heritage Authority). Although unlikely, there may be some that could require preservation *in situ* and hence modification of intended placement of development features.

Disturbance of surfaces includes any construction: of a road, erection of a pylon, or preparation of a site for a plant, or building, or any other *clearance* of, or *excavation* into, a land surface. In the event of archaeological materials being present such activity would alter or destroy their context (even if the artefacts themselves are not destroyed, which is also obviously possible). Without context, archaeological traces are of much reduced significance. It is the contexts as much as the individual items that are protected by the heritage legislation.

Some of the activities indicated here have a generally lower impact than others. For example, Sampson (1985) has shown that power lines tend to be less destructive on Stone Age sites than roads since access along the route of the line during construction and maintenance tends to be by way of a 'twee-spoor' temporary roadway (not scraped, the surface not significantly modified). Individual tower positions might be of high archaeological significance (e.g. a grave, or an engraving). The impact of a 'twee-spoor' could be far greater on Iron Age sites in other parts of South Africa, where stone walling might need to be breached.

3.4 Determining archaeological significance

In addition to guidelines provided by the National Heritage Resources Act (Act No. 25 of 1999), a set of criteria based on Deacon (nd) and Whitelaw (1997) for assessing archaeological significance has been developed for Northern Cape settings (Morris 2000a). These criteria include estimation of landform potential (in terms of its capacity to contain archaeological traces) and assessing the value to any archaeological traces (in terms of their attributes or their capacity to be construed as evidence, given that evidence is not given but constructed by the investigator).

Estimating site potential

Table 1 (below) is a classification of landforms and visible archaeological traces used for estimating the potential of archaeological sites (after J. Deacon nd, National Monuments Council). Type 3 sites tend to be those with higher archaeological potential, but there are notable exceptions to this rule, for example the renowned rock engravings site Driekopseiland near Kimberley which is on landform L1 Type 1 – normally a setting of lowest expected potential. It should also be noted that, generally, the older a site the poorer the preservation, so that sometimes *any* trace, even of only Type 1 quality, can be of exceptional significance. In light of this, estimation of potential will always be a matter for archaeological observation and interpretation.

Assessing site value by attribute

Table 2 is adapted from Whitelaw (1997), who developed an approach for selecting sites meriting heritage recognition status in KwaZulu-Natal. It is a means of judging a site's archaeological value by ranking the relative strengths of a range of attributes (given in the second column of the table). While aspects of this matrix remain qualitative, attribute assessment is a good indicator of the general archaeological significance of a site, with Type 3 attributes being those of highest significance.

Table 1: Classification of landforms and visible archaeological traces for estimating the potential for archaeological sites (after J. Deacon, National Monuments Council).

Class	Landform	Type 1	Type 2	Type 3
L1	Rocky surface	Bedrock exposed	Some soil patches	Sandy/grassy patches
L2	Ploughed land	Far from water	In floodplain	On old river terrace
L3	Sandy ground, inland	Far from water	In floodplain or near feature such as hill	On old river terrace
L4	Sandy ground, Coastal	>1 km from sea	Inland of dune cordon	Near rocky shore
L5	Water-logged deposit	Heavily vegetated	Running water	Sedimentary basin
L6	Developed urban	Heavily built-up with no known record of early settlement	Known early settlement, but buildings have basements	Buildings without extensive basements over known historical sites
L7	Lime/dolomite	>5 myrs	<5000 yrs	Between 5000 yrs

Class	Landform	Type 1	Type 2	Type 3
				and 5 myrs
L8	Rock shelter	Rocky floor	Sloping floor or small area	Flat floor, high ceiling
Class	**Archaeo-logical traces**	**Type 1**	**Type 2**	**Type 3**
A1	Area previously excavated	Little deposit remaining	More than half deposit remaining	High profile site
A2	Shell or bones visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick; shell and bone dense
A3	Stone artefacts or stone walling or other feature visible	Dispersed scatter	Deposit <0.5 m thick	Deposit >0.5 m thick

Table 2: Site attributes and value assessment (adapted from Whitelaw 1997)

Class	Attribute	Type 1	Type 2	Type 3
1	Length of sequence/context	No sequence Poor context Dispersed distribution	Limited sequence	Long sequence Favourable context High density of arte/ecofacts
2	Presence of exceptional items (incl regional rarity)	Absent	Present	Major element
3	Organic preservation	Absent	Present	Major element
4	Potential for future archaeological investigation	Low	Medium	High
5	Potential for public display	Low	Medium	High
6	Aesthetic appeal	Low	Medium	High
7	Potential for implementation of a long-term management plan	Low	Medium	High

4. OBSERVATIONS AND ASSESSMENT OF IMPACTS

The manner in which archaeological and other heritage traces or values might be affected by the proposed development may be summed up in the following terms: it would be any act or activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). The most obvious impact in this case would be land surface disturbance associated with infrastructure construction.

4.1 Fieldwork observations

The proposed development footprint area was visited on 12 September 2011. In summary the findings can be reported in relation to predictions made in the scoping report (see 3.2 above):

4.1.1 Possible engraving occurrences on dolerite koppies or exposures:

Rock engravings are known to exist on dolerite koppies in the De Aar area (McGregor Museum records). Such koppies occur as a major feature in the area surrounding the study site but are relatively minimal within the specific area examined, where dolerite exposures occur as part of a major hill overlooking the proposed development site from the east and as low-topography outcrops on a few slight rises across the site.

The proximity of dolerite to shale in the hill overlooking the site, and in the topography of the plain, has an important bearing on raw material availability in the area and hence of artefact production, as will be explained below. But of significance in this section of the report is that on none of these outcrops were any engravings found.

4.1.2 Occurrences of Stone Age artefacts:

From an archaeological point of view the farm Paarde Valley is remarkable for a tremendous wealth of stone artefacts spread across its plains and probably below present sand surfaces where these mantle older surfaces.

The reason for this would appear to be, primarily, the abundant presence of locally occurring hornfels or indurated shale, the metamorphic rock on which virtually 100% of the artefacts are produced. Hornfels is formed in the contact zone between intrusive magma (dolerite) and sedimentary rocks (shale). Interbedding of dolerite

and shale is clearly apparent in the hill east of the site as well as at exposures at a few places across the site. Erosion of the hill has resulted in hornfels scree gravitating downwards and across the gently dipping plain in the Brak River basin. What results is a vast raw material quarry-cum-workshop site across which stone artefacts have been manufactured from the readily available material over millennia. In most cases the predominant component appears to be Pleistocene and early Holocene in age (the greater number of artefacts are highly patinated – a weathering/oxidation process resulting from long exposure of knapped surfaces), but there is also a much younger component of tools that are still relatively fresh-looking (little or no apparent patination – the artefacts are nearly black or gray as opposed to the more heavily patinated orange-brown of older stone tools). The latter could range from a few hundred to no more than a few thousand years old while the former could range back to more than 100 000 years. Although a few very large flakes were noted, no definite Acheulean (Earlier Stone Age) artefacts were found. Stone Age industries present certainly include Middle and Later Stone Age assemblages (henceforth referred to as MSA and LSA).

As to their spatial spread, those that are visible are on virtually all higher-lying ground and it is presumed that the apparent gaps in their distribution are a result of being covered by sand and clayey soils that fill up the dips. Erosion features in some places show this to be the case. But there may be some certain 'hotspots' relating to proximity to richer horfels quarry contexts.

Much greater spatial differentiation is apparent for late Holocene Later Stone Age occurrences and at least two 'sites', as opposed to a generalised plenty, were documented that were clearly structured by the specific features of the landscape.

Remarkably, none was noted during a brief contextual assessment of the koppie to the east of the development footprint. The hill is actively eroding and any shelters along its krantzes, mainly of shale, are unstable. However, a small rise nearby, with dolerite outcrop, at the edge of the proposed solar energy facility at 30.60044^{o} S 24.10566^{o} E has a tightly localised distribution of barely patinated stone tools including microliths over its top. There is also a circle of packed stone but its association with the artefacts is less than certain (see discussion under colonial traces, below). Older more heavily patinated artefacts also occur on the top of this small rise. Similar LSA and older material was also noted on a nearby ridge at 30.59882^{o} S 24.10657^{o} E.

Contrary to the expectations of the scoping report, there was not an abundance of LSA material *in evidence* along the banks of the mostly dry Brak River (such material may exist in highly localised sites and much of it may be veneered by silts). But the

strong spring near to the present farmhouse, at 30.58073° S 24.06585° E, is surrounded by a rich assemblage of LSA material. This was also the only place on the farm where remains of ostrich eggshell waterflasks/containers was noted in association of the stone tools. A lower grindstone typical of those commonly found on LSA sites was located. It might well be that the spring had in the past, as in recent times, been a principal focus of activity rather than the river which would hold water only for part of the year and perhaps only in some years in this arid landscape.

At the spring itself there is in addition a well-preserved peat sequence spanning at least much of the Holocene and possibly a longer period that could yield significant data on past climate in this part of the Karoo.

This site is also at the edge of the proposed development footprint but it may be affected negatively by secondary and residual impacts due to access roads and other infrastructure associated with the development.

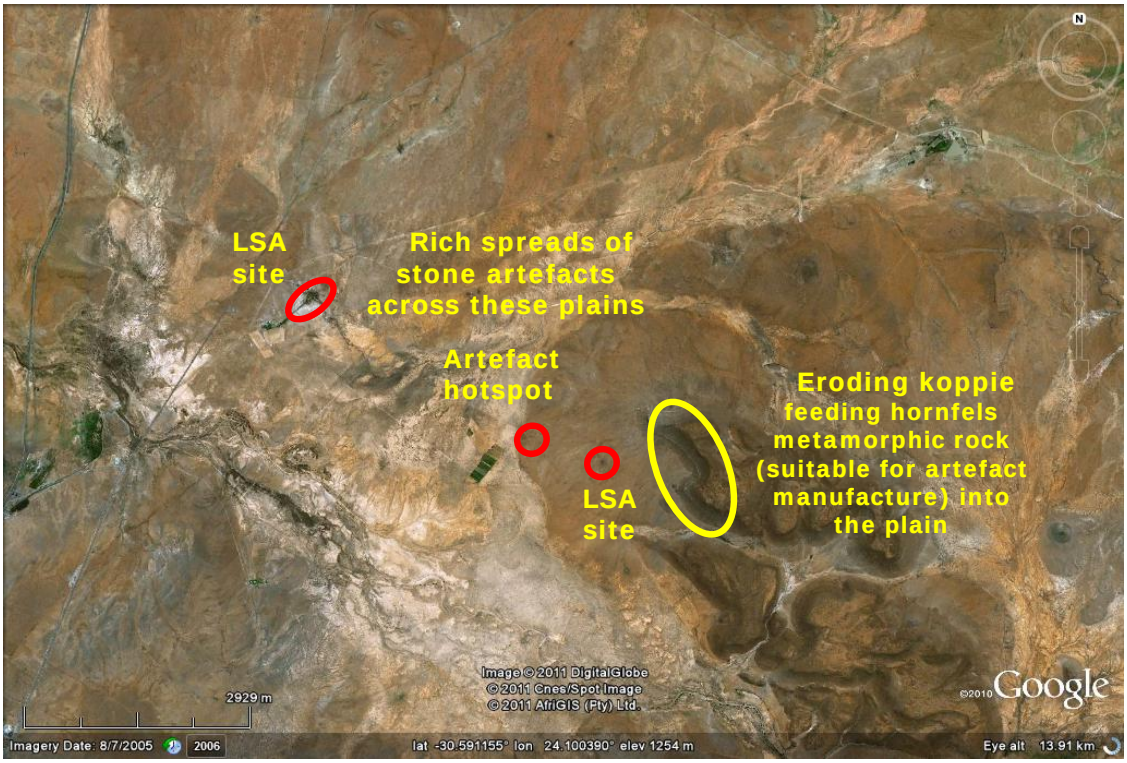

Figure 4: Summary of distribution of Stone Age occurrences noted in the text.

Figure 5: Eroding krantz with shale and hornfels gravitating to the plain below.

Figure 6: Localised dolerite outcrop on the plain: no engravings but associated with hornfels sources utilised as quarry site.

Figure 7: Hornfels and artefact 'hotspot' at 30.59695° S 24.09501° E.

Figure 8: MSA artefacts at a 'hotspot' at 30.60179° S 24.10468° E (pictured below)

Figure 9: Artefact 'hotspot' at 30.60179° S 24.10468° E, with small rise in background where LSA site was found (see below).

Figure 10: LSA artefacts at 30.60044° S 24.10566° E on small hill at eastern edge of proposed development footprint.

Figure 11: LSA artefacts at 30.58073^{o} S 24.06585^{o} E adjacent to spring.

Figures 12 & 13: Spring (above) and adjacent peat sediments (below).

4.1.3 Colonial era heritage:

A farm graveyard with headstones dating back to the earlier nineteenth century and representing the first appearances of Trekboers in this landscape is well maintained to the south west of the farm homestead, not due to be impacted by the proposed solar energy facility.

Figure 14: Farm graveyard: headstone dated 1839. 30.58694° S 24.05776° E

Also outside of the project footprint is a stockpost *skerm* (shelter) in the shadow of the koppie at the east end of the property. Pieces of ostrich eggshell, metal and glass were found in the vicinity.

Figure 15: *Skaapwagter's skerm* at 30.59404° S 24.11151° E

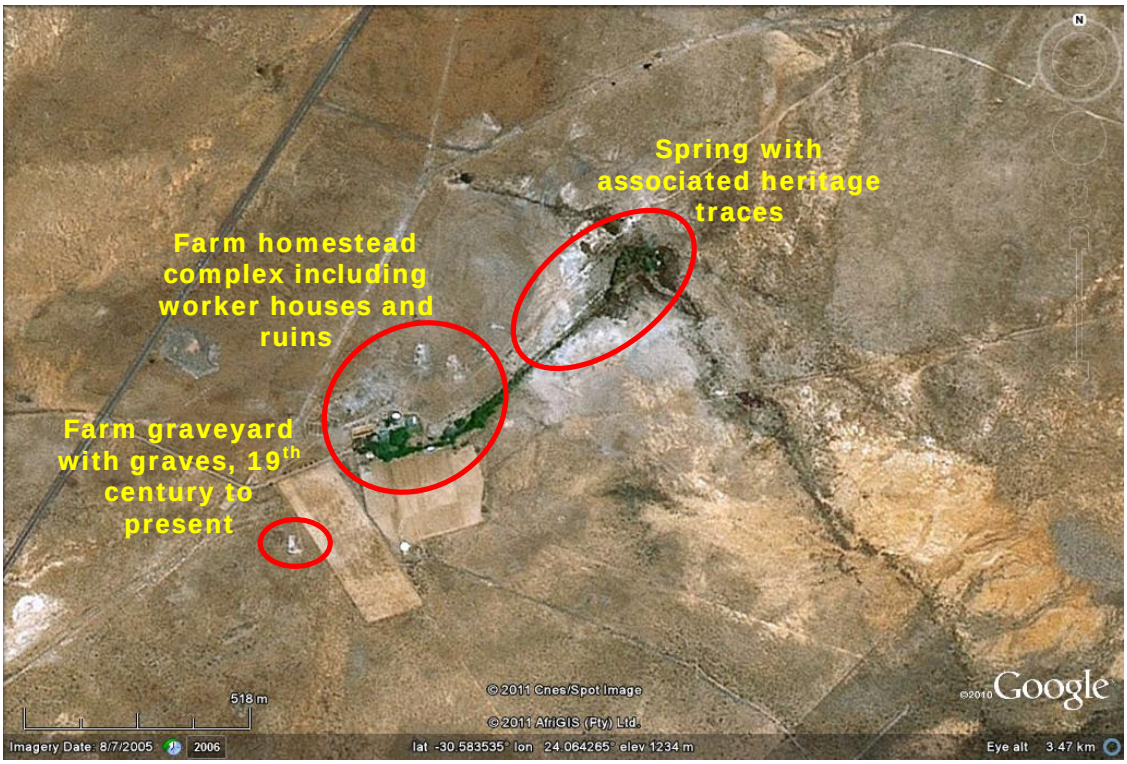

Figure 16: Google Earth image showing spring, farm complex and graveyard.

Figure 17: Google Earth image showing *skaapwagter's skerm* and stone circle.

On the small hill identified above for its LSA remains there is a small stone circle which may be of LSA date (similar structures are known at many sites in the Upper Karoo); but it may have been a farm worker's *skerm*, while the possibility exists that it relates to the Anglo-Boer War. Further research would be needed on site and using other sources to resolve the identification of this structure.

Figure 18: Stone circle on top of low dolerite hill. 30.60044° S 24.10566° E

4.2 Characterising the archaeological significance (Refer to 3.4 above)

In terms of the significance matrices in Tables 1 and 2 under 3.4 above, most of the archaeological observations fall under Landforms L3 Type 1 and in certain cases Type 2. Associations with raw material sources, with the tops of rises and small hill features and with the spring have been noted in particular. In terms of archaeological traces they mostly fall under Class A3 Type 1 although in a few instances, such as the LSA site at the spring, the deposit may be half a metre or more deep, potentially containing evidence of different episodes of site occupation. The peat deposit is also >0.5 m deep, hence Type 3. These Table 1 ascriptions reflect poor contexts for much of the material, but indicate contexts with better integrity in a few cases, giving them higher significance. Mitigation and delineation of sensitive areas that must be avoided in, for instance, construction of access roads, needs to be carried out.

For site attribute and value assessment (Table 2), many of the observations noted fall under Type 1 for Classes 1 - 7, reflecting low significance, low potential, and absence of contextual and key types of evidence. However, higher significance can be attached to the same sites highlighted above and the environmental management plan for the project provides an opportunity to implement adequate management of a few selected sites.

Table 3: ***The following sites may be impacted directly or indirectly by the development and mitigation/management as proposed below should focus on ensuring either their preservation in situ or recording and sampling, as may be the case.***

Location	Site description	Mitigation/Management action
30.60044° S 24.10566° E	Hill with Stone Age (including LSA) traces and stone circle feature as well as the rich spread of artefacts on the plain immediately to the south of it.	Delineate as no-go area.
30.58073° S 24.06585° E	Later Stone Age site and other heritage traces as well as potential peat sequence at the spring.	Delineate as no-go area where secondary impacts may need to be managed.
30.59695° S 24.09501° E as example of numerous surface artefact 'hotspots'	Rich surface spread of mainly Pleistocene age artefacts.	Surface sample and documentation for preservation as museum collection.

4.3 Characterising the significance of impacts

The following criteria are used in this EIA to characterise the significance of direct, indirect and cumulative impacts (Jodas 2010):

» The **nature**, which shall include a description of what causes the effect, what will be affected, and how it will be affected.
» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:

- local extending only as far as the development site area – assigned a score of 1;
- limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
- will have an impact on the region – assigned a score of 3;
- will have an impact on a national scale – assigned a score of 4; or
- will have an impact across international borders – assigned a score of 5.

» The **duration**, wherein it will be indicated whether:
- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5.

» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
- 0 is small and will have no effect on the environment;
- 2 is minor and will not result in an impact on processes;
- 4 is low and will cause a slight impact on processes;
- 6 is moderate and will result in processes continuing but in a modified way;
- 8 is high (processes are altered to the extent that they temporarily cease); and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
- Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
- Assigned a score of 2 is improbable (some possibility, but low likelihood);
- Assigned a score of 3 is probable (distinct possibility);
- Assigned a score of 4 is highly probable (most likely); and
- Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).

» the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.

» the **status**, which will be described as either positive, negative or neutral.

» the degree to which the impact can be reversed.

» the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

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

S= (E+D+M) P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

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

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

Impact table summarising the significance of impacts (with and without mitigation) at Paarde Valley (Ilanga Lethemba)

Nature Acts or activities resulting in disturbance of surfaces and/or sub-surfaces containing artefacts (causes) resulting in the destruction, damage, excavation, alteration, removal or collection from its original position (consequences), of any archaeological material or object (what affected).		
	Without mitigation	***With mitigation***
Extent	Regional (3)	Local (1)
Duration	Permanent (5)	Permanent – for material remaining on site after mitigation – mitigation would result in a sample of the material being preserved in a transformed state, removed from context, as museum collection (5)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (72)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	No	No
Irreplaceable loss of resources?	Yes, with regional impact given the relative scarcity of sites of this nature in the surrounding landscape.	Resources would still be lost but representative samples will have been recovered and possible no-go areas demarcated.
Can impacts be mitigated?	Yes	On-going management as per EMP
Mitigation: » By way of salvage and investigative sampling/excavation and delineating no-go areas adjacent to (rather than within) the area of proposed development. See Table 3 above.		
Cumulative Impacts: » Where any archaeological contexts occur the impacts are once-off permanent destructive events. Infrastructure development may lead to spatially extended impacts in the vicinity, hence the need to demarcate areas for zero impact.		
Residual Impacts: » Depleted archaeological record.		

MEASURES FOR INCLUSION IN THE DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

OBJECTIVE: Archaeological or other heritage materials occurring in the path of any surface or sub-surface disturbances associated with any aspect of the development are highly likely to be subject to destruction, damage, excavation, alteration, or removal. The objective should be to limit such impacts to the primary activities associated with the development and hence to limit secondary impacts during the medium and longer term working life of the facility.

Project Component/s	Any road or other linear construction over and above what is necessary and any spatial extension of other components addressed in this EIA.
Potential Impact	The potential impact if this objective is not met is that wider areas or extended linear developments may result in further destruction, damage, excavation, alteration, removal or collection of heritage objects from their current context on the site.
Activity/Risk Source	Activities which could impact on achieving this objective include deviation from the planned lay-out of infrastructure without taking heritage impacts into consideration.
Mitigation: Target/Objective	Mitigation measures as recommended. It is suggested that these measures should include clear delineation of no-go areas on the periphery of the proposed development in order to protect sensitive sites. A facility environmental management plan that takes cognizance of heritage resources in the event of any future extensions of any infrastructure.

Mitigation: Action/control	Responsibility	Timeframe
Provision for on-going heritage monitoring in a facility environmental management plan which also provides guidelines on what to do in the event of any major heritage feature being encountered during any phase of development or operation. Phase 2 mitigation and delineation of sensitive sites as recommended in Table 3 and in the measures for inclusion in the	Environmental management provider with on-going monitoring role set up by the developer.	To be in place before commencement of the development.

Draft EMP, above.		

Performance Indicator	Completed mitigation as recommended including demarcation of no-go area/s. Inclusion of further heritage impact consideration in any future extension of infrastructural elements. Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility.
Monitoring	Officials from relevant heritage authorities (National and Provincial) to be permitted to inspect the operation at any time in relation to the heritage component of the management plan.

5. CONCLUSIONS

A remarkably rich distribution of heritage traces was found: Stone Age occurrences, mostly Pleistocene/early Holocene, showing use of abundant locally available raw material, as well as a few LSA sites tightly focused on features of the landscape including a low hill and the spring; and colonial traces referring to Trekboer inhabitation (graves) and farm worker activity (*skaapwagter skerms*). In addition the vicinity of the spring may be able to yield important palaeoenvironmental evidence. The more significant of these heritage resources fall outside of the main areas of solar energy facility construction impact but the management plan must provide for their preservation. The provision of parameters for such a plan would, with selective sampling as proposed, be the main task of the recommended mitigation. Apart from these particular occurrences, from an archaeological perspective, the observed heritage resources over the bulk of the area surveyed were found to be mainly of lower significance.

6. REFERENCES

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