APPENDIX L: HERITAGE ENVIRONMENTAL IMPACT ASSESSMENT

KALKAAR SOLAR THERMAL POWER PLANT AND KALKAAR PHOTOVOLTAIC POWER PLANT PROJECT

Proposed Kalkaar Solar Thermal Power Plant and Kalkaar Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province.

Heritage Impact Assessment

Issue Date:	10 December 2013
Revision No.:	1
Client:	SLR Consulting (Africa) (Pty) Ltd

Declaration of Independence

This report has been compiled by PGS Heritage, an appointed Heritage Specialist for SLR Consulting (Africa) (Pty) Ltd. The views stipulated in this report are purely objective and no other interests are displayed during the decision making processes discussed in the Heritage Impact Assessment.

HERITAGE CONSULTANT: PGS Heritage

CONTACT PERSON: Marko Hutten
Tel: +27 (0) 12 332 5305
Email: marko@gravesolutions.co.za

SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

CLIENT: SLR Consulting (Africa) (Pty) Ltd

CONTACT PERSON: Jonathan Mograbi
Tel: (011) 467 0945
Fax: (011) 467 0978
Email: jmograbi@slrconsulting.com

SIGNATURE: _____

Report Title	*Heritage Impact Assessment for the proposed development of a Solar Thermal Power Plant and a Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province.*		
Control	**Name**	**Signature**	**Designation**
Author	**M Hutten**		**Heritage Specialist**
	W Fourie		**Principal Investigator**
Client	**J Mograbi**		**SLR Consulting**

EXECUTIVE SUMMARY

PGS Heritage was appointed by SLR Consulting (Africa) (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Report (EIA) for the proposed development of a Solar Thermal Power Plant and a Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province.

An archival and historical desktop study was undertaken which was used to compile a historical layering of the study area within its regional context. This component indicated that the landscape within which the project area is located has a rich and diverse history. However, the desktop study did not reveal any historic or heritage sites from within the study area.

These desktop studies were followed by a fieldwork component which comprised a walkthrough of the study area. Two heritage sites were identified within the area proposed for the Concentrated Solar Thermal Power Plant. The one site was a large shed or storeroom which was most probably not older than 60 years. The other site was a low density scatter of LSA lithics which was identified in and around an access road. The identified heritage sites however, have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites. The owners of the storeroom at site KA 001 should be consulted before destruction commence in order to give them the opportunity to remove personal belongings.

A Palaeontological study was performed by Dr. G. Groenewald. The Kalkaar study area is underlain by Quaternary aged aeolian deposits. A wide variety of fossil remains have been reported from these deposits (although finds are often localised) and due to the fact that most of the fossils will only be exposed during the construction phase, a Medium Palaeontological Sensitivity is allocated to the study area. The following mitigation measures were recommended regarding this project:

- The EAP and ECO of the project must be informed of the probability that fossils might be present in the aeolian sand deposits.
- A qualified palaeontologist must be appointed to do a Phase 1 PIA study to record any fossils that are present in the aeolian sand. Due to the fact that most of the fossils will only be exposed during the construction phase, it is recommended that

the phase 1 study must be done during initial soil movement activities and where possible, concurrently with the construction phase.

•If fossils are recorded, the appointed palaeontologist must apply for a collection permit in accordance with SAHRA specifications.

The identified heritage sites have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites. The development of the proposed Kalkaar Solar Thermal Power Plant and the Kalkaar Photovoltaic Power Plant and the associated infrastructure can continue if the recommendations as outlined in this report are adhered to.

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1 INTRODUCTION

PGS Heritage (PGS) was appointed by SLR Consulting (Africa) (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Report (EIA) for the proposed development of a Solar Thermal Power Plant and a Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The Heritage Impact Assessment aims to inform the S&EIA in the development of a comprehensive EMP to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This Heritage Impact Report was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 60 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where its staff has the relevant expertise and experience to undertake that work competently.

Mr Marko Hutten, heritage specialist and project archaeologist, has 15 years of experience in the industry and is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Field Director.

Ms Jennifer Kitto, Heritage Specialist for this project, has 15 years' experience in the heritage sector, a large part of which involved working for a government department responsible for administering the National Heritage Resources Act, No 25 of 1999. She is therefore well-versed in the legislative requirements of heritage management. She holds a BA in Archaeology and Social Anthropology and a BA (Hons) in Social Anthropology.

Dr Gideon Groenewald has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma in Nature Conservation from the University of South Africa (1990). He specialises in research on South African Permian and Triassic sedimentology and macrofossils

with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)

b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
d. Environmental Management Plan (EMP) – Section (34)(b)

ii. National Heritage Resources Act (NHRA) Act 25 of 1999
a. Protection of Heritage Resources – Sections 34 to 36; and
b. Heritage Resources Management – Section 38

iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…". The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA and the DFA legislation. In the latter cases, the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Sections of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

1.5 Terminology and Abbreviations

Archaeological resources

This includes:

i. 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;

ii. 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;

iii. 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 in the Maritimes Zones Act, 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;

iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;

ii. carrying out any works on or over or under a place;

iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;

iv. constructing or putting up for display signs or boards;

v. any change to the natural or existing condition or topography of land; and

vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age, between 700 000 and 2 500 000 years ago.

Fossil

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

Heritage

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

Heritage resources

This means any place or object of cultural significance

Holocene

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

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 1: Abbreviations

ABBREVIATIONS	DESCRIPTION
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Refer to **Appendix A** for further discussions on heritage management and legislative frameworks

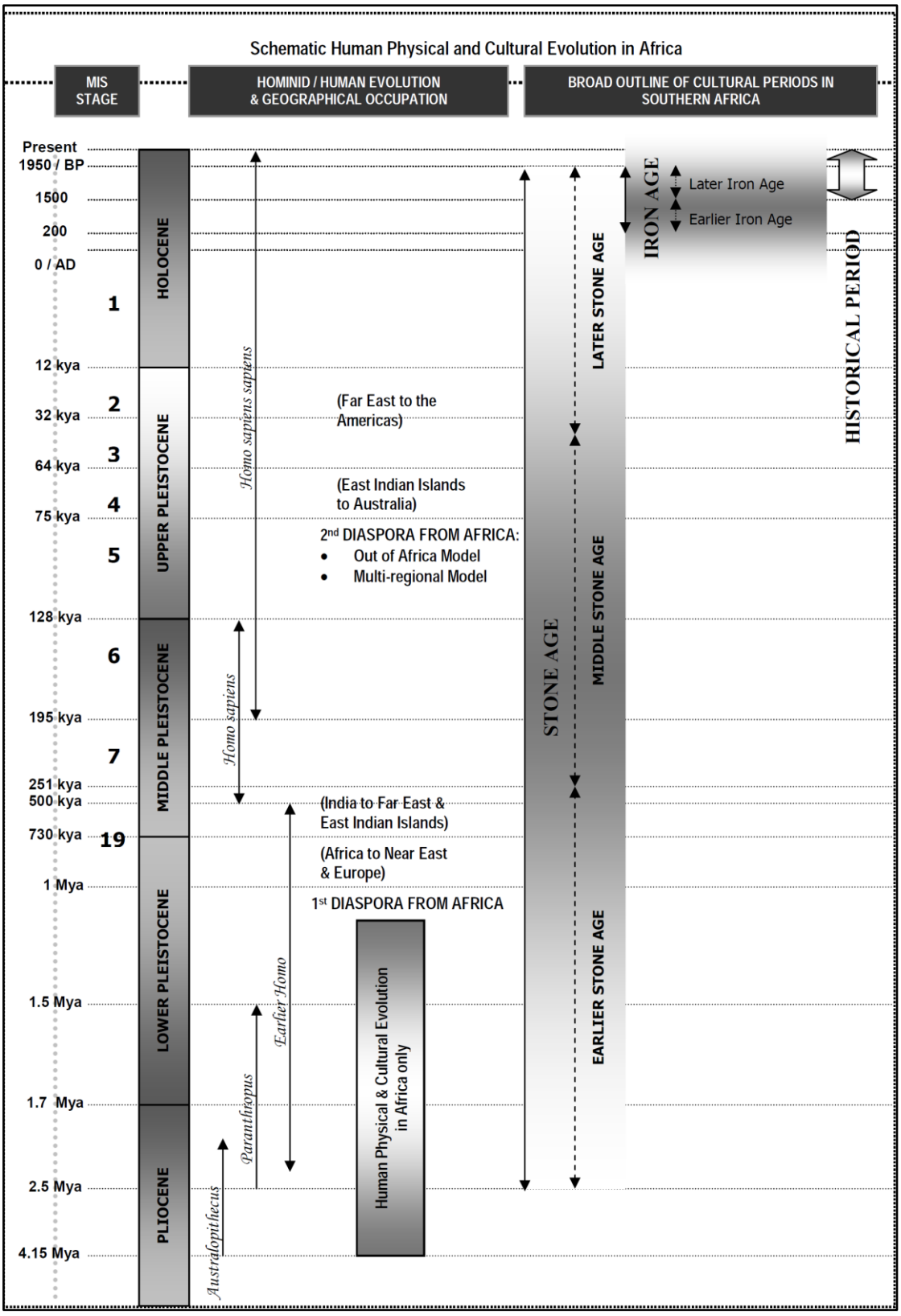

Figure 1 – Human and Cultural Timeline in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

The proposed Kalkaar Solar Thermal Power Plant and Kalkaar Photovoltaic Power Plant will be situated on Portion 1 of the Farm Kalkaar 389 approximately 19km east of the small town of Jacobsdal in the Letsemeng Local Municipality, Free State Province. The proposed study area is approximately 1400ha in size of which approximately 800ha will be required for the Concentrated Solar Thermal Power Plant and approximately 280ha will be required for the Photovoltaic Power Plant. (**Figure 2**).

Figure 2 – Google image showing the location of the proposed project (from SLR Consulting)

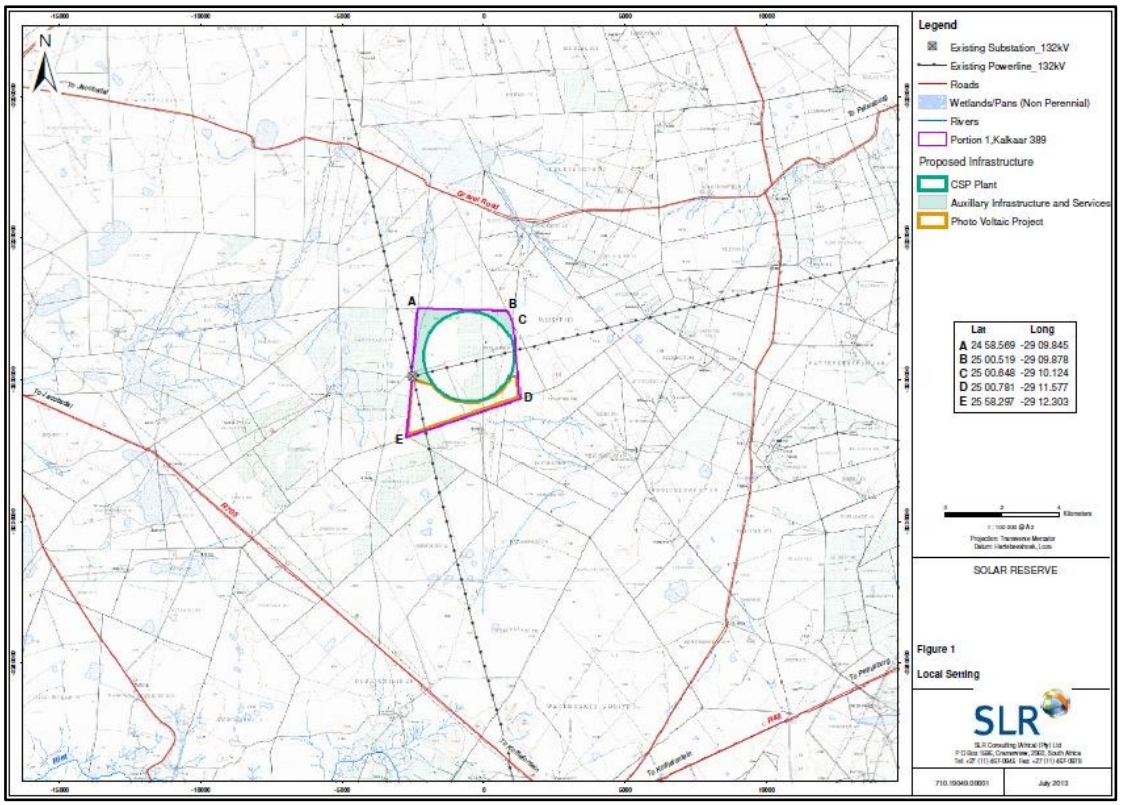

Figure 3 – Locality map of the proposed project (from SLR Consulting)

2.2 Site Description

Location	GPS: S29° 10' 54.4" E024° 59' 02.5" The proposed development site is situated on Portion 1 of the Farm Kalkaar 389**,** located approximately 19km east of Jacobsdal in the Letsemeng Local Municipality, Free State Province.
Land Size	Approximately 1400ha of which approximately 800ha is required for the Concentrated Solar Power Plant and approximately 280ha is required for the Photovoltaic Power Plant.
Land Description	The land is relatively flat and was previously and is currently used as a grazing facility for livestock. An existing 132kV power line crosses the central parts of the property from east to west. Another 132kV power line is situated at the south-western corner of the property and crosses the property from north to south. The two power lines meet each other at an existing 132kV substation on the western extent of the property.

The proposed project will be situated on Portion 1 of the Farm Kalkaar 389, approximately 19km east of Jacobsdal in the Letsemeng Local Municipality, Free State Province. The study area measured approximately 1400ha of which approximately 800ha is required for the Concentrated Solar Power Plant and approximately 280ha is required for the Photovoltaic Power Plant. The rest of the available area will be used for auxiliary infrastructure and services.

The land is relatively flat and was previously and is currently used as a grazing facility for livestock. The proposed site is covered with grass and Karoo-type vegetation (figure 4). A few trees are also spread across the property. A few power lines and a substation are also situated on the property (figure 5). A large shed/storeroom is situated in the central part of the property.

Figure 4 *– General view of the proposed study area*

Figure 5 – View of the substation and the power lines

2.3 Technical Project Description

The proposed development will comprise two separate solar energy power generation projects: a solar thermal-electric power plant in the form of a Concentrated Solar Power (CSP) Plant; and a Photovoltaic (PV) Power Plant.

2.3.1 Concentrated Solar Thermal Power (CSP)

The CSP Plant being considered employs Central Receiver Molten Salt technology which uses molten salt as its heat transfer medium. This technology relies on thousands of large tracking mirrors (heliostats) which track the sun and reflect the beam radiation to a common focal point (central receiver) at the top of a tower. The tower is positioned off-centre (northern alignment) in the heliostat field. The central receiver acts as a heat exchanger which absorbs the concentrated beam radiation, heating a molten salt solution which is in turn used to generate steam for conventional

power generation. An installed generation capacity of up to 200 MW is proposed, which will require approximately 800ha of a relatively flat surface area to be developed. A brief description of the infrastructure to be used at the plant is given below:

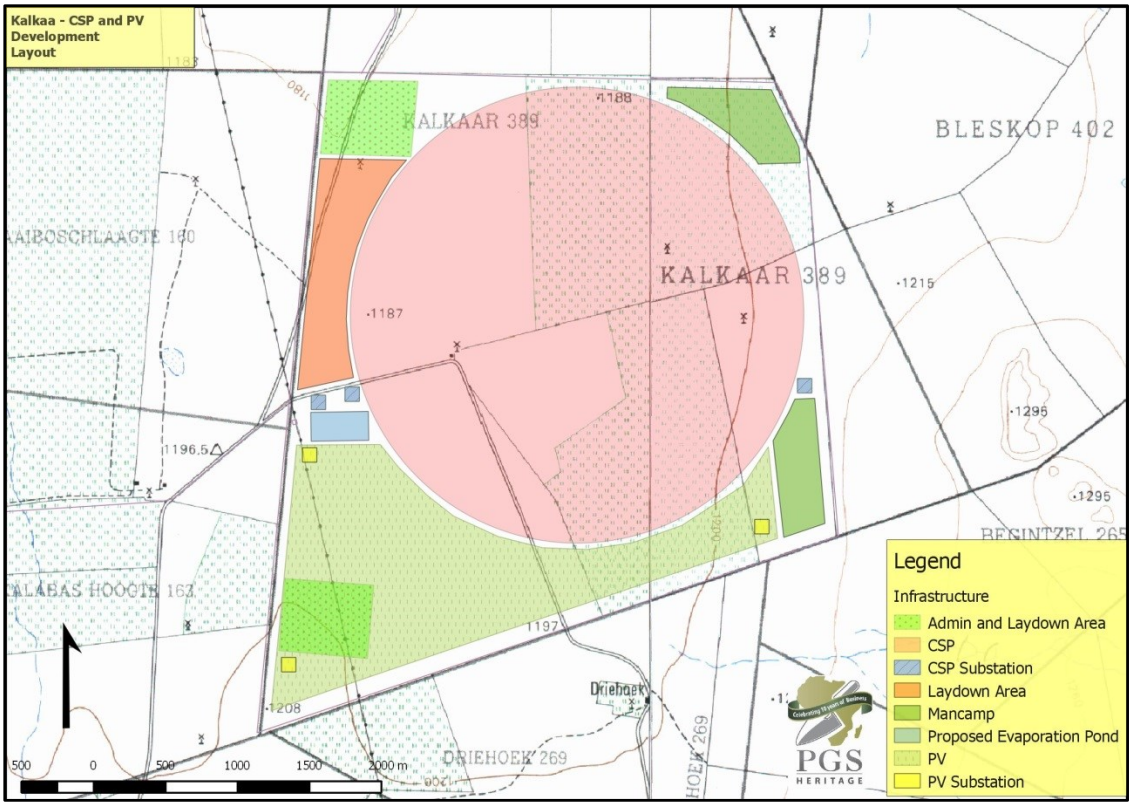

Figure 6 – Proposed site layout map

2.3.2 **Heliostat Field**

A heliostat is a mirror mounted on a pedestal by which the sun is steadily reflected onto one spot – the receiver. Heliostats are arranged in a circular formation around the central receiver which is slightly offset to the north of the field. It is estimated that approximately 10,000 – 17,500 heliostats will be required. The proposed heliostat dimensions can range between 64m2 – 120m2 dependent on the technology supplier. The heliostat field has a diameter of approximately 2.7 km.

2.3.3 **Molten Salt and Central Receiver**

A salt mixture is used as the heat transfer medium for the technology proposed. The "cold" salt is circulated through the tower (approximately 300 °C) to the central receiver where it is heated to approximately 580 °C for power generation purposes. The technology allows for the storage of heat via the molten salt storage tanks. Through thermal storage of the heated molten salt, the CSP system has the ability to generate power over a 24hour period or in overcast scenarios.

2.3.4 **Power Generation process**

Power is generated through a conventional "Rankine-cycle" (steam turbine process) and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

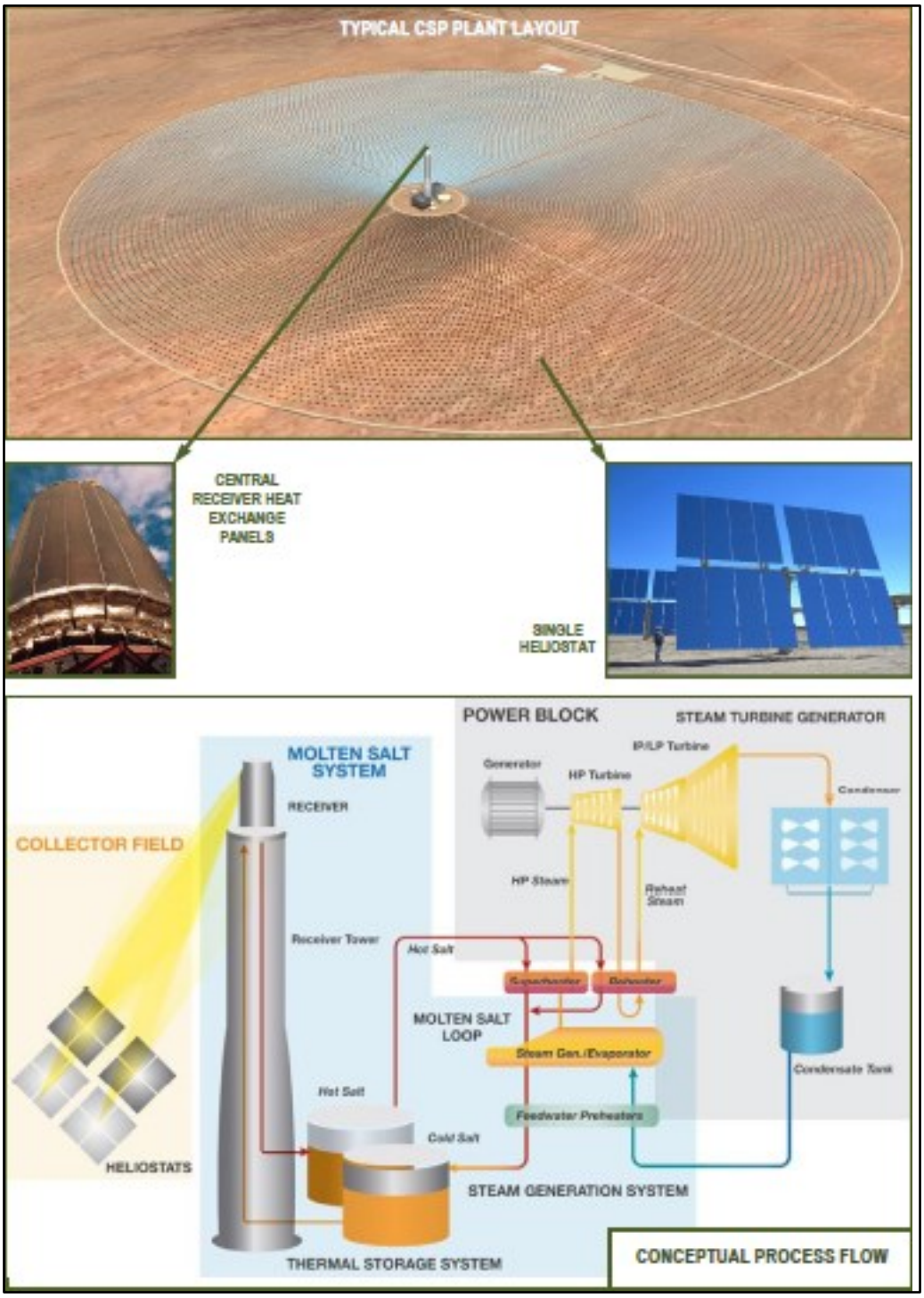

Figure 7 – Concentrated Solar Thermal Power Plant Technology

2.3.5 **Auxiliary facilities**

Auxiliary facilities and infrastructure include the electricity transmission lines, a grid connection, access routes, water supply and treatment facilities, waste management facilities, facility start-up (gas or diesel) generators, administration and staff facilities, man-camp, stores, fire water, storm water management infrastructure, substation and other supportive services and infrastructure, as well as related construction facilities and laydown areas.

2.3.6 **Photovoltaic Power Plant**

The proposed PV Power Plant component involves direct conversion of solar energy into direct current (DC) electrical power from semiconductors within solar cells (PV elements) when they are illuminated by sunlight (photons). The proposed PV Power Plant will have a generation capacity of up to 100 MW and requires approximately 280 ha of surface area. Power is generated as long as the PV elements are exposed to sunlight (**Figure 8**).. The main components of a utility scale PV power plant include:

- Photovoltaic element arrays and support structures;
- Power inverters to convert Direct Current (DC) power to Alternating Current (AC) power;
- Electrical substation to accommodate step-up transformers and switch gear connecting the plant to the electricity grid for each PV development;
- Transmission lines to tie in to the closest transmission network;
- Control and monitoring systems; and
- Additional support services and infrastructure such as access roads, water supply and treatment facilities and staff facilities.

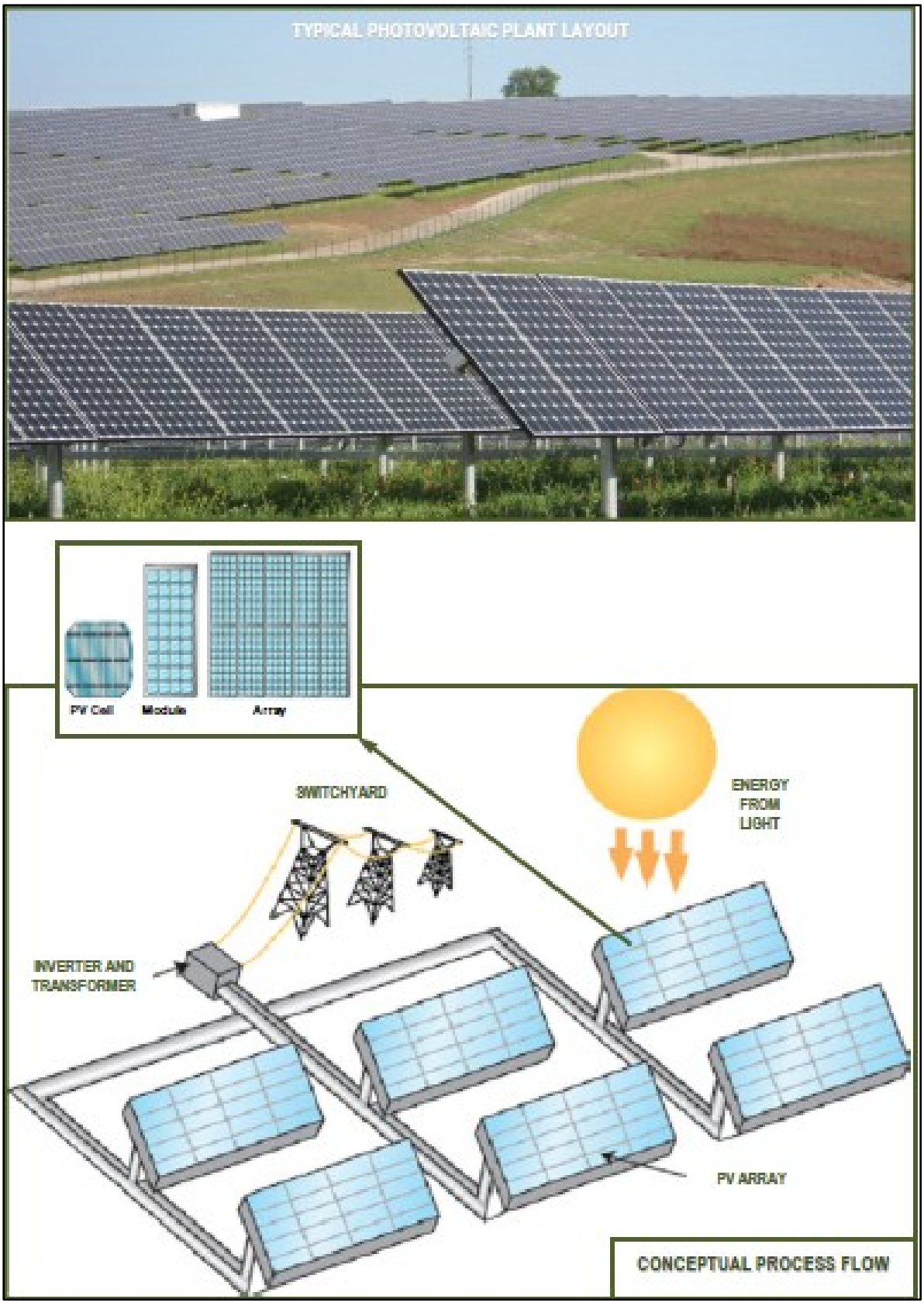

Figure 8 – Photovoltaic Power Plant Technology

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This Heritage Impact Assessment (HIA) report was compiled by PGS Heritage (PGS) for the proposed development of a Solar Thermal Power Plant and a Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by a qualified archaeologist, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of identified heritage sites was based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium - 10-50/50m2
    - High - >50/50m2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated as follows:

3.1.1 Site Significance

Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 2: Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

3.2

3.3 Methodology for Impact Assessment

In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

Table 3: Impact rating table (SLR Conslting)

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
SEVERITY = L					
DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**
SEVERITY = M					
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
SEVERITY = H					
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			Localised - Within site boundary - Site	Fairly widespread - Beyond site boundary - Local	Widespread - Far beyond site boundary - Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

4 BACKGROUND RESEARCH

4.1 Previous historical studies

Researching the SAHRIS online database (http://www.sahra.org.za/sahris) other studies were identified in the wider vicinity of the study area:

- Phase 1 Cultural Heritage Impact Assessment Of The Proposed Boschkop Farm Solar Energy Plant, Near Jacobsdal, Free State Province. Mamoluoane Seliane for Strategic Environmental Focus (Pty) Ltd. 2011.
- Phase 1 Archaeological Impact Assessment, Ratanang Ex Jacobsdal, (Phethogo Consulting), Karen Van Ryneveld (Archaeomaps Archaeological Consultancy) for Phethogo Consulting. 2009.
- Phase I Cultural Heritage Impact Assessment Of The Proposed Olam Energy Project 10 Solar Plant On The Farm Boschkop, Near Jacobsdal, Free State Province. Mamoluoane Seliane for Strategic Environmental Focus (Pty) Ltd. 2011.
- Phase I Cultural Heritage Impact Assessment Of The Proposed Inyanga Energy Project 8 Solar Plant To Be Constructed On The Farm Boschkop, Near Jacobsdal, Free State Province. Mamoluoane Seliane for Strategic Environmental Focus (Pty) Ltd. 2012.
- Assessment Of Proposed Balancing Dam Options On The Oranje-Riet Canal (on farm Kareevlakte 422, Letsemeng Local Municipality, Free State) In Terms Of Archaeological And Other Heritage Sites Zoe Henderson & Loudine Philip. National Museum for BKS (Pty) Ltd. 2008.
- Heritage Impact Assessment for the Proposed Dioflash Solar Park, South-east of Kimberley, Free State Province. Marko Hutten for AGES (Africa-Geo environmental Services). 2012.
- Webley, L & Orton. J. 2012. Heritage Impact Assessment: Proposed Construction Of The Ruinte Photovoltaic Solar Energy Facility, Wagenmaker's Drift 24, Xhariep District Municipality, Free State Province. ACO Associates for ERM Southern Africa (Pty) Ltd. 2012.

4.2 Archival findings

The aim of the archival background research is to identify possible heritage resources that could be encountered during the field work, as summarised in **Table 4**.

Table 4: Summary of History of the Jacobsdal Area

DATE	DESCRIPTION
2.5 million to 250 000 years ago	The Earlier Stone Age (ESA). The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulian phase dates back to

	approximately 1.5 million years ago. No recorded sites were located during the desktop study.
250 000 to 40 000 years ago	The Middle Stone Age (MSA). The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique. No recorded sites were located during the desktop study.
40 000 years ago to the historic past	The Later Stone Age is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (microliths). The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the wider vicinity of the study area (Bergh, 1998). Burkitt (1928) mentions two Late Stone Age sites on the farm Brakfontein, 24km from Fauresmith on the Koffiefontein Road: one yielded Smithfield lithics and the other yielded Fauresmith lithics. A site with engravings is mentioned on a koppie called Afvallingskop, located on the road from Koffiefontein to Jacobsdal, just outside Koffiefontein. This koppie had many boulders strewn over the flat top which had been engraved.
AD 200 - 900	Early Iron Age (EIA). No recorded sites were located during the desktop study.
AD 900 - 1300	Middle Iron Age (MIA). No recorded sites were located during the desktop study.
AD 1300 - 1840	Late Iron Age (LIA). A specific type of settlement known as "Type R" settlements is limited to the Riet River between Kalkfontein Dam in the east and the hilly country around the village of Plooysburg in the west, a distance of some 130 km. Maggs (1971) has identified a large number, consisting of at least 78 settlement units, in the eastern half of this area between Kalkfontein Dam and the town of Jacobsdal. From here there is a gap of about 50 km until the settlement at Driekops Eiland is reached. In this area north and west of Plooysburg are an additional six or more settlement units. (Maggs, 1971)
AD 1859	Historical period. The town of Jacobsdal derives its name from Christoffel Jacobs who made a portion of his farm Kalkfontein available for the establishment of the town. The layout of the town commenced in 1859 and the town obtained municipal status in 1860. The Riet River irrigation settlement starts about 3 km west of the town and extends 15 km upstream to the confluence of the Riet and Modder Rivers (Webley & Orton, 2012). Several provincial heritage sites are located in and around the town of Jacobsdal, as recorded on the SAHRA database SAHRIS. These include the following: Magersfontein Burgher Memorial, on the farm Magersfontein 219; Anglo-Boer War Blockhouse, on the road to Paardeberg; Nederduitse Gereformeerde Church, Andries Pretorius Street; Jacobsdal (SAHRIS)
1899-1902 South Africa War	Jacobsdal saw a great deal of military action during the Second Anglo-Boer War of 1899-1902 because it was close to the strategic towns of Kimberley and Mafeking. The wounded from the battles of Belmont/Graspan, Modder River, Magersfontein and Paardeberg were all nursed in the town. There are a number of important memorials and buildings in town, including the Burger Monument in front of the Dutch Reformed

Church, erected in memory of the deceased at the Battle of Roodelaagte (or Graspan) on 25 November.1899. The town also has a cairn memorial erected by the Boers of Jacobsdal in November 1899 before departing for the battle of Graspan. The Dutch Reformed Church, consecrated in 1879 and enlarged in 1930, was used as a hospital during the Anglo Boer War. The oldest grave in the Jacobsdal Cemetary dates from 1859. British War graves and monuments can be found dating from the Anglo Boer War (1899 - 1902) (Webley & Orton, 2012).

The Battles of Modder River and Magersfontein both occurred in late 1899. The battle of Modder River was an immediate precursor to the battle of Magersfontein in relation to the Boer siege of Kimberley. The Boers had dug themselves in on the Northern bank of the Modder River close to its confluence with the Riet. However, the Commonwealth forces eventually forced the Boers to retreat after an intense artillery fire. Notwithstanding, the Boers held up the British advance for 10 days and entrenched themselves at a series of low dolerite hills called Magersfontein The site of the Battle of Modder River is marked by a Commonwealth War Graves cemetery (Hart, 2003)
At Magersfontein, the Boers in their trenches at the base of the hills opened fire on the British forces at a range of 400m. The result was some 700 Commonwealth troop fatalities. After two days of fierce fighting, the British Forces retreated to Modder River camp to await reinforcements before attempting to reach Kimberly. Magersfontein was a huge shock for the Commonwealth army. Today Magersfontein battle site is one of the best preserved (Hart, 2003). The town of Jacobsdal played a key role in most of these engagements, being at first the Boer headquarters and later taken over by the British for the same purpose (Hart, 2003)

The following heritage sites were identified in and around Jacobsdal from the Letsemeng Local Municipality web-site:
http://www.letsemeng.gov.za/index.php/council/76-uncategorised/58-jacobsdal

- *British Block House (Fort)*

  The blockhouse with its unique architecture was built in 1900 on the road to Paardeberg. It was declared a national monument in 1983.

- *Burger Monument*

  In front of the Dutch Reformed Church - erected in memory of the deceased at the Battle of Roodelaagte 25.11.1899 under command of D.S. Lubbe.

- *Cairn - Heap of stones (Klipstapel)*

  It was erected by the Boers from Jacobsdal in November 1899 before departing for the battle of Roodelaagte (Graspan). Each boer engraved his name on a stone and these stones

were used to build the monument. The monument can be reached by a walking trail from the Agricultural School.

- *Dutch Reformed Church*

  Consecrated in 1879 and enlarged in 1930, was used as a hospital during the Anglo Boer War - now a national monument. A Bullet hole in the front door is evidence of the many skirmishes which took place between Boer and Brit in the area.

- *Jacobsdal Cemetery (at the end of De Villiers St)*

  The oldest grave date from 1859. British War graves and monuments can be found dating from the Anglo Boer War (1899 - 1902). Some "Boers" that fought the Magersfontein battle were reburied at Magersfontein which included Commandant D.S. Lubbe's grave (1923).

- *Jacobs Farmhouse*

  It is the first dwelling that was built in the area where Jacobsdal is today. It was built by Mr C.J. Jacobs. The house is situated in Sarel Cilliers St next to First National Bank.

- *Magersfontein Battlefield & Museum*

  20 km North-west of Jacobsdal.

- *Old Market Square*

  The market square was where the city hall is today and it was used as a British soldier's lager. A big battle took place on 25 October 1900. Boers fired at the British from behind a stone wall which still stands today.

- *Paardeberg (18 - 27 February 1900)*

  By means of a wide flanking movement to avoid the Boers at Magersfontein, Lord Roberts succeeded in relieving Kimberley on 15 February 1900. Due to his precarious position, Cronje was forced to fall back to Bloemfontein along the Modder River. He was denied crossing Vendusiedrif due to the British onslaught with the result that the Boers entrenched themselves on both sides of the river. 40000 British troops supported by 100 guns besieged the small Boer force of 4000 men, women and children. After 10 days of continuous bombardment, the Boer force surrendered on 27 February 1900. Majuba was at last revenged.

- *"Tuishuis"*

  The old fashioned dwelling, still with its original wallpaper, was used during religious ceremonies. It is situated directly opposite the southern entrance of the Dutch Reformed Church.

4.3 Palaeontology of the area

The following section is an extract from the Palaeontological Desktop Study, attached as **Appendix B**.

The Quaternary deposits of this area might contain a very wide range of possible fossil remains, though these are often sparse, including mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms and other microfossil groups. Plant fossils including fossilized wood and pollen grains have also been recorded in the Quaternary deposits. Fossils are generally very difficult to recognize in the Aeolian deposits and fossils are normally associated with localized concentrations of material associated with calcrete beds close to water ways.

The study area is underlain by Quaternary aged Aeolian sand deposits as seen from the geological map of the area.

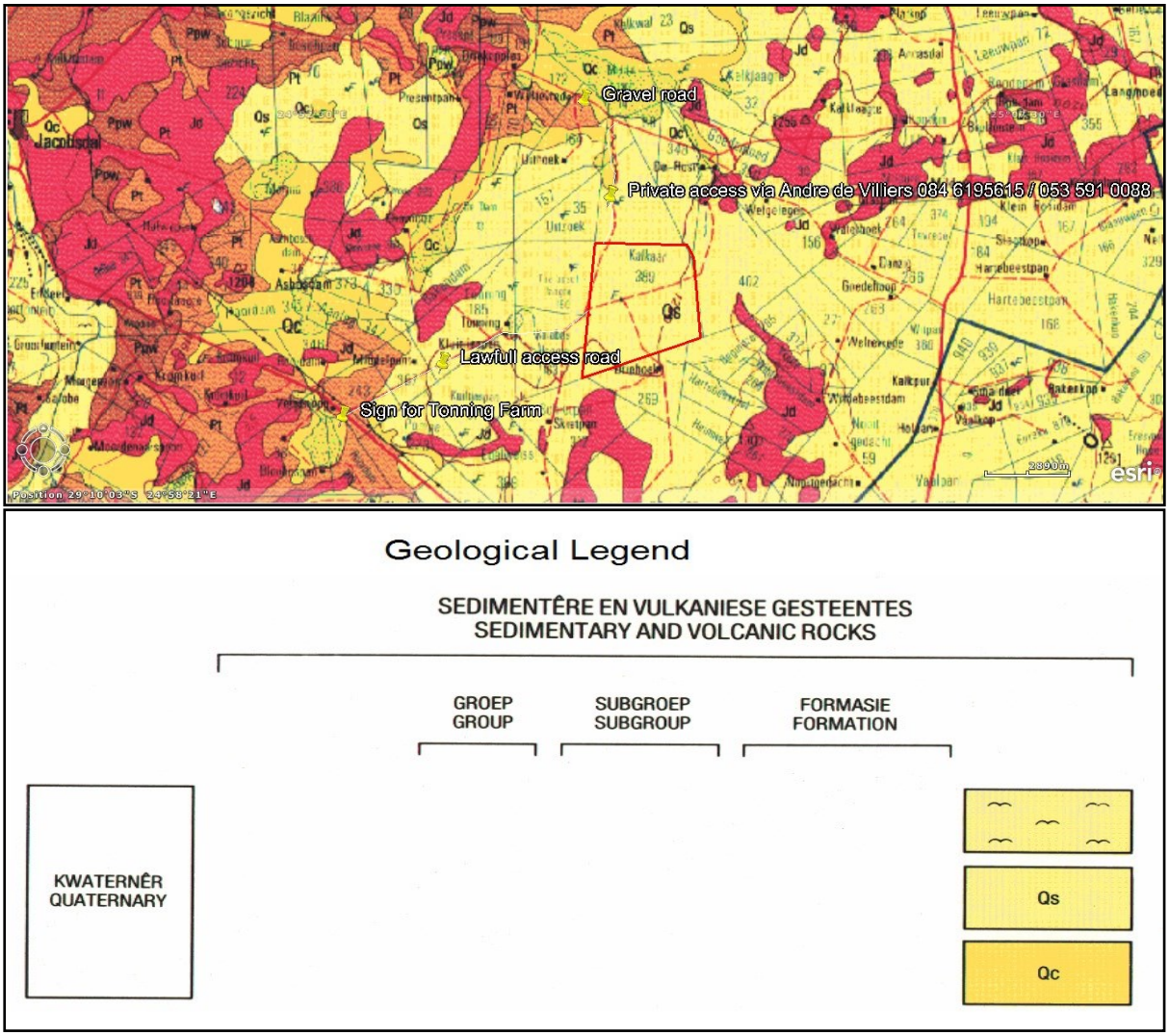

Figure 9 – Geology of the Kalkaar study area

5 FIELDWORK FINDINGS

A systematic walkthrough of the study area was undertaken by a fieldwork team comprising an archaeologist and two experienced field assistants. The field assistants flanked the archaeologist who carried a hand-held GPS, and the track logs are depicted in red on the map provided. Two sites of heritage significance were identified. The sites were named and numbered **KA 001** and **KA 002** respectively and will be discussed below.

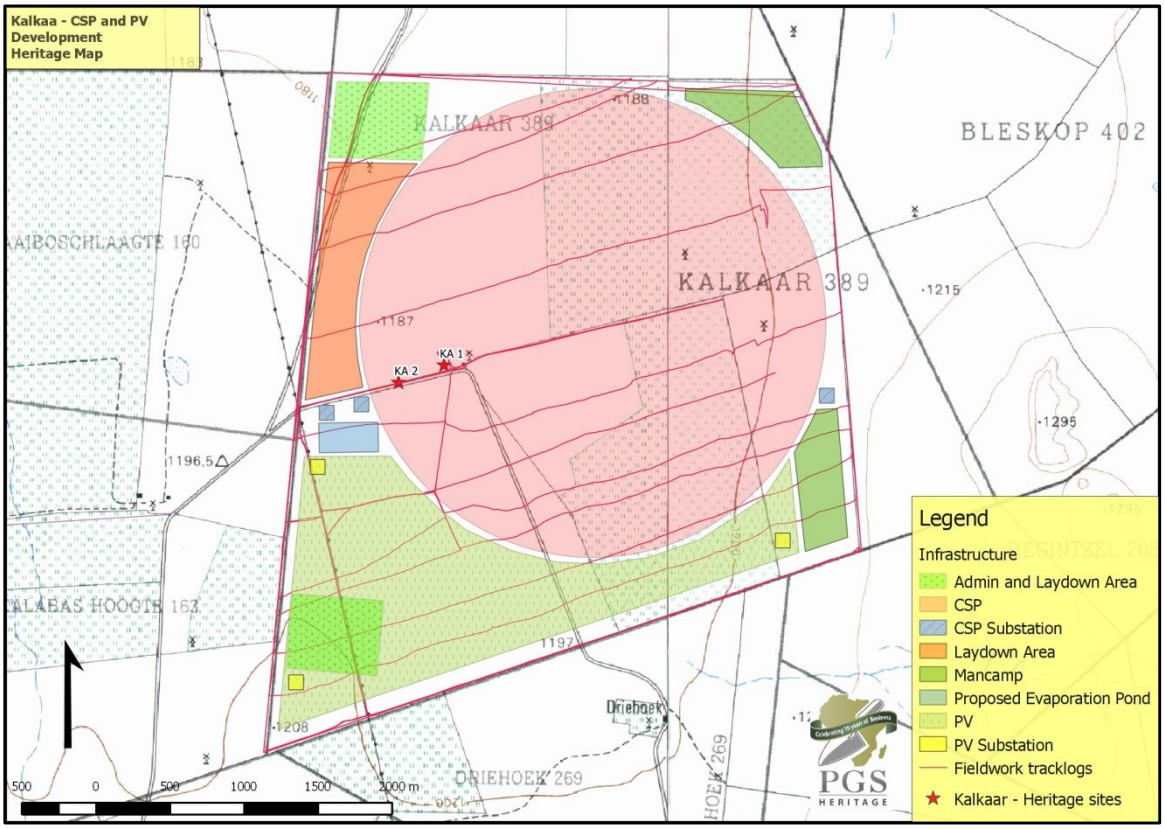

Figure 10 – Development layout map with track log and heritage sites

5.1 Site KA 001:

GPS: 29,18179° S 24,98403° E

A brick-built shed or storeroom was identified at this location (**Figure 11**). The structure had a steel frame which was closed up with bricks. It also had a pitched corrugated roof and metal window frames and metal door frames. The structure measured approximately 16m x 16m in size. The northern extent of the structure (***Figure 13***) was divided into several smaller rooms, which also served as accommodation. The storeroom or shed was situated within a fenced yard which

measured approximately 40m x 40m. A windmill and cement dam (**Figure 12**) was also situated within the fenced yard. The storeroom or shed was most probably not older than 60 years.

Figure 11 - View of the brick-built structure from the east

Figure 14 – Another view of the structure from the north

Figure 12 - View of the cement dam in the yard

The site is graded as Grade 4C with low heritage significance and may be desmolished after consultation with the owner of the property.

Impact Evaluation

IMPACT	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	PROBABILITY	SIGNIFICANCE
Destruction of structures	Low	Low	High	**Medium**	**High**	**Medium**

Mitigation:

- The structure is most probably not older than 60 years and has very little heritage significance and/or value and is also not protected under the Heritage Act (Act 25 of 1999).
- The structure may be destructed after consultation with the owner of the property.

5.2 Site KA 002:

GPS: 29,18284° S 24,98088° E

A low density scatter of lithic tools was identified at this location (± 2-5 artefacts in 10m x10m). The site was situated in and around the access road to the storeroom/shed as described in site KA 001. The tracks of this access road and some of the immediate surrounding areas were exposed by erosion (**Figure 15**). The lithics were mostly identified from within the tracks of the road and from other clearings which were exposed by sheet erosion along the access road (**Figure 17**). The stone tools consisted mostly of Later Stone Age (LSA) blades, scrapers and a few cores and were scattered in a small area which measured approximately 40m in diameter (figure 16). Most of the artefacts were heavily weathered and patinated and some were also damaged due to the traffic along the access road.

Figure 15 - View of the exposed site within the access road

Figure 16 – View of some of the identified stone tools

Figure 17 - View of the exposed areas next to the access road

The site is graded as Grade 4C with low heritage significance.

Impact Evaluation

IMPACT	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	PROBABILITY	SIGNIFICANCE
Impact on archaeological site	Low	Low	High	**Medium**	**High**	**Medium**

Mitigation:

- The site is of low heritage value and significance and the traffic on the access road caused previous disturbance to the site and the associated artefacts.
- No further mitigation measures or actions are required.

5.3 Palaeontological sensitivity

The palaeontological sensitivity of the development is related to the specific geology that underlies the development footprint. The Quaternary aged deposits are known to contain a wide variety of fossil remains and local finds can be rich if associated with calcrete deposits. The windblown nature of the aeolian deposits will, however, make it difficult to identify fossils and it is likely that most of the fossils will only be exposed during the construction phase. Due to the fact that local finds of fossils can be rich, a Moderate Palaeontological Sensitivity has been allocated to the study area (**Figure 18**).

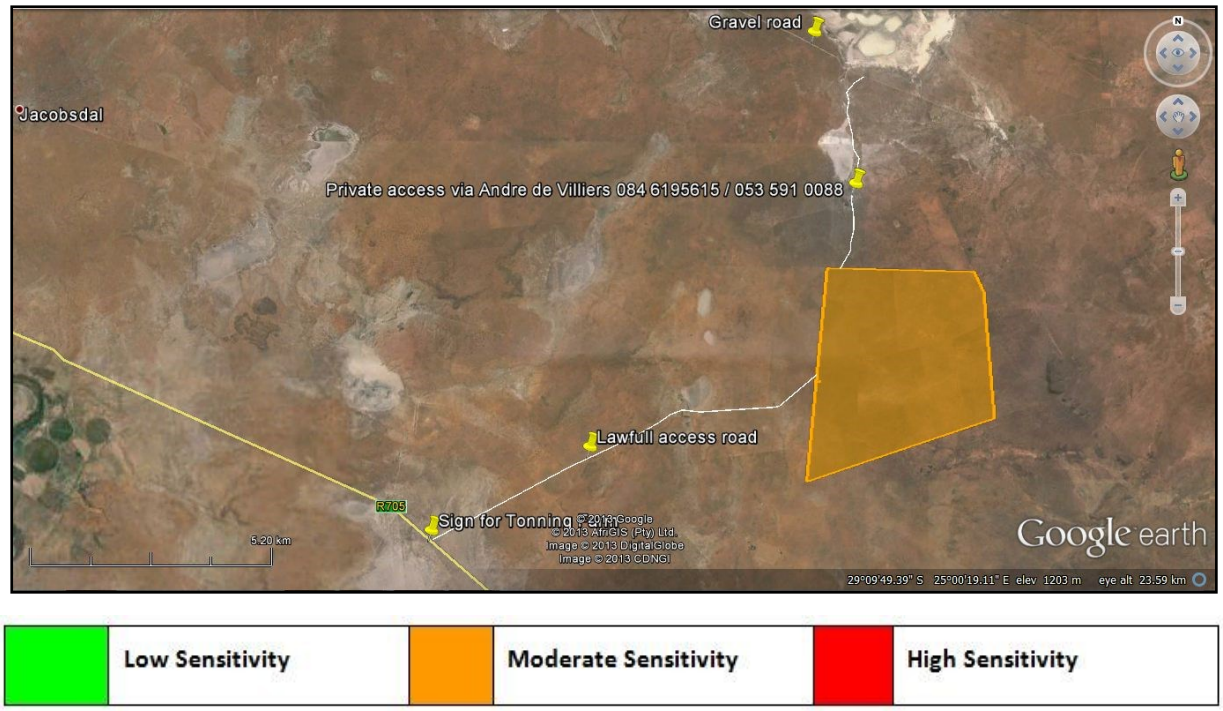

Figure 18 - Palaeontological Sensitivity of the Kalkaar study area

6 IMPACT OF PROPOSED DEVELOPMENT ON HERITAGE RESOURCES

The development of the proposed Concentrated Solar Thermal Power Plant and the Photovoltaic Power Plant will have a negative impact on the identified heritage resources. Two heritage sites were identified within the area proposed for the Concentrated Solar Thermal Power Plant. The identified heritage sites however, have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites.

7 MITIGATION MEASURES AND GENERAL RECOMMENDATIONS

Two heritage sites were identified within the area proposed for the Concentrated Solar Thermal Power Plant. The identified heritage sites however, have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites. The Palaeontological study showed that the occurrence of fossils is possible and that a palaeontologist should be appointed during the construction phase for further investigations. The owners of the storeroom at site **KA 001** should be consulted before destruction commences in order to give them the opportunity to remove personal belongings.

8 CONCLUSIONS

PGS Heritage was appointed by SLR Consulting (Africa) (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Report (EIA) for the proposed development of a Solar Thermal Power Plant and a Photovoltaic Power Plant on Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Letsemeng Local Municipality, Free State Province.

An archival and historical desktop study was undertaken which was used to compile a historical layering of the study area within its regional context. This component indicated that the landscape within which the project area is located has a rich and diverse history. However, the desktop study did not reveal any historic or heritage sites from within the study area.

These desktop studies were followed by a fieldwork component which comprised a walkthrough of the study area. Two heritage sites were identified within the area proposed for the Concentrated Solar Thermal Power Plant. The identified heritage sites however, have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites. The owners of the storeroom at site KA 001 should be consulted before destruction commences in order to give them the opportunity to remove personal belongings.

A Palaeontological study was performed by Dr. G. Groenewald. The Kalkaar study area is underlain by Quaternary aged aeolian deposits. A wide variety of fossil remains have been reported from these deposits (although finds are often localised) and due to the fact that most of the fossils will only be exposed during the construction phase, a Medium Palaeontological Sensitivity is allocated to the study area. The following measures were recommended regarding this project:

- The EAP and ECO of the project must be informed of the probability that fossils might be present in the aeolian sand deposits.
- A qualified palaeontologist must be appointed to do a Phase 1 PIA study to record any fossils that are present in the aeolian sand. Due to the fact that most of the fossils will only be exposed during the construction phase, it is recommended that the phase 1 study must be done during initial soil movement activities and where possible, concurrently with the construction phase.
- If fossils are recorded, the appointed palaeontologist must apply for a collection permit in accordance with SAHRA specifications.

The identified heritage sites have very little heritage value or significance and no further heritage mitigation measures are required regarding these sites. The development of the proposed Kalkaar Solar Thermal Power Plant and the Kalkaar Photovoltaic Power Plant and the associated infrastructure can continue if the recommendations as outlined in this report are adhered to.

9 REFERENCES

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SAHRIS database http://www.sahra.org.za/sahris

South African History Online, http://www.sahistory.org.za.

Appendix A

HERITAGE MANAGEMENT GUIDELINES

1 HERITAGE MANAGEMENT GUIDELINES

1.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

  (i) exceeding 5 000 m^2 in extent; or

  (ii) involving three or more existing erven or subdivisions thereof; or

  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA.SAHRA;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. If a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA) and or the Association of Professional Heritage Practitioners (APHP).

This survey and evaluation must include:

(a) The identification and mapping of all heritage resources in the area affected;

(b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;

(c) An assessment of the impact of the development on such heritage resources;

(d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the **SHEQ training** given to contractors involved in surface earthmoving activities. These sections must include basic information on:

    a) Heritage;
    b) Graves;
    c) Palaeontology;
    d) Archaeological finds; and
    e) Historical Structures.

    This module must be tailor made to include all possible finds that could be expected in that area of construction.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.

5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.

6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.

7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.

8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.

9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.

10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

The purpose of an archaeological/palaeontological monitoring programme[1] is:

- To allow, within the resources available, the preservation by recording of archaeological/palaeontological deposits, the presence and nature of which could not be established (or established with sufficient accuracy) in advance of development or other potentially disruptive works
- To provide an opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological/palaeontological find has been made for which the resources allocated to the watching brief itself are not sufficient to support treatment to a satisfactory and proper standard.
- A monitoring programme is not intended to reduce the requirement for excavation or preservation of known or inferred deposits, and it is intended to guide, not replace, any requirement for contingent excavation or preservation of possible deposits.
- The objective of the monitoring programme is to establish and make available information about the archaeological resource existing on a site.

PGS can be contacted on the way forward in this regard.

Table 5: Roles and responsibilities of archaeological and heritage management

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology support team
If chance finds and/or graves or burial	The client	Archaeologist and a

[1] The definition of an archaeological/palaeontological monitoring programme is a formal program of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, in the inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.

grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.		competent archaeology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into the employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites.	The client	Environmental Consultancy and the Archaeologist
After the specialist/archaeologist has been appointed, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

1.2 All phases of the project

1.2.1 Archaeology

Based on the findings of the HIA, all stakeholders and key personnel should undergo an archaeological induction course during this phase. Induction courses generally form part of the employees' overall training and the archaeological component can easily be integrated into these

training sessions. Two courses should be organised – one aimed more at managers and supervisors, highlighting the value of this exercise and the appropriate communication channels that should be followed after chance finds, and the second targeting the actual workers and getting them to recognize artefacts, features and significant sites. This course should be reinforced by posters reminding operators of the possibility of finding archaeological/palaeontological sites. **This needs to be supervised by a qualified archaeologist.**

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area and small scale infrastructure development associated with the project/operations.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction/operational phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. A responsible archaeologist must be appointed for this commission. This person does not have to be a permanent employee, but needs to attend relevant meetings, for example when changes in design are discussed, and notify SAHRA of these changes. The archaeologist would inspect the site and any development on a recurrent basis, with more frequent visits to the actual workface and operational areas.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Programme (EMPr) of the project. Should an archaeological site or cultural material be discovered during construction (or operation), such as

burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery.

SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist available to do such work.

1.2.2 **Procedure**

In the case where archaeological finds are identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological finds, a buffer of at least 20 meters should be implemented.
- If archaeological finds are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find.
- If the evaluation of the finds require further documentation and mitigation such as excavations, surface collections and/or in situ documentation, a permit must be applied from SAHRA.
- This documentation and mitigation must conform to the guidelines and requirements of SAHRA and international accepted standards and must include as a minimum:
    - *Non-technical summary*

      This should outline in plain, non-technical language the principal reason for the work, its objectives and main results. It should include reference to authorship and commissioning body.

    - *Introductory statements*

      These could include acknowledgements, circumstances of the project such as planning background, the archaeological background, an outline nature of work, the site description (including size, geology and topography, location), when the project was undertaken and by whom.

    - *Aims and objectives*

      These should reflect or reiterate the aims set out in the project design or specification.

- *Methodology*

  The methods used, including the detail of any variation to the agreed project design or specification should be set out carefully, and explained as appropriate. These should be set out as a series of summary statements, organised clearly in relation to the methods used, and describing structural data, associated finds and/or environmental data recovered. Descriptive material should be clearly separated from interpretative statements. Technical terminology (including dating or period references) should be explained where necessary if the report is aimed at a largely non-archaeological audience. The results should be amplified where necessary by the use of drawings and photographs; and by supporting data contained in appendices (below).

- *Conclusions*

  It is appropriate to include a section, which sums up and interprets the results and puts them into context (local, national or otherwise). Other elements should include a confidence rating on techniques used, or on limitations imposed by particular factors (eg weather or problems of access).

- Archive location

  The final destination of the archive (records and finds) should be noted in the report.

- *Appendices*

  These should contain essential technical and supporting detail, including for example lists of artefacts and contexts or details of measurements, gazetteers etc. It may also be appropriate to include the project design or specification for ease of reference.

- *Illustrations*

  Most reports will need the inclusion of one or more illustrations for clarity; as a minimum a location plan should be included. Any plans or sections should be clearly numbered and easily referenced to the National Grid and related to the specified area.

- *References and bibliography*

  A list of all sources used should be appended to the report.

- *Other*

  Contents list, disclaimers.

1.2.3 **Procedure for discovery of human remains / graves**

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 20 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a permit must be applied for from SAHRA and other relevant authorities. The local South African Police Services must immediately be notified of the find.
- Where it is recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation;
iii. Newspaper notices indicating the intent of the relocation;
iv. A permit from the local authority;
v. A permit from the Provincial Department of Health;
vi. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
vii. An exhumation process that keeps the dignity of the remains intact;
viii. The whole process must be done by a reputable company that is well versed in relocations;
ix. The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

Appendix B

PALAEONTOLOGICAL DESKTOP ASSESSMENT

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE DEVELOPMENT OF THE PROPOSED KALKAAR SOLAR THERMAL POWER PLANT AND THE KALKAAR PHOTOVOLTAIC POWER PLANT PROJECT ON PORTION 1 OF THE FARM KALKAAR 389 NEAR JACOBSDAL, FREE STATE PROVIINCE

For:

HIA CONSULTANTS

DATE: 02 December 2013

By

GIDEON GROENEWALD

EXECUTIVE SUMMARY

Gideon Groenewald was appointed by PGS Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed Kalkaar Solar Thermal Power Plant and the Kalkaar Photovoltaic Power Plant Project on Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State Province

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

The proposed development will comprise two separate solar energy power generation projects: a solar thermal-electric power plant in the form of a Concentrated Solar Power (CSP) Plant; and a Photovoltaic (PV) Power Plant.

The Kalkaar study area is underlain by Quaternary aged aeolian deposits. A wide variety of fossil remains have been reported from these deposits (although finds are often localised) and due to the fact that most of the fossils will only be exposed during the construction phase, a Medium Palaeontological Sensitivity is allocated to the study area.

Recommendations:

- The EAP and ECO of the project must be informed of the probability that fossils might be present in the aeolian sand deposits.
- A qualified palaeontologist must be appointed to do a Phase 1 PIA study to record any fossils that are present in the aeolian sand. Due to the fact that most of the fossils will only be exposed during the construction phase, it is recommended that the phase 1 study must be done during initial soil movement activities and where possible, concurrently with the construction phase.

If fossils are recorded, the appointed palaeontologist must apply for a collection permit in accordance with SAHRA specifications.

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1 INTRODUCTION

1.1 Background

Gideon Groenewald was appointed by PGS Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed Kalkaar Solar Thermal Power Plant and the Kalkaar Photovoltaic Power Plant Project on Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State Province

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

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

1.2 Aims and Methodology

Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

In preparing a palaeontological desktop study, the potential fossiliferous rock units (groups, formations, etc) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature and previous palaeontological impact studies in the same region.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.1 below.

Table 1.1 -Palaeontological Sensitivity Analysis Outcome Classification

Sensitivity	Description
Low Sensitivity	Areas where a negligible impact on the fossil heritage is likely. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. A field-based assessment by a professional palaeontologist is usually warranted.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Programme

1.3 Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an 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).

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

The proposed development will comprise two separate solar energy power generation projects:
a solar thermal-electric power plant in the form of a Concentrated Solar Power (CSP) Plant; and
a Photovoltaic (PV) Power Plant.

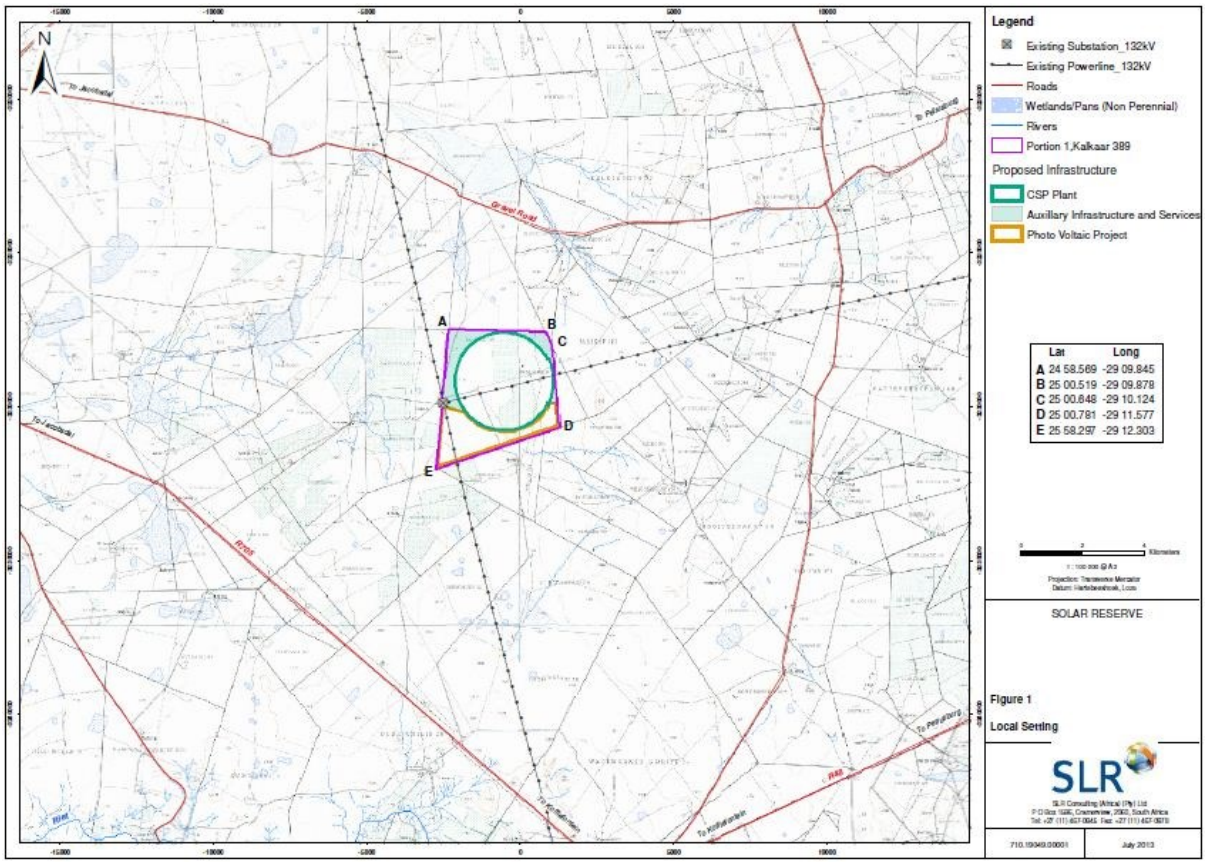


*Figure **Error! No text of specified style in document.**..2 Locality of the development, showing the proposed layout of the CSP and PV facilities*

*Figure **Error! No text of specified style in document.**.1 Google Image showing the locality of the proposed development*

2.1 Concentrated Solar Thermal Power (CSP)

The CSP Plant being considered employs Central Receiver Molten Salt technology which uses molten salt as its heat transfer medium. This technology relies on thousands of large tracking mirrors (heliostats) which track the sun and reflect the beam radiation to a common focal point (central receiver) at the top of a tower. The tower is positioned off-centre (northern alignment) in the heliostat field. The central receiver acts as a heat exchanger which absorbs the concentrated beam radiation, heating a molten salt solution which is in turn used to generate steam for conventional power generation. An installed capacity of up to 200 MW is proposed, which will require approximately 800ha of a relatively flat surface area to be developed. A brief description of the infrastructure to be used at the plant is given below:

2.2 Heliostat Field

A heliostat is a mirror mounted on a pedestal by which the sun is steadily reflected onto one spot – the receiver. Heliostats are arranged in a circular formation around the central receiver which is slightly offset to the north of the field. It is estimated that approximately 14 000 to 17 500 heliostats at roughly 75 m2 each will be required. The heliostat field has a diameter of 2.7 km.

2.3 Molten Salt and Central Receiver

A salt mixture is used as the heat transfer medium for the technology proposed. The “cold” salt is circulated through the tower (approximately 300 °C) to the central receiver where it is heated to approximately 580 °C for power generation purposes. The technology allows for the storage of heat via the molten salt storage tanks. Through thermal storage of the heated molten salt, the CSP system has the ability to generate power over a 24hour period or in overcast scenarios.

2.4 Power Generation process

Power is generated through a conventional “Rankine-cycle” (steam turbine process) and is very similar to the operations of a standard coal-fired power plant, except for the fact that it is fuelled by clean, renewable and free solar energy.

2.5 Auxiliary facilities

Auxiliary facilities and infrastructure include the electricity transmission lines, a grid connection, access routes, water supply and treatment facilities, waste management facilities, facility start-up (gas or diesel) generators, administration and staff facilities, man-camp, stores, fire water, storm water management infrastructure, substation and other supportive services and infrastructure, as well as related construction facilities and laydown areas.

2.6 Photovoltaic Power Plant

The proposed PV Power Plant component involves direct conversion of solar energy into direct current (DC) electrical power from semiconductors within solar cells (PV elements) when they are illuminated by sunlight (photons). The proposed PV Power Plant will have a generation capacity of up to 100 MW and requires approximately 280 ha of surface area. Power is generated as long as the PV elements are exposed to sunlight. The main components of a utility scale PV power plant include:

- Photovoltaic element arrays and support structures;
- Power inverters to convert Direct Current (DC) power to Alternating Current (AC) power;
- Electrical substation to accommodate step-up transformers and switch gear connecting the plant to the electricity grid for each PV development;
- Transmission lines to tie in to the closest transmission network;
- Control and monitoring systems; and
- Additional support services and infrastructure such as access roads, water supply and treatment facilities and staff facilities.

3 GEOLOGY

3.1 Aeolian sand (Qs):

The study area is underlain by Quaternary aged Aeolian sand deposits

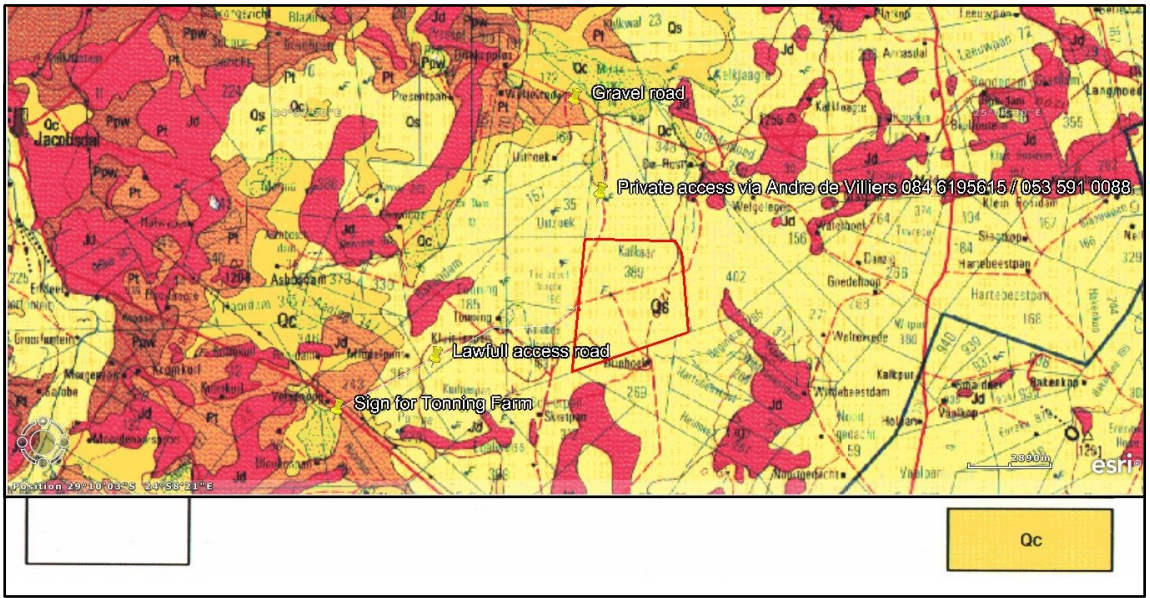


*Figure **Error! No text of specified style in document.**.19 Geology of the study area*

4 PALAEONTOLOGY OF THE AREA

The Quaternary deposits of this area might contain a very wide range of possible fossil remains, though these are often sparse, including mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms and other microfossil groups. Plant fossils including fossilized wood and pollen grains have also been recorded in the Quaternary deposits. Fossils are generally very difficult to recognize in the Aeolian deposits and fossils are normally associated with localized concentrations of material associated with calcrete beds close to water ways.

5 PALAEONTOLOGICAL SENSITIVITY

The palaeontological sensitivity of the development is related to the specific geology that underlies the development footprint. The Quaternary aged deposits are known to contain a wide variety of fossil remains and local finds can be rich if associated with calcrete deposits. The windblown nature of the aeolian deposits will, however, make it difficult to identify fossils and it is likely that most of the fossils will only be exposed during the construction phase. Due to the fact that local finds of fossils can be rich, a Moderate Palaeontological Sensitivity has been allocated to the study area (Figure 5.1).

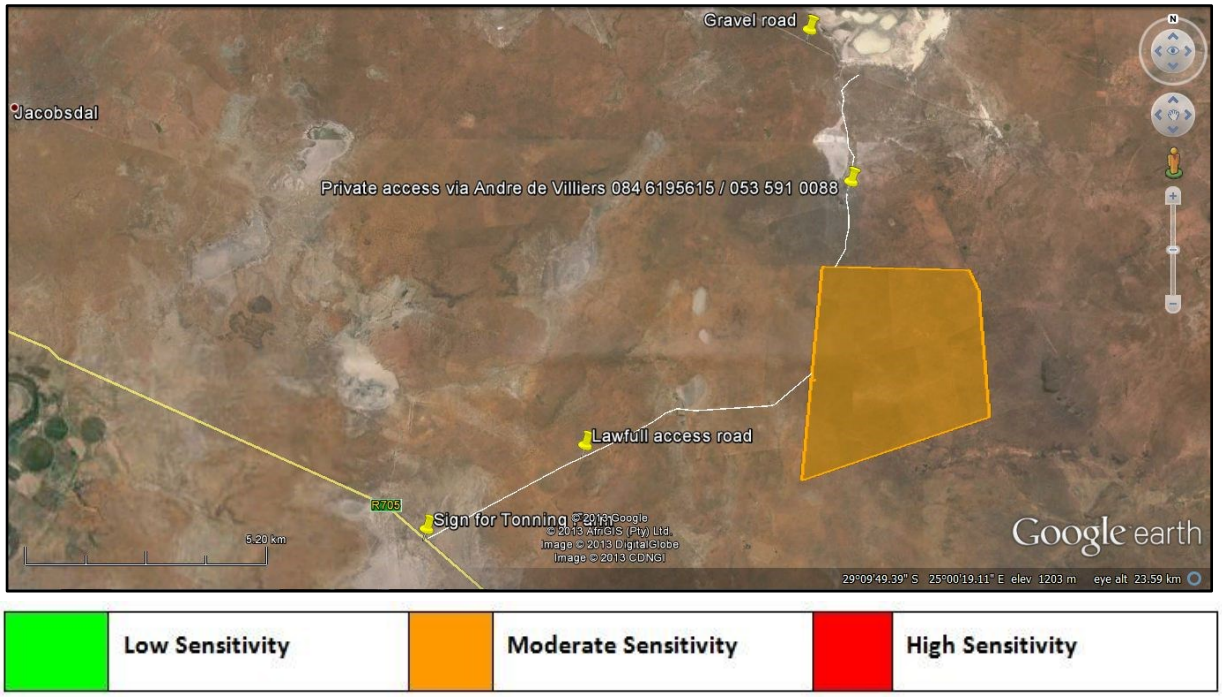


*Figure **Error! No text of specified style in document.**.20 Palaeontological Sensitivity of the Kalkaar study area*

6 CONCLUSION AND RECOMMENDATIONS

The Kalkaar study area is underlain by Quaternary aged aeolian deposits. A wide variety of fossil remains have been reported from these deposits (although finds are often localised) and due to the fact that most of the fossils will only be exposed during the construction phase, a Medium Palaeontological Sensitivity is allocated to the study area.

Recommendations:

- The EAP and ECO of the project must be informed of the probability that fossils might be present in the aeolian sand deposits.

- A qualified palaeontologist must be appointed to do a Phase 1 PIA study to record any fossils that are present in the aeolian sand. Due to the fact that most of the fossils will only be exposed during the construction phase, it is recommended that the phase 1 study must be done during initial soil movement activities and where possible, concurrently with the construction phase.
- If fossils are recorded, the appointed palaeontologist must apply for a collection permit in accordance with SAHRA specifications.

7 REFERENCES

Johnson MR, Anhausser CR and Thomas RJ. 2009. The Geology of South Africa. Geological Society of South Africa.

8 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

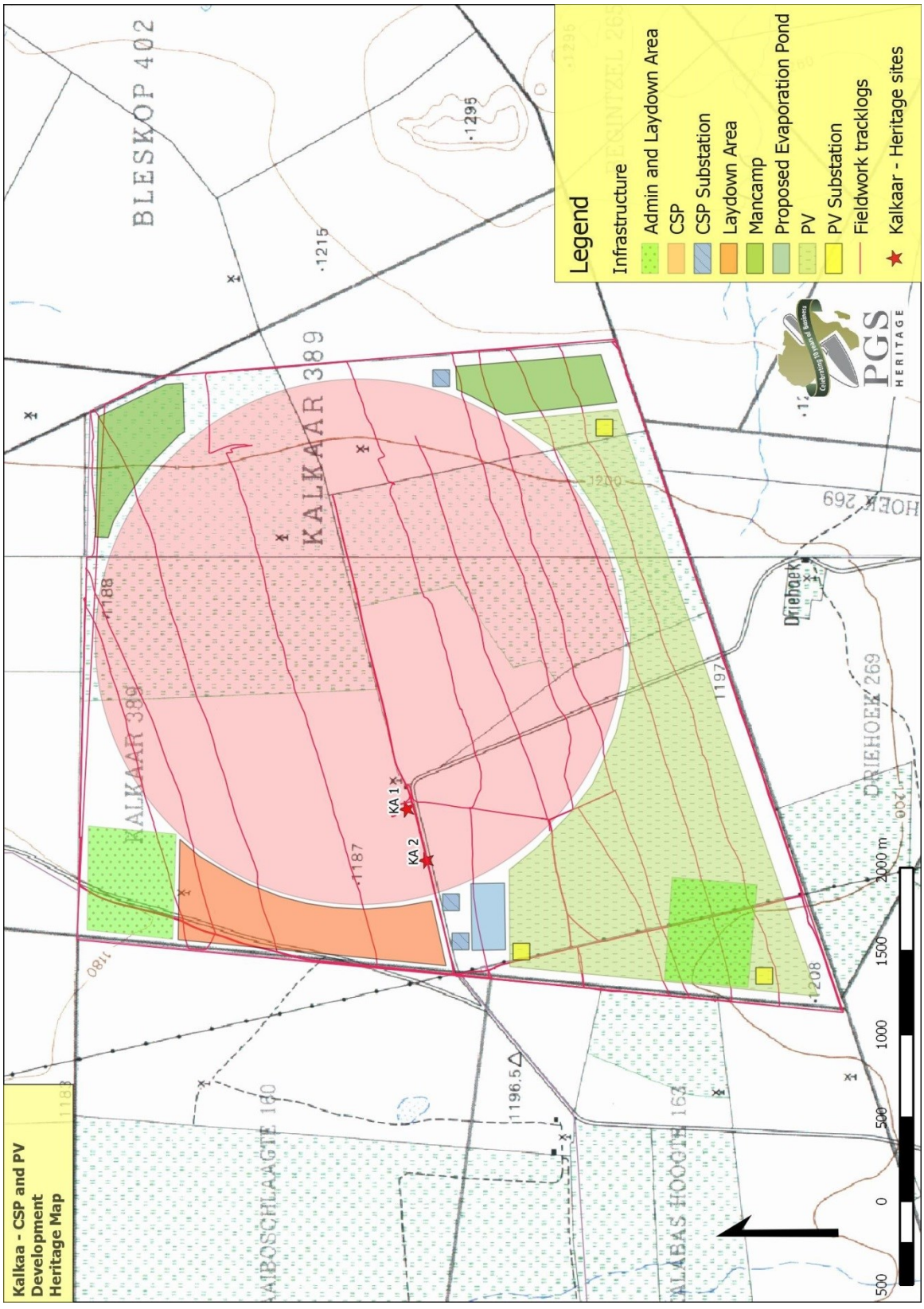
9 DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist

Appendix C

HERITAGE MAP WITH SURVEY TRACK LOG


Kalkaa - CSP and PV
Development
Heritage Map
Legend
Infrastructure
Admin and Laydown Area
CSP
CSP Substation
Laydown Area
Mancamp
Proposed Evaporation Pond
PV
PV Substation
Fieldwork tracklogs
Kalkaar - Heritage sites
BLESKOP 402
KALKAAR 389
DRIEHOEK 269
KA 1
KA 2
1187
1197
1208
1196.5
0
500
1000
1500
2000 m
PGS
HERITAGE

5 September 2014

SLR Africa (Block 7)

Fourways Manor Office Park

Cnr Roos and Macbeth Streets

Fourways,

Johannesburg,

2060

Attention: Nicholas Arnott

CUMULATIVE IMPACT ON HERITAGE RESOURCES: PROPOSED KALKAAR SOLAR THERMAL POWER PLANT AND KALKAAR PHOTOVOLTAIC POWER PLANT ON PORTION 1 OF THE FARM KALKAAR 389 NEAR JACOBSDAL IN THE LETSEMENG LOCAL MUNICIPALITY, FREE STATE PROVINCE

This letter aims to address the assessment of the possible cumulative impact of the Kalkaar PV project.

Cumulative impacts are important as the impact from a single development may not be significant on its own, but when combined with other impacts from similar developments could become significant. Cumulative impact is likely to occur where permission has already been granted in adjacent locations. The potential for cumulative impact of solar PV sites arising from consents given in any one area should therefore be avoided.[1]

1. LOCALITY

The Kalkaar project is situated some 22 kilometres to the south east of Jacobsdal in the Free State Province.

2. FINDINGS OF HERITAGE STUDY

The Heritage Impact Assessment (HIA) completed in November 2103 and Updated in August 2014, indicated that no major heritage impact is foreseen and that the only resources that could be impacted on was the possible palaeontology of the area.

[1] North Somerset Council. 2013. *Renewable and Low Carbon Energy generation in North Somerset: Solar Photovoltaic (PV) Arrays.*

Recommendations included:

- The EAP and ECO of the project must be informed of the probability that fossils might be present in the aeolian sand deposits.
- A qualified palaeontologist must be appointed to do a Phase 1 PIA study to record any fossils that are present in the aeolian sand. Due to the fact that most of the fossils will only be exposed during the construction phase, it is recommended that the phase 1 study must be done during initial soil movement activities and where possible, concurrently with the construction phase.
- If fossils are recorded, the appointed palaeontologist must apply for a collection permit in accordance with SAHRA specifications.

3. CUMULATIVE ASSESSMENT

Subsequent to this report the client requested that the cumulative impacts posed by the proposed project are evaluated as the region has been subjected to numerous solar project applications (**Figure 1**)as part of the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

The closest solar developments to the Klakaar Project (KP) is listed as the Ruinte (75MW PV)(12km south east of the KP) and the Lulida Solar Park (75MW PV)(18km north west of KP) (**Figure 1**).

Most heritage resources are point specific and in general impacts are found to be localised and impacting on the specific resource in a development. As such the cumulative impact on archaeological and historical heritage resources area deemed to be low.

1.1. Palaeontology

Although palaeontological heritage resources are in most cases incidental finds, the geology of the region is rated as medium to highly sensitive. This rating does however not exclude development but requires further mitigation steps to be taken during construction. The projects in the region will add to the possible exposure of palaeontological finds, and subsequently aid in further palaeontological research in the area. A medium positive cumulative impact is anticipated on palaeontological resources if the recommended mitigation measures are implemented (**Table 1**).

Table 1 - Impact Rating Table - Palaeontology

IMPACT	SEVERITY	SPATIAL SCALE	DURATION	CONSEQUENCE	PROBABILITY	SIGNIFICANCE
Impact on regional palaeontology	Moderate	High	Medium	**Medium**	**Medium**	**Medium**

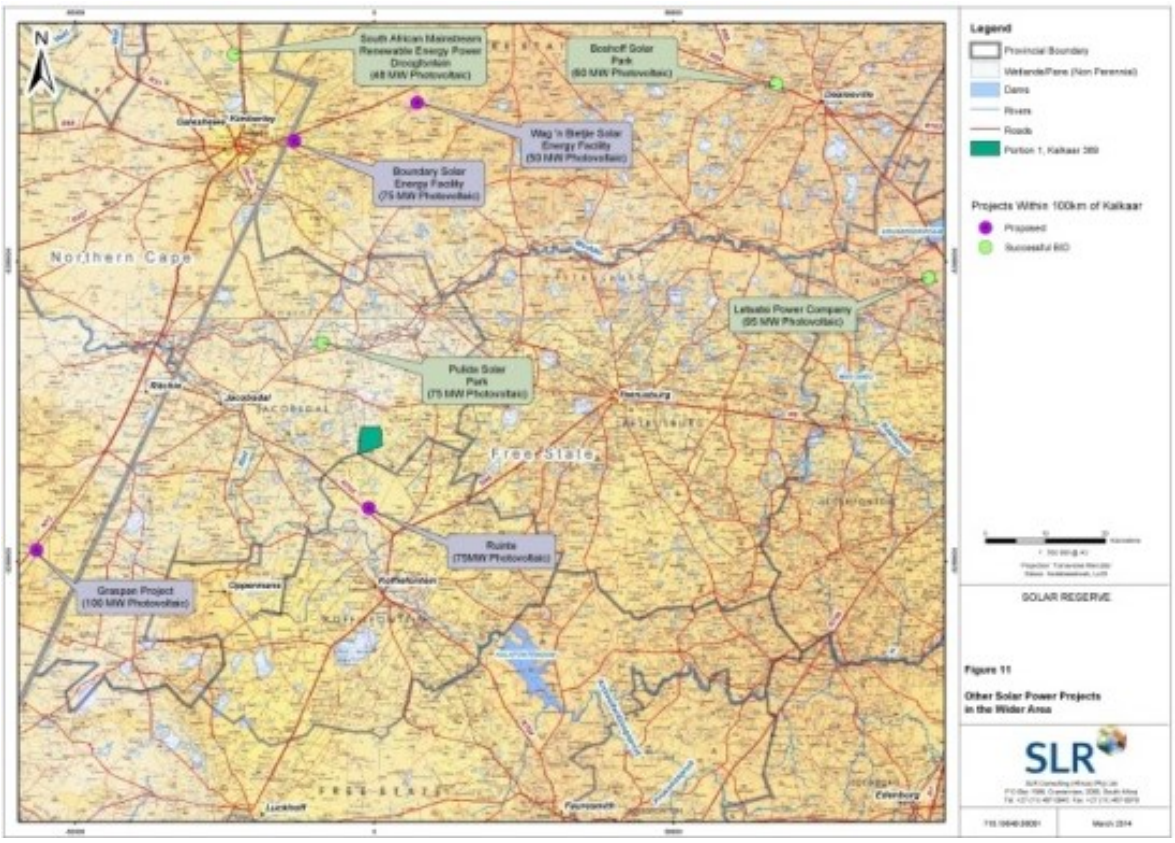


Figure 1 – Locality of the Klakaar project in relation to other proposed Solar projects

1.2. Cultural Landscape

The character of PV arrays lends itself to a general low impact on the cultural landscape with the implementation of screening mitigation measures. The overall impact on the landscape is also much lower than that of wind turbine with wind energy generation.

The closest PV developments are more than 10 kilometres away from the KP and thus no cumulative impact on the cultural landscape is foreseen at this stage.

Please contact me on 086 111 4771 or wouter@gravesolutions.co.za if you require any further information.

Warm regards

Wouter Fourie

Accredited Professional Heritage Practitioner (APHP), Accredited Professional Archaeologist (ASAPA)

Director

PGS Heritage