Report to SiVEST

Desktop Geotechnical Specialist Study for the:

PROPOSED CONSTRUCTION AND OPERATION OF THE BATTERY ENERGY STORAGE SYSTEM (BESS) AND ASSOCIATED INFRASTRUCTURE FOR THE AUTHORISED PLATSJAMBOK EAST SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY, LOCATED NEAR THE TOWN OF PRIESKA, IN THE SIYATHEMBA LOCAL MUNICIPALITY, PIXLEY KA SEME DISTRICT IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

DEA Reference:	2020-09-0031
Report Prepared by:	GaGE Consulting (Pty) Ltd
Issue Date:	6 November 2020
Version No.:	F0
GaGE Ref No.:	KSV20700/G0263

GaGE CONSULTING

Report to:	SiVEST Environmental Division 51 Wessel Road, Rivonia, 2129
Project name:	Platsjambok East Photovoltaic (PV) Energy Facility Battery Energy Storage System (BESS)
Report title:	Desktop Geotechnical Specialist Study
Report number:	KSV20700/G0263 revision F0

Revision	Date	Comment	Prepared by	Reviewed by
F0. FINAL	07/10/2020	Issued to client for distribution	SNB	FPP

Revision Details:	

Report by:	Approved by:
Steven Bok *BSc Hons (Geology) Pr.Sci.Nat*	Fernando Pequenino PrEng (SA) 20070109 *BEng(Civil) BEng(Hons)(Geotech) MSAICE*

PROPOSED CONSTRUCTION AND OPERATION OF THE BATTERY ENERGY STORAGE SYSTEM (BESS) AND ASSOCIATED INFRASTRUCTURE FOR THE AUTHORISED PLATSJAMBOK EAST SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY, LOCATED NEAR THE TOWN OF PRIESKA, IN THE SIYATHEMBA LOCAL MUNICIPALITY, PIXLEY KA SEME DISTRICT IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

Executive Summary

This desktop geological and geotechnical specialist study assed the proposed development of a Battery Energy Storage System (BESS) and associated infrastructure for the authorised Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3), located near Prieska in the Siyathemba Local Municipality, Pixley ka Seme District in the Northern Cape Province of South Africa. The assessment area comprises of a 500 m radius around the authorised substation position.

The assessment area is located on a plain and slopes very gently in a general westerly direction, although localised undulations were noted. There are no distinct drainage features on the site, although a broad ephemeral drainage line appears to run in an easterly to westerly direction near the northern site boundary. The study area has an arid climate. Quaternary deposits comprising of aeolian sands occur over the north eastern half of the assessment area and calcrete occurs over the south western section. Founding conditions will generally be adequate for founding the proposed infrastructure at shallow depths on conventions footings, although a deeper footing depth may be required where aeolian sands are encountered. Given the inherent variability within calcrete soil profiles, the founding conditions beneath individual structures must be confirmed on site.

No rock outcrop, faults, lineaments or other geological features were identified. The quaternary deposits are not fossiliferous.

No fatal flaws have been identified that would render the proposed BESS site unsuitable from a geological and geotechnical perspective. No geologically or geotechnically sensitive areas were identified within or near the assessment area. While sections of the assessment area are anticipated to have differing geotechnical constraints, the whole site is considered suitable for development form a geotechnical viewpoint. No preferences for the final BESS layout within the assessment area are therefore provided.

The proposed BESS is assessed to have a "Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation" from a geological and geotechnical viewpoint. The mitigation measures provided in this report 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.

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 Table 6-1
l) any conditions for inclusion in the environmental authorisation;	6.1 Table 6-1
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6.1 Table 6-1
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 Table 6-1
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

Table of Contents

Figures

Tables

1. Introduction

GaGE Consulting (Pty) Ltd has been appointed by SiVEST (PTY) Ltd, on behalf of South Africa Mainstream Renewable Power Platsjambok East (Pty) Ltd to undertake the assessment of the development of a Battery Energy Storage System (BESS) and associated infrastructure for the authorised Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3), located near located the town of Prieska, in the Siyathemba Local Municipality, Pixley ka Seme District in the Northern Cape Province of South Africa.

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DEFF), prior to the commencement of such activities. This desktop geological and geotechnical specialist study has been commissioned to assess and verify the BESS under the applicable specialist protocols.

1.1. Scope and Objectives

Assess the geological and geotechnical conditions and impacts associated with the installation of a BESS on the Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3), including potential fatal flaws, if present.

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
- 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 and allow enable comparison of environmental impacts, efficient review, and collation of the specialist studies into their Basic Assessment report. This study is undertaken in accordance with the requirements provided in Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6.

A detained description of the infrastructure required for the BESS including layouts of the proposed development were provided by SiVEST.

1.3. Specialist Credentials

This study has been undertaken by Steven Bok, a Professional Natural Scientist registered by the South African National Council for Natural Scientific Professions (SACNASP) registration number 400279/07 (Geological Science). Mr Bok's 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 3022 BRITSTOWN (Council for Geoscience,1991)

ii) Aerial photographs (Google Earth imagery, current and historical)
iii) Technical report titled "Prieska Solar PV/WindFarm Project Report on Preliminary Geotechnical Investigation" produced by Mainstream Renewable Power dated February 2012 (Version Number 1)
iv) Technical report titled "Proposed Development of a Wind & Solar Power Generation Plant near Copperton, NC Visual Impact Assessment Report, EIR Phase" produced by Mainstream Renewable Power dated March 2012
v) Technical report titled "Proposed Wind and Photovoltaic Energy Facilities Near Prieska, Northern Cape Final Soil and Agricultural Assessment Report" produced by SiVEST dated May 2012
vi) Screening Report for Environmental Authorisation (national web based environmental screening tool)
vii) General site photographs provided by SiVEST
viii) 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 BESS is located on the authorised Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3), located near located the town of Prieska, in the Siyathemba Local Municipality, Pixley ka Seme District in the Northern Cape Province of South Africa.

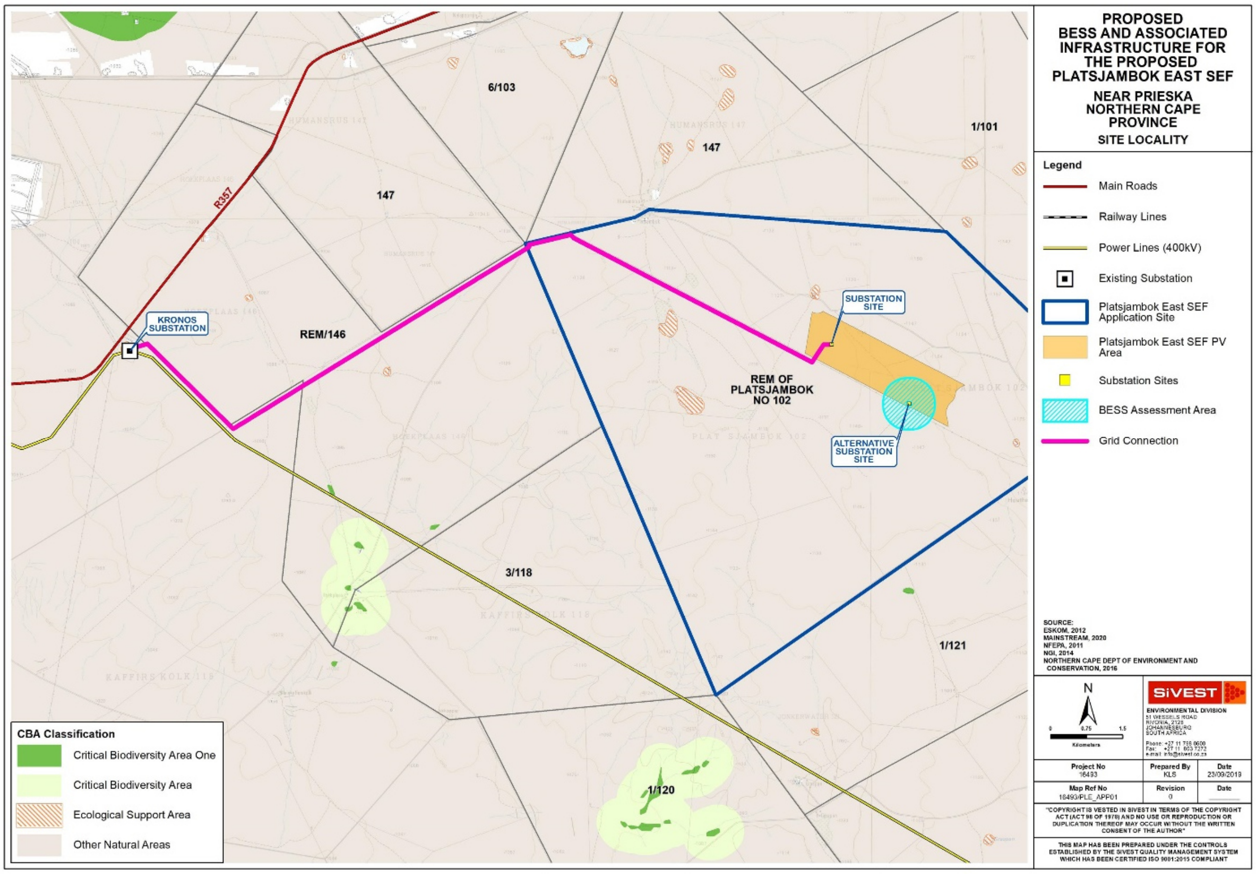

Figure 3-1 BESS is located on the authorised Platsjambok East Photovoltaic (PV) Energy Facility

3.2. Project Description

South Africa Mainstream Renewable Power Platsjambok East (Pty) Ltd is proposing the construction and operation of Battery Energy Storage System (BESS) and associated infrastructure for the authorised Platsjambok East PV (12/12/20/2320/4/AM3). The need for a BESS stems from the fact that electricity is only produced by the Renewable Energy Facility while the sun is shining, while the peak demand may not necessarily occur during the day-time. Therefore, the storage of electricity and supply thereof during peak-demand will mean that the facility is more efficient, reliable and electricity supply more constant.

The BESS will:

- Store and Integrate a greater amount of renewable energy from the Renewable Energy Facility into the electricity grid
- This will assist with the objective to generate electricity by means of renewable energy to feed into the National Grid which will be procured under either the Renewable Energy Independent Power Producer Procurement Program (REIPPPP), other government run procurement programmes or for sale to private entities if required

The Platsjambok East PV BESS will be located adjacent to the approved Platsjambok East PV substation associated with the approved Platsjambok East PV. To reduce electrical losses the BESS must be in close proximity to the on-site 33/132kV substation. A ~5ha study site has been established around the approved substation (500m zone) to allow for the micrositing / specialist guidance regarding placement can be made.

3.2.1. Alternatives

No site alternatives for this proposed development were considered as the placement of the proposed BESS is dependent on the location of the Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3).

Technology alternatives are limited to battery types, namely Redox flow batteries and Solid State Batteries. No other activity alternatives are being considered.

The BESS alternatives are:

BESS Specifications	
BESS Footprint	Up to 2Ha
BESS Capacity	200MWh
BESS Technology	Lithium Ion
BESS Type Alternative-Solid State Batteries	Containerised systems assembled within shipping containers and delivered to the project site. Dimensions are approximately 17 m long x 3.5 m wide x 4 m high. Containers will be placed on a raised concrete plinth (30 cm) and may be stacked on top of each other to a maximum height of approximately 15 m. Additional instrumentation, including inverters and temperature control equipment, may be positioned between the battery containers.

The 'no-go' alternative is the option of not constructing and operating a BESS in support of the authorised Renewable Energy (RE) facility. This alternative would result in no additional environmental impact other than that assessed during the EIA for the RE facility.

The 'no-go' option is an option; however, this would prevent the Platsjambok East Photovoltaic (PV) Energy Facility from contributing to the environmental, social and economic benefits associated with the development of the renewables sector.

The above-mentioned alternatives (including 'no-go' alternative) will all be assessed by the appointed specialists as part of the BA process. All the above-mentioned location alternatives will be informed by the identified environmental sensitive and/or 'no-go' areas (i.e. status quo). Micro-site alternatives within the assessment are being considered and comparatively assessed as part of the BA process for the proposed development.

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

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. A climatic N-value of greater that 10 implies an arid climate with no significant chemical decomposition and residual soil profile development.

Weinert's climatic N-value for the site is approximately 22. This implies an arid climate with an non-existent or extremely shallow residual soil profile. Very shallow bedrock can be anticipated (unless the rock is covered with transported soils). This climate is conducive to the formation of pedogenic calcrete.

5.2. Topography and Drainage

The topography in the general area surrounding the site is characterised by flat plains with areas of slightly more undulating relief, including some low ridges. The assessment area is located on a plain and slopes very gently in a general westerly direction, although localised undulations were noted from Google Earth elevation data.

There are no distinct drainage features on the site, although a broad ephemeral drainage line appears to run in an easterly to westerly direction near the northern site boundary. Pans appear to occur to the north east.

The natural topography and drainage do not appear to have been impacted by any previous activities.

5.3. Bedrock Geology

According to the 1:1250 000 scale geological map 3022 BRITSTOWN, the BESS assessment area lies near the contact between bedrock units of the Dwyka Group of the Karoo Supergroup (designated ***C-Pd***) and the Uitdraai Formation of the Brulpan Group of the Mamaqua Matamorphic Province (***Mu***).

The Dwyka Group comprises of "tillite, boulder shale, sandstone, siltstone, shale, varved shale" of glacial, sub-glacial and subaqueous origin. The most common lithology is the massive diamictite facies, comprising of generally clast-rich diamictite (Johnson, *et.al.* 2006) also referred to as tillite. The tillite rock comprises of a fine dark grey rock matrix with characteristic rounded to angular frequently striated drop stones of various origin. The stratified diamictite facies comprises of bedded diamictite, mudrock, sandstone and conglomerate. A carbonate-rich facies is also present.

The Brulpan Group comprises or quartz-muscovite schist and sericitic quartzite (quartzite containing a type of muscovite mica). Fine-grained, light grey quartzite, sugar-textured sandstone and subordinate schist make up the Uitdraai Formation (Johnson, *et.al.* 2006).

Quaternary deposits are shown on the geology map to overlie the bedrock at the site. These comprise of "red aeolian sands" (***Qs***) over the north eastern half of the assessment area and "calcrete" (***T-Qc***) over the south western section.

Occasional Kimberlite pipes, occur in the general area, but not in close proximity to the site.

Rock outcrop is not evident from the aerial photography and is not expected on the site.

No faults, lineaments or other geological features are illustrated on the geological map or are visible from aerial photography.

The quaternary deposits are not fossiliferous.

No mining activities have taken place on or close to the BESS assessment area.

An extract from the 1:250 000 scale geological map 3022 BRITSTOWN is provided below with the assessment area shown in red.

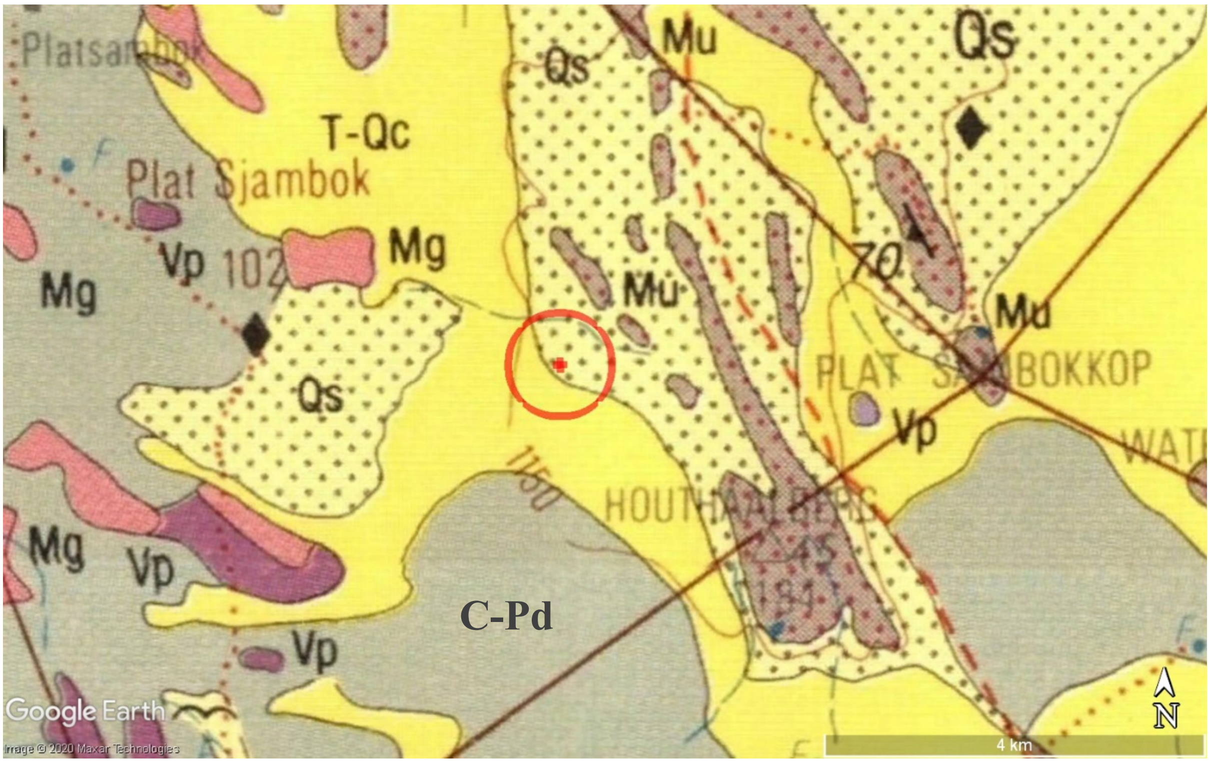

Figure 5-1 Extract of 1:150 000 scale Geological Map 3022 BRITSTOWN

5.4. Engineering Geology

The engineering geological characteristics at shallow depth are anticipated to be determined by the properties of the quaternary deposits. However, bedrock may occur at relatively shallow depth below ground level and may be encountered in trenches or deeper excavations.

The test pits excavated during the preliminary geotechnical investigation referenced in Section 1.4 are located >3 km north west of the site and were not located on the quaternary deposits. The assessment of the engineering geology is therefore based solely on the desktop study, experience in the general area and engineering judgement.

The aeolian deposits are formed by redistribution of predominantly sand-sized particles by wind and are colloquially known as Kalahari sands. The sands are typically medium to fine grained sands with combined silt and clay contents of less than 35 %. The consistency of the sands is anticipated to range from “loose” becoming “medium dense” with depth. The aeolian deposits are known to be potentially collapsible. Soils with a collapsible structure have an open-voided texture with individual grains being separated or weakly bonded by bridging material such as clay, iron oxides, calcium or other bridges (Brink, 1985). While these soils have a high to moderate strength and can withstand fairly large loads under low soil moisture conditions, an increasing moisture content can weaken the bridging materials. Increasing the soil moisture content under load can cause a decrease in the soil volume, resulting in large settlements with no increase in the applied stress. This can lead to sudden settlements beneath foundations and structures.

The thickness of the aeolian sands could not be determined from the desktop study. These may only occur at shallow depths or extend to beyond the founding depth of the proposed structures.

Calcrete is a calcareous pedocrete, which is formed by the cementation or replacement by carbonate, typically calcium carbonate. A broad range of calcretes occur, based in the degree and nature of the cementation. These varieties are described by Brink (1985) as follows:

Variety:	*Description:*
Calcareous soil	Some authigenic mineralisation, not sufficient to indurate the soil significantly
Powder calcrete	Loose silt or sand sized cemented particles
Glaebular calcrete	Silt to gravel sized cemented particles
Honeycomb calcrete	Partly coalesced glaebular particles
Hardpan calcrete	Indurated and strongly cemented, rock like material

Based on the knowledge of the area, it is probable that hardpan calcrete predominates over the section of the site illustrated to be underlain by calcrete on the geological map. Shallow hardpan calcrete is anticipated beneath a thin mantle of gravelly to sandy soils in this area.

Problematic geotechnical conditions related to calcrete include lateral and vertical variations within the soil profile (layers of hardpan calcrete may not be continuous and can be underlain by significantly looser soils). As such, the thickness of the calcrete layer and nature of the underlying materials should investigated before founding structures on calcrete, even where the material appears hard and competent on initial inspection. Hard excavation conditions are anticipated.

The hardpan calcrete is likely to provide a suitable founding medium for the relatively light structures to be constructed for the BESS. However, further intrusive investigations beneath each structure footprint are required to confirm this assessment.

5.5. Desktop Geotechnical Appraisal

Based on the desktop study, the proposed BESS assessment area may be divided into two Ground Units where similar geotechnical conditions are anticipated. These correspond to areas underlain by aeolian sands and calcrete on the geological map. The boundary of the two zones is approximate only and will need to be confirmed on site through intrusive investigations.

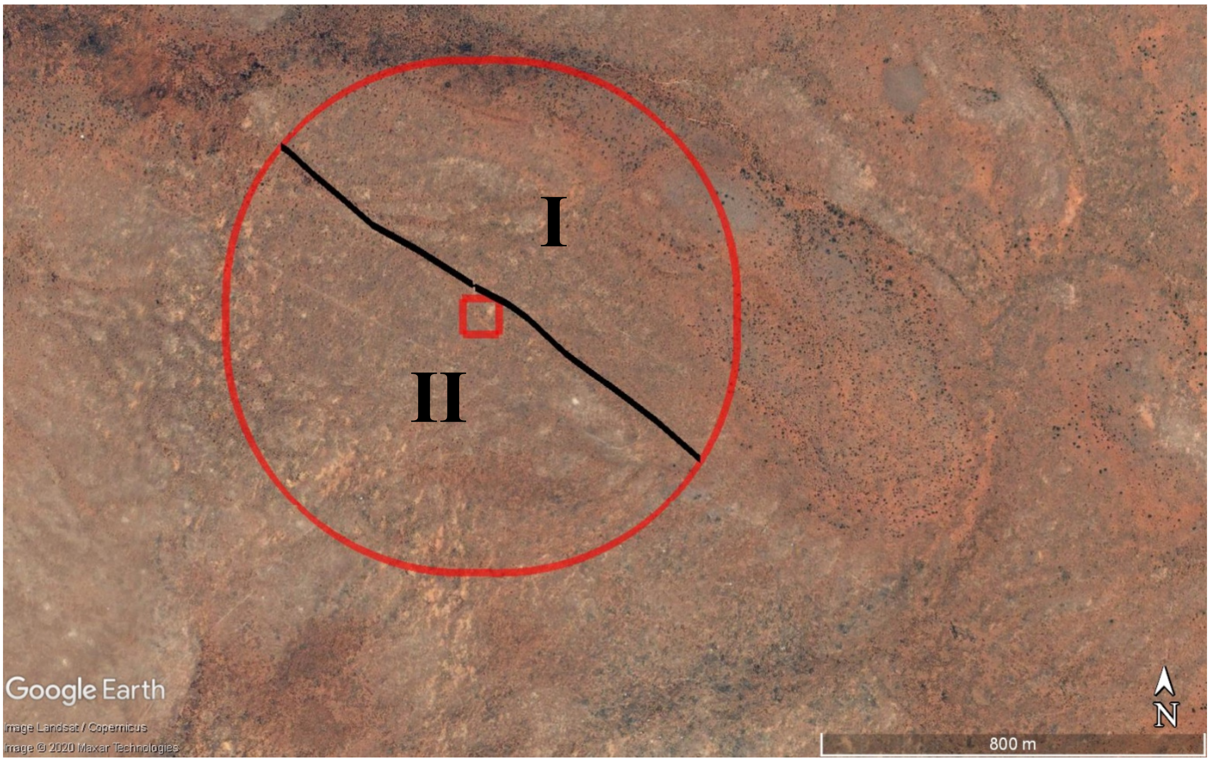

Figure 5-2 Inferred Ground Units

Both ground units are considered suitable for the development of the BESS infrastructure, from a geotechnical viewpoint, provided that standard engineering design and construction measures are implemented to mitigate the identified geotechnical constraints. While differing geotechnical conditions and constraints are expected between the two zones, no distinct preference between either zone could be provided from this study.

The anticipated geotechnical constraints and mitigation measures are summarised in Table 2-1.

Table 5-1 Summary of Geotechnical Conditions

Ground Unit	Shallow Geology	Geotechnical Conditions / Constraints	Impacts on Engineering Design and Construction
I	Aeolian sands	• Loose sandy soils • Potentially collapsible soils • Moderate soil cover thickness • Moderate depth to bedrock	• Limit bearing pressures beneath structures • Soil improvement below footings / roads • Pre-collapse (heavy compaction) • Deeper spread footings (found below aeolian sands) • Soft excavation conditions • Unstable trench sidewalls – shoring/battering required
II	Calcrete	• Variable hardpan layers • Potentially loose underlying soils • Moderate soil cover • Variable depth to hardpan • Hard excavation conditions	• Adequate founding materials, but confirmation required beneath individual structures • Hard excavation required

6. Identification and Assessment of Impacts

No fatal flaws have been identified that would render the proposed BESS site unsuitable from a geological and geotechnical perspective.

The BESS is containerised and the impact of the activity on the geological environment is limited to topsoil stripping, excavations for plinth foundations, trenching, the construction of access roads and associated light infrastructure. Bulk earthworks, where required for the construction of platforms and access roads, may be a significant impact.

6.1. Impact of the Project on the Geological Environment

The main impact of the BESS development from a geological perspective is the displacement and possible 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 BESS development on the geological environment was 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 Table 6-1, the development of the proposed BESS on the Platsjambok East Photovoltaic (PV) Energy Facility, from a geological and geotechnical perspective, will be “Negative Low impact”.

The topography of the site is flat to gentle and significant earthworks are not anticipated (although some minor earthworks are anticipated where local undulations occur). The soils and topography do not render the site particularly susceptible to soil erosion. No ridges or rock outcrops which may be of geological importance were identified.

Table 6-1 Impact Assessment Methodology Matrix

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																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during platform earthworks, road subgrade preparation, trenching	1	4	2	2	3	1	12	-	Low	1) Design facility layout to minimise earthworks and levelling based on high resolution 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	3	2	2	2	1	10	-	Low	1) Temporary berms and drainage channels to divert surface runoff where needed 2) Landscape and rehabilitate disturbed areas timeously (e.g. regrassing) 3) Correct engineering design of road and site drainage 4) Use designated access and laydown areas only to minimise	1	2	1	1	2	1	7	-	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
											disturbance to surrounding areas									
Operational Phase																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain drainage channels 2) Monitor for erosion and remediate and rehabilitate timeously	1	1	1	1	2	1	6	-	Low
Decommissioning Phase																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during platform earthworks, road rehabilitation, removal of subsurface infrastructure	1	4	2	2	2	1	11	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate disturbed areas timeously (e.g. regrassing)	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 ground disturbance during rehabilitation activities	1	2	2	2	2	1	9	-	Low	1) Temporary 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
Cumulative																				
Disturbance/ displacement/ removal of soil and rock Soil Erosion	No cumulative effect																			

7. Comparative Assessment of Alternatives

Layout alternatives which subsequently informed the area for the potential construction of the proposed substation and subsequent BESS assessment area were identified and comparatively assessed as part of the BA process undertaken in 2016.

No geologically or geotechnically sensitive areas were identified within or near the assessment area. No preferences for the final BESS layout within the assessment area are therefore provided.

8. Conclusion and Summary

8.1. Summary of Findings

This desktop geotechnical specialist study was undertaken development of a Battery Energy Storage System (BESS) and associated infrastructure for the authorised Platsjambok East Photovoltaic (PV) Energy Facility (12/12/20/2320/4/AM3). The assessment area is underlain by aeolian sands and calcrete (both Quaternary deposits). The bedrock beneath these deposits is either sedimentary rock units of the Dwyka Group or quartzites/schists of the Namaqua Metamorphic Province (or both). Some geotechnical constraints have been identified, including the presence of shallow and variable hardpan calcrete and loose/collapsible sands. These constraints may be mitigated via standard engineering design and construction measures. Shallow spread footings are considered suitable to support the structures, with ground improvement if required.

No fatal flaws have been identified that would render the proposed BESS site unsuitable from a geological and geotechnical perspective.

The proposed BESS is assessed to have a “Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation”. The recommended 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.

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, sensitivities, or areas to be avoided have been identified within or close to the BESS assessment area. It is therefore recommended that the proposed activity be authorised.

References

Brink, A.B.A. Engineering Geology of Southern Africa, The Karoo Sequence, Volume 3. Building Publications, 1983

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

Appendix B. Specialist CV

Appendix C. Environmental Impact Assessment (EIA) Methodology