Report to SiVEST SA (PTY) LTD

Desktop Geotechnical Specialist Study for the:

PROPOSED BONSMARA SOLAR PHOTOVOLTAIC (PV) FACILITY FREE STATE PROVINCE, SOUTH AFRICA

DEA Reference:	
Report Prepared by:	GaGE Consulting (Pty) Ltd
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GaGE CONSULTING

Report to:	SiVEST Environmental Division 51 Wessel Road, Rivonia, 2129
Project name:	Proposed Bonsmara Solar Photovoltaic (PV) Facility
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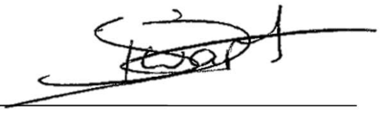 Duan Swart *MSc (Eng Geology) MSAIEG Pr.Sci.Nat*	 Steven Bok *BSc Hons (Geology) Pr.Sci.Nat*

PROPOSED BONSMARA SOLAR PHOTOVOLTAIC (PV) AND BASIC ASSESSMENT (BA) FOR ASSOCIATED GRID CONNECTION INFRASTRUCTURE, NEAR KROONSTAAD, FREE STATE PROVINCE, SOUTH AFRICA
DESKTOP GEOTECHNICAL SPECIALIST STUDY

Executive Summary

This desktop geotechnical specialist study was undertaken for the development of the 100MW Bonsmara Solar Energy Facility (SEF) and BA Process for the associated grid connection infrastructure near Kroonstad in Free State Province. The assessment area is underlain by rock units of Beaufort Group of Karoo Supergroup and Klipriviersberg Group. Some geotechnical constraints have been identified, primarily shallow bedrock which may cause excavation difficulties, and localised steep slopes. These constraints may be mitigated via standard engineering design and construction measures.

The topography over the assessment area is generally flat and undulating terrain sloping between 2° to 4°. Minor potions of the site have slope angles up to 10° adjacent to small ridges. The site is underlain by alternating sandstone, mudstone and siltstone of Adelaide Subgroup, Beaufort Group, Karoo Supergroup. A portion of the eastern section of the site is underlain by porphyritic lava, amygdale-free and amygdaloidal lava of the Klipriviersberg Group forming part of the Ventersdorp Supergroup. Some geotechnical constraints have been identified, primarily shallow and outcropping bedrock which may cause excavation difficulties, localised steep slopes and existing borrow pit areas. These constraints may be mitigated via standard engineering design and construction measures

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective. No geologically or geotechnically sensitive areas were identified within or near the assessment area. It is recommended however that areas of steeper slope gradients are avoided when determining the final infrastructure layout.

The proposed developments are assessed to have a "Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation" provided that the recommended mitigation measures are implemented. The remaining mitigation measures provided to minimise the impacts relate to the appropriate engineering design of earthworks and site drainage, erosion control and topsoil and spoil material management. These do not exceed civil engineering and construction best practice. It is recommended that the proposed activity be authorised.

Further intrusive geotechnical investigations should be undertaken to confirm the engineering recommendations provided in this report.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 1.3 Appendix B
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
c) an indication of the scope of, and the purpose for which, the report was prepared;	1.1, 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	1.4, References
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	5, 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Not applicable
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	1.4, Appendix C
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	3, 6, 7
g) an identification of any areas to be avoided, including buffers;	None identified
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	No sensitivities identified
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	5,6,7
k) any mitigation measures for inclusion in the EMPr;	6.1 Appendix D
l) any conditions for inclusion in the environmental authorisation;	6.1 Appendix D
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6.1 Appendix D
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	6.1, 8 6.1 Appendix D
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q) any other information requested by the competent authority.	None
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

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Figures

Tables

1. Introduction

GaGE Consulting (Pty) Ltd was appointed by SiVEST Environmental (PTY) Ltd (hereafter referred to as “SiVEST”) to undertake a desktop study for the proposed Bonsmara Solar Energy Facility and associated grid connection infrastructure near Kroonstad in the Free State Province, South Africa.

WKN has appointed SiVEST to undertake the required Environmental Impact Assessment (EIA) process for the SEF and Basic Assessment (BA) process for the grid connection infrastructure.

The proposed SEF will be subject to a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) and EIA Regulations, 2014 (as amended). Accordingly, the EIA process as contemplated in terms of the EIA Regulations (2014, as amended) are being undertaken in respect of the proposed SEF project. The competent authority for this EIA is the national Department of Forestry, Fisheries and the Environment (DFFE).

Grid connection infrastructure for the SEF will be subject to a separate Basic Assessment (BA) Process as contemplated in terms of regulation 19 and 20 of the Environmental Impact Assessment Regulations, 2014, which is being undertaken in parallel to the EIA process.

1.1. Scope and Objectives

Assess the impacts associated with the installation of the 100 MW Bonsmara Solar PV Facility and the associated grid infrastructure (Bonsmara Grid Connection Infrastructure up to 132kV).

The following key considerations were taken into account during the desktop study:

- The geological and geotechnical conditions (ground conditions) and the influence thereof on the competency of founding of civil infrastructure and structures,
- Site topography and influence thereof on the site stability and suitability,
- The presence of geological or geomorphological features such as faults, lineaments and unstable ground,
- The presence of problem soils, geotechnical constraints, shallow groundwater conditions, and
- Geologically significant or sensitive features such as ridges, outcrops and exposures.

1.2. Terms of Reference

The terms of reference were provided by SiVEST to allow a consistent approach to the various specialist studies that are required as part of the Environmental Impact Assessment (EIA) and Basic Assessment (BA) processes being conducted in respect of the Solar Energy Facility (SEF) and associated grid connection infrastructure. This will enable comparison of environmental impacts, efficient review and collation of the specialist studies into the EIA / BA reports, in accordance with the latest requirements of the EIA Regulations, 2014 (as amended).

A detailed description of the infrastructure required for the project including layouts of the proposed development were not provided by SiVEST.

1.3. Specialist Credentials

This study has been undertaken by Duan Swart, a Professional Natural Scientist registered by the South African National Council for Natural Scientific Professions (SACNASP) registration number 137549 (Geological Science). The report was reviewed by Steven Bok, a Professional Natural Scientist registered by the SACNASP registration number 400279/07 (Geological Science). Mr Swarts CV is attached in Appendix B.

1.4. Assessment Methodology

The assessment involved a review of the following information:

i) 1:250 000 Scale Geological Map 3222 Kroonstad (Council for Geoscience,1986)
ii) Aerial photographs (Google Earth imagery, current and historical)
iii) Screening Report for Environmental Authorisation (national web based environmental screening tool)
iv) Literature as referenced within this report

An Environmental Impact Assessment matrix was used to quantify the impacts of the project on the receiving environment (provided by SiVEST and attached as Appendix C).

2. Assumptions and Limitations

The services performed by GaGE Consulting (Pty) Ltd were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practising under similar conditions in the locality of the project. The interpretation of the site conditions is based on available information, experience in the general project area and professional judgement and is considered to provide sufficient confidence to meet the objectives of this specialist study. The nature of geotechnical engineering is such that conditions at variance with those described may be encountered on site. Engineering recommendations provided in this report are preliminary and must be confirmed through further intrusive investigations.

Third party information has been utilised in good faith.

A site visit was not undertaken.

3. Technical Description

3.1. Project Location

The proposed Bonsmara Solar PV Facility and associated grid connection is located approximately 12 km south-east from the town of Kroonstad, in Free State Province. The facility will be located on Portion 0 of Farm 636 and portion 1 of Farm 636 located in the Moqhaka Local Municipality within Fezile Dabi District Municipality. The general location is shown in Figure 3-1.

The facility will compromise of several arrays of PV panels and associated infrastructure that includes BESS and will have a contracted capacity of 100MW. The Solar PV facility will connect to the grid via a 2km 132kv powerline from the on-site substation to the Kroonstad Switching Station.

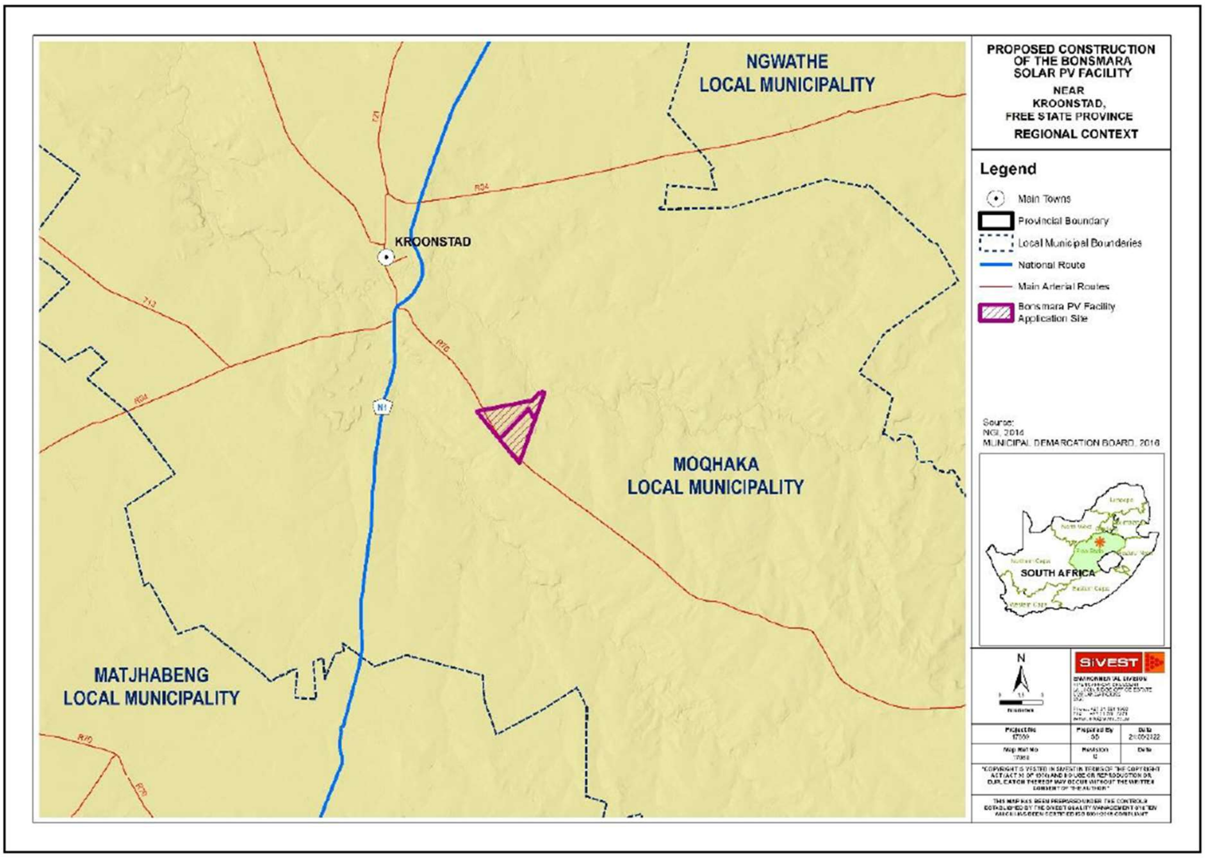


Figure 3-1 Location of the proposed Bonsmara Solar PV Facility

3.1.1. Grid Connection

A 132kv powerline shall connect the project from the onsite substation to Kroonstad 132kV Switching Station. The powerline is approximately 2km in length and a 300m corridor is to be assessed (150m on either side), as shown in Figure 3-2.

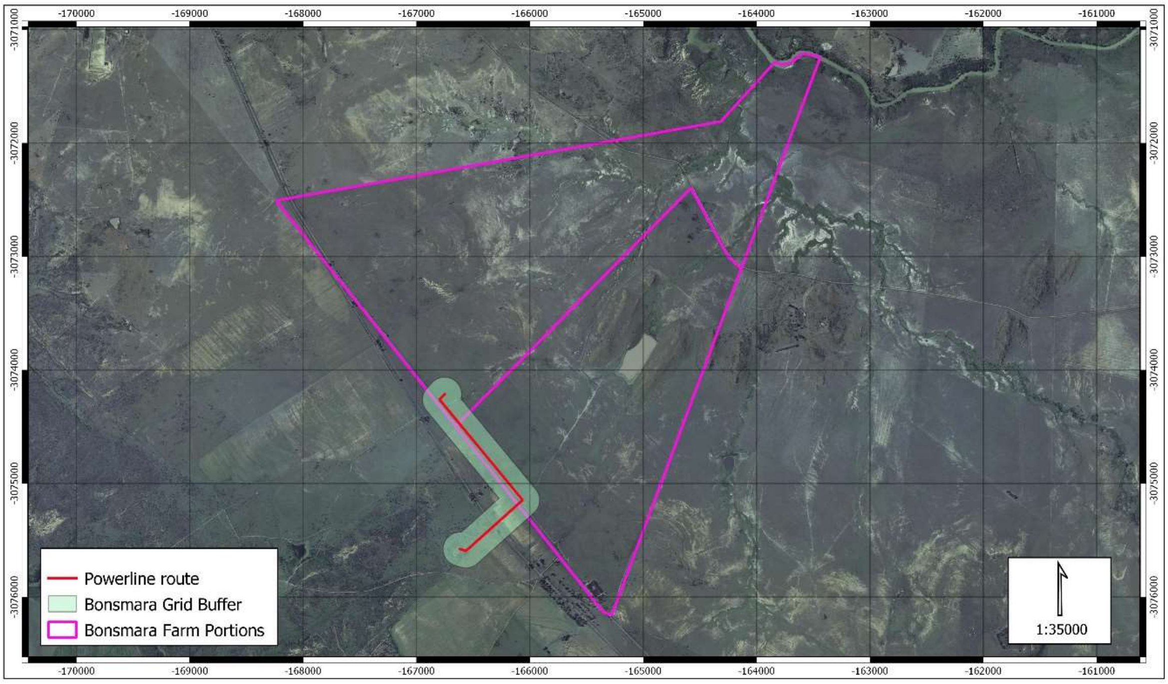


Figure 3-2 Location of the grid infrastructure

3.2. Project Description

It is anticipated that the proposed Solar PV Energy Facility (SEF) will comprise of generating capacity of up to 100MW. The Solar facility will cover an area of approximately 720Ha. The 132 kV overhead power line will however require a separate EA and is subject to a BA process, which is currently being undertaken in parallel to this EIA process.

3.2.1. Solar Farm Components

The Solar Farm will comprise of the following components:

- PV modules and mounting structures (monoracial or bifacial) with fixed, single or double axis tracking mounting structures.
- Associated stormwater management infrastructure.
- Battery Energy Storage System (BESS);
- Site and internal access roads (up to 6 m wide);
- Auxiliary buildings (offices, parking, etc.);
- Ablution facilities and associated infrastructure.
- Temporary laydown area during the construction phase for the construction camp and laydown area (which will be a permanent laydown area for the BESS during the operational phase);
- Infrastructure including offices, operational control centre, operation and maintenance area, ablution facilities etc.
- On-site 33 kV/132kV on-site substation (facility substation);
- Grid connection infrastructure including medium-voltage cabling between the project components and the facility substation (underground cabling will be used where practical (up to 33kV);
- Perimeter fencing; and,
- Rainwater and/or groundwater storage tanks and associated water transfer infrastructure.

3.2.2. Grid Connection Components

The proposed grid connection infrastructure to serve the Bonsmara SEF will include the following components:

- One (1) new 132 kV overhead power line connecting the on-site substation to Kroonstad 132kV Switching Station. The powerline is approximately 2km in length and a 300m corridor is to be assessed (150m on either side).

3.3. Alternatives

3.3.1. Location Alternatives

No other location alternatives are being considered. The site has been confirmed to have sufficient capacity to evacuate the generation and the land has been confirmed as available from the private landowners.

3.3.2. Technology Alternatives

No other activity alternatives are being considered. CSP technology would not be suitable for this site because it requires a flat surface, has a high visual impact and requires large volumes of water. In addition, CSP has not been catered for in the IRP2019. The climatic conditions show that the wind resource in the area is not suitable for a wind energy facility.

3.3.3. SEF Layout Alternatives

Design and layout alternatives will be considered and assessed as part of the EIA taking into consideration the environmental constraints identified by the various specialists, and the layout amended were necessary. In terms of the BESS, laydown areas and substations etc., these are all optimally located in the south-east corner of the site, closest to the grid connection point and access roads. The powerline takes the shortest route to the grid connection point and a portion of it follows an existing 132kV powerline.

3.3.4. No-Go Alternative

The 'no-go' alternative is the option of not undertaking the proposed project. Hence, if the 'no-go' option is implemented, there would be no development, and thus no associated environmental impacts on the site or the surrounding area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

The 'no-go' option is a feasible option; however, this would prevent the proposed development from contributing to the environmental, social and economic benefits associated with the development of the renewable energy sector.

4. Legal Requirement and Guidelines

The desktop study was undertaken according to the guidelines provided by The South African Institution of Civil Engineering Site Investigation (SAICE) Code of Practice published by The Geotechnical Division of SAICE, 2010.

This report has been prepared to meet the requirements for a specialist report as provided in Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6.

5. Description of the Receiving Environment

The following description of the receiving environment is relevant to assessing the geological and geotechnical impacts.

5.1. Climate

The area surrounding Kroonstad is considered to be a local steppe climate. There is little rainfall throughout the year. The area is considered to be a cold, semi-arid, climate (BSk) according to the Köppen-Geiger climate classification. The average annual rainfall is 615 mm with the average temperatures of 17.4°C.

Climate plays a fundamental role in rock weathering and soil development. The effect of climate on the weathering processes (i.e. soil formation) in a particular area can be determined from the climatic N-value, defined by Weinert (1980). A climatic N-Value of 5 or less implies a water surplus and the dominant mode of weathering is chemical decomposition. These climatic conditions are favourable for the development of a deep residual soil profile. Where the climatic N-value is greater than 5, mechanical disintegration is the predominant mode of rock weathering. In these drier areas residual soils are typically shallow. Climatic N-values of greater than 10 imply an arid climate with a limited or absent residual soil profile.

Weinert's climatic N-value for the site was determined to be 4, which indicates a water surplus climate condition. Therefore, rock and soil are expected to predominantly undergo chemical weathering and the presence of residual soils can be expected.

5.2. Topography and Drainage

The site topography is gently undulating and sloping between 2° to 4° towards the northeast. Minor potions of the site have slope angles up to 10° adjacent to small ridges. The site exists between the elevations of 1435 m to 1350 m above mean sea level (AMSL). The undulations have caused surface water to congregate into the lower-lying valleys and formed erosion gullies and rills which occur throughout most of the site. The site drainage is expected to occur as sheetwash into the rills and gullies, becoming concentrated flow into the Vals River to the northeast of the site.

There are two ridge lines and a small dam present within the site area. The site topography is shown in Figure 5-1.

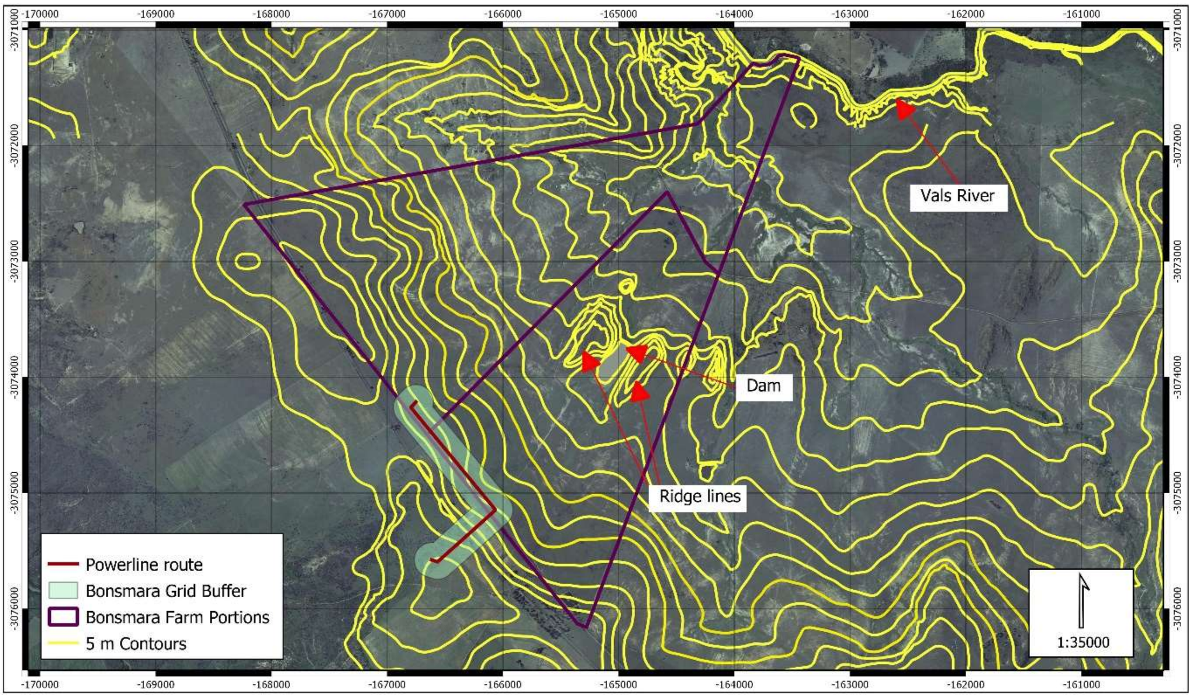


Figure 5-1 Site topography

5.3. Seismicity

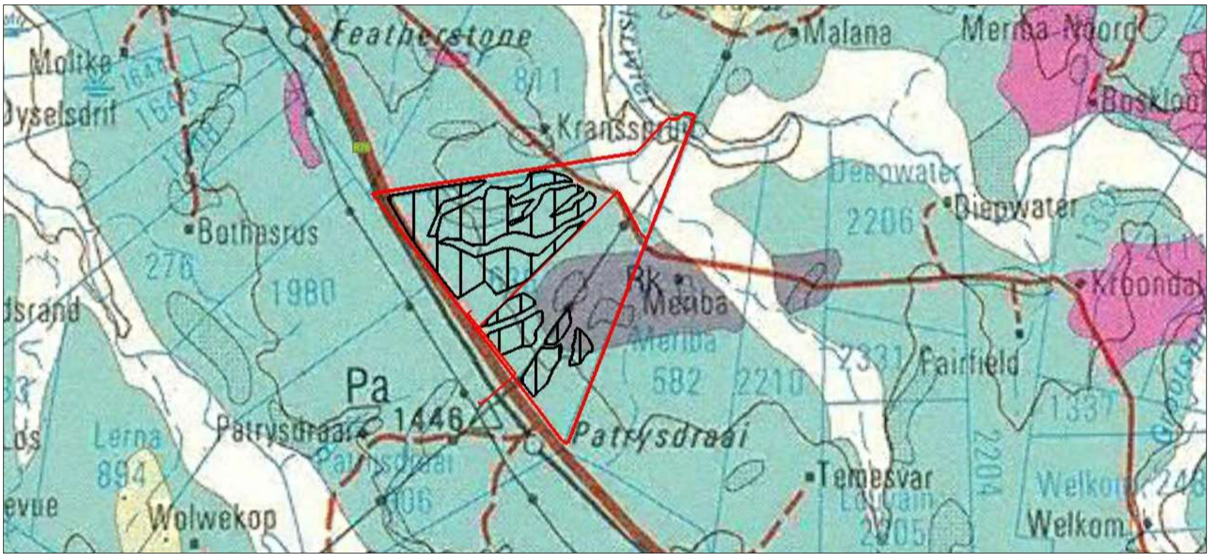
According to the Seismic Hazard Map of South Africa (SANS 10160-4, 2017), the peak ground acceleration is approximately 0.2 g for the site. The peak ground acceleration may be described as the maximum acceleration of the ground shaking during an earthquake, which has a 10% probability of being exceeded in a 50-year period.

The site is within seismic hazard Zone II as per SANS 10160-4 (2017) – regions of mine-induced and natural seismic activity.

5.4. Bedrock Geology

According to the 1:250 000 2726 Kroonstad geological sheet, the proposed assessments is underlain by alternating sandstone, mudstone and siltstone of Adelaide Subgroup, Beaufort Group, Karoo Supergroup. A portion of the eastern section of the site is underlain by porphyritic lava, amygdale-free and amygdaloidal lava of the Klipriviersberg Group forming part of the Ventersdorp Supergroup. The most northern portion of the Farm areas is underlain by thick, unconsolidated, alluvium material, though this falls outside the solar PV area.

The regional geology of the site is illustrated in Figure 5-2.



Symbol	Age	Sedimentary and Volcanic Rocks			Intrusive Rocks	Geological Unit Type
		Supergroup	Group	Formation		
	Quaternary	N/A				Alluvium
Jd	Jurassic	-	-	-	Dykes / Sills	Dolerite
Pa	Permian	Karoo	Beaufort	Adelaide	-	Sandstone, mudstone, siltstone
Rk	Randian	Ventersdorp	Klipriversberg	-	-	Porphyritic lava

Figure 5-2 The regional geology of the site

5.5. Engineering Geology

The layered, and alternating generally hard to soft rock, nature of the bedrock in the Adelaide Formation may result in complex and variable geotechnical conditions, even beneath individual foundation footprints. It is possible for less competent mudstone and siltstone to be encountered below more competent sandstone layers and for zones of preferential weathering to occur within un-weathered surrounding rock. The geological layers in the Adelaide Formation are generally horizontal.

Based on the satellite, the sandstone bedrock may be encountered at shallow depth which is generally less than 3.00 m from natural ground level. Rock outcrops are visible locally across the site footprint and sandstone may be encountered from surface. Sandstone is generally not rippable by a tractor-loader-backhoe (TLB) when logged as hard rock. The mudstones and siltstones will generally be more weathered and exhibit a higher degree of rippability than the sandstones. The crests of small ridges and terrain undulations are expected to comprise sandstone whereas the side slopes and valley bottoms will comprise mudstone and siltstone bedrock at depth.

Thin, sandy, cover soil is expected on the crests and general high lying areas. The low-lying areas is expected to have thick (>1.50 m), sandy to clayey transported and residual soil material overlaying the bedrock. In areas where rills and gullies have formed in the low-lying areas, there may be a net removal of material exposing the bedrock. However, these areas are expected to support thick, clayey material and wet soil conditions.

Shallow occurring, variably cemented, ferricrete is expected to exist adjacent to depressions and low-lying areas. Ferricete forms from seasonal soil moisture changes and can exhibit strongly cemented hardpan to very weakly cemented nodular ferricrete. Ferricrete can also exist on top of sandstone banks along crests and mid-slopes.

In terms of construction material for access roads and other structures, a quarry near the site should be explored or consideration should be given to commercial suppliers. Informal borrow pits seemingly exist on site that targeted rippable sandstone banks. These areas will result in non-drained conditions and may need to be rehabilitated back to natural ground level before utilising as founding areas.

It is expected that local areas with steep gradients will exist on site. This entails that terracing and additional earthworks for roads and platforms may be required for construction in the steeper sections of the site.

5.6. Desktop Geotechnical Appraisal

Based on the desktop study, the assessment areas may be divided into five (5No.) Ground Units (GU), I, II, III, IV and V.

The assessment area is considered suitable for the development of the proposed infrastructure, from a geotechnical viewpoint, provided that standard engineering design and construction measures are implemented to mitigate the identified geotechnical constraints. The anticipated geotechnical constraints and mitigation measures are summarised in Table 5-1.

Table 5-1 Summary of geotechnical conditions

Ground Unit	Shallow Geology	Geotechnical Conditions / Constraints	Impacts on Engineering Design and Construction
I	Bedrock covered by transported material	• Sandy transported soil on surface • Locally occurring, variably cemented ferricrete at depths between 0.50 m to 2.00 m BGL • Residual soils sandy to clayey depending on underlying bedrock • Possible, localised, low to medium expansive potential soil material at depth • Localised shallow subsurface water seepage	• Generally good founding conditions for structures at shallow depths • Minor earth works required at founding level • Conventional shallow foundations suitable • Conventional subgrade preparation for roads • Variable excavation conditions • Pre-drilled holes, filled with G5 material required for ground mount PV system
II	Steep slopes (Talus on foot slopes)	• Mass earthworks on gradients greater than 1:10 • Potentially unstable slopes	• Terracing and slope stabilisation required
III	Outcropping / shallow bedrock	• Hard excavation conditions	• Heavy plant machinery / pneumatic methods / required for excavations (pole planting earthworks / trenching / foundations) • Good founding conditions for structures • Overbreak is anticipated during trenching
IV	Alluvium	• Loose sandy soils • Potentially collapsible soils • Moderate soil cover • Moderate bedrock depth • Increased erosion potential • Deep erosion gullies and rills	• Deeper spread footings (found below alluvial sands) • Soft excavation conditions becoming intermediate with depth • Unstable trench sidewalls – shoring/battering required • Erodible soils • Surface drainage measures required to minimise risk of flooding and erosion
V	Borrow Pits	• Existing borrow excavations	• Rehabilitation required

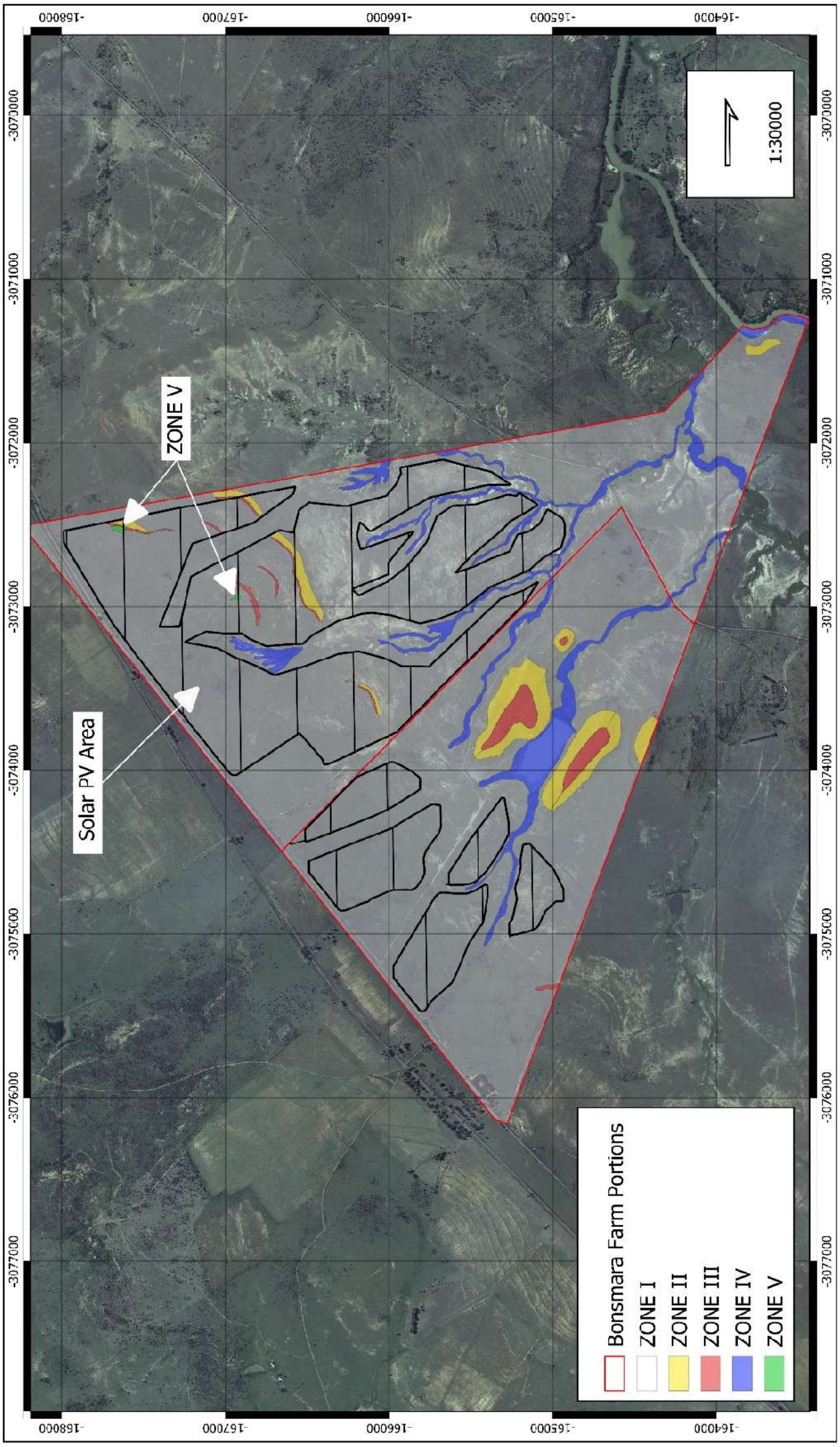


Figure 5-3 Geotechnical Desktop Zonation for Solar PV Facility

Figure 5-4 Geotechnical Desktop Zonation for grid infrastructure

6. Identification and Assessment of Impacts

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective.

The impact of the SEF will be caused by the construction of access roads to the PV modules and mounting structures, earthworks required for the construction of crane pads, excavations as well as trenching for underground cables. Additional impacts would be caused by the opening of borrow pits that may be undertaken to obtain construction materials. The impact of the substation and powerlines on the geological environment is limited to topsoil stripping, excavations for plinth foundations, trenching, the construction of access roads and associated light infrastructure.

6.1. Impact of the Project on the Geological Environment

The main impact of the proposed development from a geological perspective is the displacement and removal of soil and rock materials. These activities will predominantly take place during the construction phase. The degree of disturbance is largely dependent on the topography of the project site and the nature of the proposed infrastructure. Steep slopes are unfavourable as these require bulk earthworks to create working platforms and access roads. Earthworks on steep slopes increases the risk of soil movements or slope failure.

The risk of soil erosion is also increased during construction activities, by the removal of vegetation and by possible disturbance to the natural surface drainage environment. These activities may prevent infiltration of rainwater, increase surface runoff and cause concentration of surface water flow. Erosion will increase the disturbance and displacement of soils and the impact may extend beyond the infrastructure footprint/s over time.

The effects of the proposed development on the geological environment were evaluated using an Environmental Impact Assessment (EIA) Methodology, provided by SiVEST, which aids in determining the significance of an environmental impact on an environmental parameter through a systematic analysis. The EIA methodology is attached as Appendix C.

Based on the impact significance ratings, presented in Appendix D, the development of the proposed construction of the Bonsmara Solar Energy Facility (SEF) and associated grid infrastructure. From a geological and geotechnical perspective, a "Negative Low impact" rating has been assigned for this site provided that the recommended mitigation measures are implemented.

The topography of the major portion of the site is generally flat with localised areas of steep slopes these areas will require minor earthworks. Access routes should be carefully planned to avoid these areas.

Detailed geotechnical materials investigations should be undertaken to assess the suitability of the in-situ materials and the need for processing (e.g. crushing, stabilisation).

Two areas defined as GU V are seemingly existing borrow pits which will need to be rehabilitated if area is to be utilised for the proposed infrastructure.

The soils do not render the site particularly susceptible to soil erosion, although mitigation measures need to be implemented, particularly within the lower-lying sections of the site where concentrated surface flow is anticipated after heavy rainfall events. The crest of the ridges is expected to be characterised by outcropping or very shallow bedrock. This will provide good founding for the PV modules.

7. Comparative Assessment of Alternatives

There are no alternatives provided at this stage.

8. Conclusion and Summary

8.1. Summary of Findings

This desktop geotechnical specialist study was undertaken for the development of the 100MW Bonsmara SEF and associated grid infrastructure near Kroonstad in Free State Province. The assessment area is underlain by rock units of Beaufort Group of Karoo Supergroup and Kliprivier Group of Ventersdorp Supergroup. Some geotechnical constraints have been identified, primarily shallow and outcropping bedrock which may cause excavation difficulties, localised steep slopes and existing borrow pit areas. These constraints may be mitigated via standard engineering design and construction measures.

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective.

The proposed developments are assessed to have a "Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation" provided that the recommended mitigation measures are implemented. The remaining mitigation measures provided to minimise the impacts relate to the appropriate engineering design of earthworks and site drainage, erosion control and topsoil and spoil material management. These do not exceed civil engineering and construction best practices.

Further intrusive geotechnical investigations should be undertaken to confirm the engineering recommendations provided in this report.

8.2. Impact Statement and Conclusion

From a geotechnical and geological perspective, no fatal flaws or sensitivities have been identified within or close to the SEF assessment area and the grid corridor. It is therefore recommended that the proposed activity be authorised.

References

Brink, A.B.A. Engineering Geology of Southern Africa, The first 2 000 million years of geological time, Volume 1. Building Publications, 1979.

Brink, A.B.A. Engineering Geology of Southern Africa, Post-Gondwana Deposits, Volume 4. Building Publications, 1985.

Johnson, M.R. Anhaeusser, C.R. Thomas, R.J. The Geology of South Africa. Council for Geoscience, 2006.

Appendix A. Specialist Declaration of Interest and Undertaking Under Oath

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED BONSMARA SOLAR PHOTOVOLTAIC (PV) AND BASIC ASSESSMENT (BA) FOR ASSOCIATED GRID CONNECTION INFRASTRUCTURE, NEAR KROONSTAAD, FREE STATE PROVINCE, SOUTH AFRICA DESKTOP GEOTECHNICAL SPECIALIST STUDY

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GaGE Consulting (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	135 %
Specialist name:	Duan Swart			
Specialist Qualifications:	MSc (Engineering Geology)			
Professional affiliation/registration:	Professional Natural Scientist SACNASP Reg. No. 137543			
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2. DECLARATION BY THE SPECIALIST

I, Duan Swart, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GaGE Consulting

Name of Company:

03/10/2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Duan Swart, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GaGE Consulting

Name of Company

03/10/2022

Date

GUSTAF SWART PLS 1444 (PROFESSIONAL LAND SURVEYOR)

Signature of the Commissioner of Oaths

03/10/2022

Date

Appendix B. Specialist CV

Appendix C. Environmental Impact Assessment (EIA) Methodology

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Table 2: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	4	2	1	3	2	24	-	Low

Operational Phase																				
Fauna	Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise generated by the wind turbines as well.	2	3	2	1	4	3	36	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	4	2	22	-	Low
Decommissioning Phase																				
Fauna	Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.	2	3	2	1	2	3	30	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	2	2	18	-	Low

Cumulative																				
Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.	2	4	2	2	3	2	26	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	3	2	1	3	2	22	-	Low

Appendix D. Impact Rating Tables

PROPOSED BONSMARA SOLAR PHOTOVOLTAIC (PV) RENEWABLE ENERGY FACILITY (SEF) AND BASIC ASSESSEMNT (BA) FOR ASSOCIATED GRID CONNECTION INFRASTRUCTURE, NEAR KROONSTAAD, FREE STATE PROVINCE, SOUTH AFRICA																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase (SEF)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	3	1	12	-	Low	1) Design access roads and pile locations to minimise earthworks and levelling based on high resoultion ground contour information 2) Correct topsoil and spoil management	1	4	2	1	3	1	11	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	4	2	2	2	1	11	-	Low	1) Avoid development in preferential drainage paths 2) Appropriate engineering design of road drainage and watercourse crossings 3) Temporary berms and drainage channels to divert surface runoff where needed 4) Landscape and rehabilitate disturbed areas timeously (e.g. regressing) 5) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	2	1	1	2	1	7	-	Low
Construction Phase (GRID)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	3	1	12	-	Low	1) Design access roads and pile locations to minimise earthworks and levelling based on high resoultion ground contour information 2) Correct topsoil and spoil management	1	4	2	1	3	1	11	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	4	2	2	2	1	11	-	Low	1) Avoid development in preferential drainage paths 2) Appropriate engineering design of road drainage and watercourse crossings 3) Temporary berms and drainage channels to divert surface runoff where needed 4) Landscape and rehabilitate disturbed areas timeously (e.g. regressing) 5) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	2	1	1	2	1	7	-	Low
Operational Phase (SEF)																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain access roads including draiange features 2) Monitor for erosion and remediate and rehabilitate timeously	1	2	1	1	2	1	7	-	Low
Operational Phase (GRID)																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain access roads including draiange features 2) Monitor for erosion and remediate and rehabilitate timeously	1	1	1	1	2	1	6	-	Low
Decommissioning Phase (SEF)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	2	1	11	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing)	1	4	2	1	2	1	10	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	2	2	2	2	1	9	-	Low	1) Temorary berms and drainage channels to divert surface runoff where needed 2) Restore natural site topography 3) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	1	1	1	2	1	6	-	Low
Decommissioning Phase (GRID)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	2	1	11	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing)	1	4	2	1	2	1	10	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	2	2	2	2	1	9	-	Low	1) Temorary berms and drainage channels to divert surface runoff where needed 2) Restore natural site topography 3) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	1	1	1	2	1	6	-	Low