Proposed Melkhout Battery Energy Storage System (BESS), Humansdorp, Eastern Cape

Final Basic Assessment Report

Report Prepared for

Eskom

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Final Basic Assessment Report

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

AC	Alternating Current
BA	Basic Assessment
BESS	Battery Energy Storage System
BGIS	Biodiversity GIS
BMS	Battery Management System
DEA	Department of Environmental Affairs
DBAR	Draft Basic Assessment Report
DC	Direct Current
DoE	Department of Energy
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EMP	Environmental Management Plan
FBAR	Final Basic Assessment Report
IAP	Interested and Affected Party
IPP	Independent Power Producer
PCS	Power Conversion System
MW	Megawatt
NEM:BA	National Environmental Management Biodiversity Act
NEMA	National Environmental Management Act

PPP	Public Participation Process
PV	Photovoltaic
VRF	Vanadium Redox Flow
WEF	Wind Energy Facility
WMA	Water Management Area

List of Definitions

Anode	An anode is an electrode through which the conventional current enters into a polarized electrical device.
Battery	An electrochemical storage device consisting of one or more cells, that converts chemical energy into electricity and is used as a source of power.
Battery Energy Storage System	Term used to describe the entire system including the battery, inverter, controller and management system.
Battery Management System	A system which manages and monitors the battery to ensure even charging and discharging.
Battery Capacity	A battery's capacity is the amount of electric charge it can deliver at the rated voltage. Battery capacity is measured in amps × hours (AH). The higher the discharge rate, the lower the capacity.
Battery Cell	The smallest component of a battery. A battery may be single celled of multi-celled.
Cathode	Negatively charged electrode by which electrons enter the electrolyte.
Charge	The process of storing energy to the BESS.
Curtailment	The reduction of output of a renewable resource below what it could have otherwise produced.
Battery Cycle	The process of charge and discharge of a battery. The number of cycles specifies the expected life of a battery.
Depth of Discharge	The Depth of discharge (DoD) refers to how much energy is cycled into and out of the battery on a given cycle, expressed as a percentage of the total capacity of the battery.
Discharge	The process of extracting stored energy from the BESS.
Dispatchable Generation	Sources of electricity that can be used on demand and dispatched at the request of power grid operators, according to market needs.

Energy capacity	The energy available for transfer either from battery energy storage system to the grid or vice versa, usually expressed in kWh.
Battery Module	An aggregation of several battery cells.
Non-dispatchable generation	Sources of electricity that cannot be turned on or off in order to meet s fluctuating electricity needs such as wind power and solar power.
Battery Pack/Stack	An aggregation of several battery modules.
Peaking Power Plant	Peaking power plants run only when there is a high demand for electricity for short periods and therefore supply power at a much higher price per kilowatt hour than base load power.
Peak shifting	Altering the time of day at which electricity is used to reduce “demand charge” on electricity.
Power Capacity:	The power available for transfer either from battery energy storage system to the grid or vice versa, usually expressed in kW.
Renewable generation smoothing	The fluctuating nature of renewable generation means that supply is not constant and requires a peaking plant to supply the load when renewable generation falls away. Grid-scale battery storage enables the smoothing out of this fluctuating generation. Charging can take place when renewable generation output is above a certain pre-defined threshold, and similarly discharge can take place below a pre-defined renewable generation output value, thus reducing the peaks and filling the troughs in generation.
Voltage Support	Battery energy storage systems may be used to support local voltage levels and stability and provides an alternative to strengthening the network in conventional ways.

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by Eskom Holdings SOC Ltd (Eskom). The opinions in this Report are provided in response to a specific request from Eskom to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

1 Introduction

1.1 Background

The Applicant, Eskom Holdings SOC Ltd, intends to construct a Battery Energy Storage System (BESS) adjacent to the Melkhout substation, located north of Humansdorp, off the R330 in the Eastern Cape (Refer to Figure 1).

In terms of the National Environment Management Act No. 117 of 1998 (NEMA) and the 2014 EIA Regulations as amended, the construction of the BESS triggers certain listed activities that require a Basic Assessment (BA) process prior to commencement of the activity. The applicant, Eskom, must therefore apply to the Competent Authority for environmental approval to proceed with the development. In terms of Section 24C (2)(d)(ii) of NEMA, the competent authority that must consider and decide on the application for authorisation in respect of the relevant listed activities is the National Department of Environmental Affairs (DEA). As such, Eskom appointed SRK Consulting South Africa (Pty) Ltd. (SRK) as their independent Environmental Assessment Practitioner (EAP), to undertake the Basic Assessment process for the project.

A BESS utilises battery technology on a large scale to temporarily store energy and discharge to the grid when needed. In recent years battery energy storage at utility scale has increasingly been recognised as an effective solution to several challenges within the current grid system such as inefficiency, network bottlenecks and overloads.

The Melkhout BESS forms part of a broader Eskom project to deploy 1440 MWh of storage capacity into the South African electricity system at various locations around the country. As part of the funding agreement for Medupi and Kusile power stations, which are coal-fired, Eskom committed to rolling out cutting edge clean technologies. Eskom had originally considered rolling out a concentrated solar power plant (CSP) project of 100MW capacity with 60% 'round the clock' load factor, however the CSP project was ultimately abandoned due to its financial implications. The World Bank and co-financiers approved distributed battery energy storage and Solar PV as alternatives to support renewable energy expansion in South Africa and to replace the terminated Kiwano CSP (Upington CSP) 100MW project. Eskom has chosen battery energy storage systems as the technology to roll out.

The project is being rolled out in two phases, with Phase 1 targeting the completion of 800 MWh (at about 200 MW) at Eskom distribution substation sites and Phase 2 targeting 640 MWh (about 160 MW) at large renewable power plant sites shortly thereafter. The Melkhout system is one of Eskom's pilot projects using this technology and is currently one of the largest proposed BESS's to be developed in South Africa with a planned capacity of 40 MW/160 MWh. The project will be co-financed by Development Finance Institutions (DFI) lenders including the World Bank and concessional funding from the Clean Technology Fund (CTF).

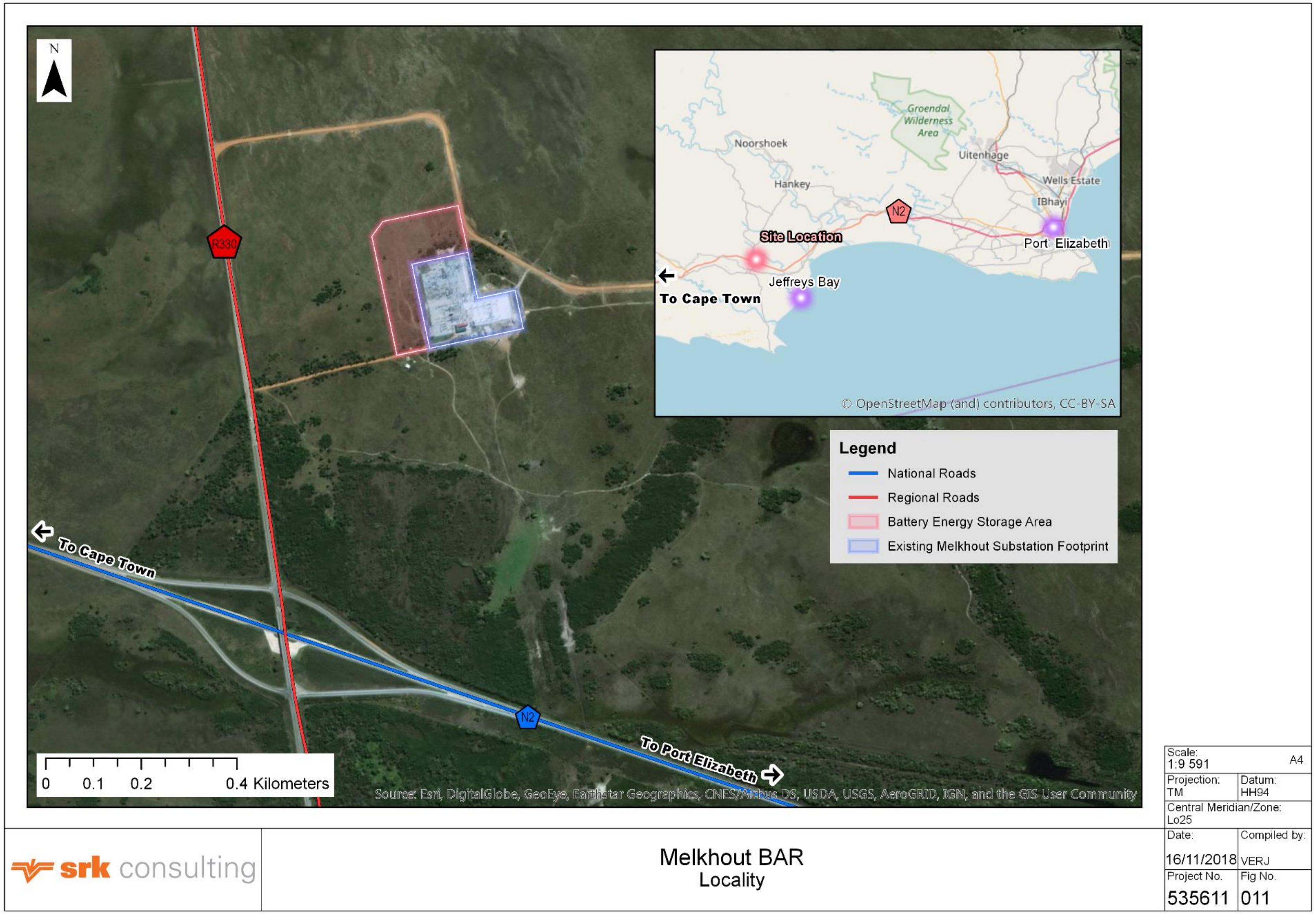

Figure 1: Locality Plan for Melkhout BESS

1.2 Details and Expertise of the Environmental Assessment Practitioners (EAPs)

SRK Consulting comprises over 1,500 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Port Elizabeth environmental department has a distinguished track record of managing large environmental projects and has been practicing in the Eastern Cape since 2001. SRK has rigorous quality assurance standards and is ISO 9001 certified.

The qualifications and experience of the independent Environmental Assessment Practitioners (EAPs) undertaking the Basic Assessment are detailed below and Curriculum Vitae provided in Appendix G.

Tanya Speyers (BSc Hons) is an Environmental Scientist in the SRK Port Elizabeth office. Tanya has been involved in EIA's and environmental management for the past 7 years. Her expertise includes Basic Assessments, Environmental Impact Assessments, Environmental Management Plans, environmental compliance auditing, and Water Use License Applications. Tanya is the principal author of this Basic Assessment.

Rob Gardiner (MSc, MBA, Pr Sci Nat) is the Principal Environmental Scientist and head of SRK's Environmental Department in Port Elizabeth. He has more than 25 years environmental consulting experience covering a broad range of projects, including Environmental Impact Assessments (EIAs), Environmental Management Systems (EMS), Environmental Management Programmes (EMPr), and environmental auditing. His experience in the development, manufacturing, mining and public sectors has been gained in projects within South Africa, Lesotho, Botswana, Angola, Zimbabwe, Suriname and Argentina. Rob is the technical reviewer of this Basic Assessment.

1.1 Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK's fee for conducting this BA process is based on its normal professional daily rates plus reimbursement of incidental expenses. The payment of that professional fee is not contingent upon the outcome of the Report(s) or the BA process.

As required by the legislation, SRK has completed and submitted a declaration of interest, as part of the EIA application form, and the qualifications and experience of the individual practitioners responsible for this project are detailed above.

2 Project Description

The Melkhout 132/66/22 kV distribution substation is situated approximately 2.5 km to the north of the town of Humansdorp in the Eastern Cape on the Remainder of Erf 499. The land is currently leased from the Kouga Local Municipality, however Eskom are in negotiations to purchase the portion occupied by the substation. It is anticipated that construction of the BESS will take place between January 2021 and February 2022.

Currently four Wind Energy Facilities (WEFs) are supplying the Melkhout distribution substation. These are as follows:

- 80 MW Kouga WEF;
- 138 MW Jeffreys Bay WEF;
- 110 MW Gibson WEF; and
- 95 MW Tsitsikama WEF.

A further 140 MW WEF at Oyster Bay has been approved by the Department of Energy (DoE) as part of Round 4 of the Renewable Energy Independent Power Producer Programme (REIPPP) to connect at Melkhout, thus increasing the installed WEF capacity at Melkhout substation to 563 MW in 2021. With the addition of the Oyster bay WEF, the three 132 kV lines will be operating close to their thermal limits.

Renewable energy sources are by nature intermittent and do not offer a reliable supply of energy. This intermittent supply of energy creates difficulties in planning the daily operation of the grid to maintain the supply/demand balance of the system. The WEFs provide additional generation capacity to Eskom when available (dependant on wind speed) and run on a take or pay basis. During times when there is available capacity from the WEF's but this energy cannot be dispatched due to excess energy in the system, the WEF's are curtailed and Eskom is required to pay energy costs to the IPP. Installation of the BESS will reduce/eliminate the need for curtailment as the excess energy can be stored in the batteries.

In addition to mitigating the impacts of curtailment the BESS may be utilised for morning and evening peak shaving. Peak demand on the grid generally only occurs for a few hours a day. Grid operators keep peaking resources on standby, ready to inject a surge of additional power into the grid. Peaking power supply resources typically have been served by fossil fuels such as gas peaking plants, however battery energy storage can be used for this purpose. The BESS dispatches its load during peak periods to minimise the need to use fossil fuels to meet peak demand.

During periods where the BESS is not required to charge or discharge it may be used for frequency response. The electrical grid transmits power from generators to end users at a fixed alternating current (AC) frequency. When power generation is equal to power usage, the frequency is stable. If usage is higher than generation, the frequency drops and can, in extreme cases, cause brownouts and blackouts. When power generated exceeds the demands of the grid, the frequency rises and this can damage the grid and connected devices. Frequency regulation involves monitoring the AC frequency and responding to anomalies to keep the frequency as close to the target frequency of 50 Hz as possible. As more and more renewables are connected to the electrical grid, variability in supply and fluctuations in frequency are increasingly frequent and severe. Typically, fossil fuel plants are ramped up or down to provide frequency regulating services. BESS can be used instead for this application as it provides further flexibility and a much faster response time.

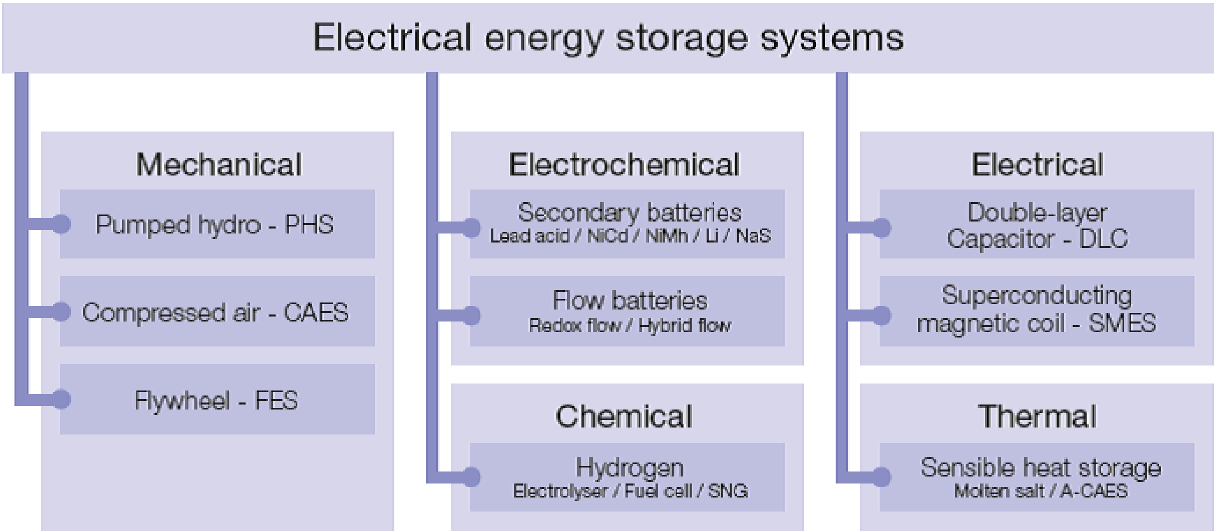

Figure 2: Types of Energy Storage Systems (Source: (International Electrotechnical Commission, 2011))

Several types of Energy storage exist as depicted in Figure 2. Storage on a large scale has until recently been dominated by pumped hydro-electric power which utilises fossil fuels. This however takes years to build and is limited to areas that have the right topography and water availability. The falling costs and advances in battery technology along with the increase in renewable energy facilities has led to the rise in use of this type of energy storage option. A high level summary of the different storage technologies and their suitability for use in South Africa is given in Table 2-1 below.

Table 2-1: Comparison of Energy Storage Technologies Source: (US Trade and Development Agency, 2017)

Technology	Maturity	Risks/Barriers	Disadvantages	Advantages	Best Applications **	Future potential for SA utility-scale energy storage
Lead-Acid Battery	mature	environmental consideration	• low cycle life and DoD • Deteriorates with microcycles • limited lifetime	• Very mature technology • Low capital cost	**CEMS**	none
Advanced Lead Acid Battery	mature	environmental consideration	Low cycle life and limited DoD	• Better performance than lead-acid • Capital cost relatively low	**AS, GIS, CEMS**	Moderate-, near-, to mid-term
Nickel-Cadmium Battery	mature	environmental - toxic cadmium	• Low cycle life • Exhibits memory effect • low energy-to-weight • Relatively expensive	• Few maintenance requirements • Can operate in low temperatures	CEMS	none
Lithium Ion Battery (chemistry dependent)	commercial	• Safety - thermal runaway • More expensive than Lead-Acid	• limited but improving cycle life • Deep discharge cycles lower lifetime • Requires monitoring / BMS	• high round trip efficiency • high energy-to-weight ratio • continuing performance improvements • continuing manufacturing cost reductions	**BES, AS,** GIS, **CEMS**	Significant near- to long-term
Sodium Sulfur Battery	mature	• Safety - containment issues • Competition from other technologies	• limited cycle life • requires external heat system • high temperature system • large daily self-discharge	• high power and energy density • Longer discharge times than Li-ion	**BES, AS, GIS,** CEMS	Moderate near-term
Sodium Nickel Chloride	commercial	Competition from other technologies	Large daily self-discharge	Able to operate in relatively harsh climates	CEMS	limited
Vanadium Redox Flow	demo	• Not proven at utility scale • Rx stack membrane degradation	• lower round trip efficiency • low energy density • requires mechanical systems • high cost of Vanadium	• Power and energy scale independently • Mature for a flow technology • Vanadium is a SA resource • high cycle life, full DoD	**BES, AS, GIS, CEMS**	Significant now & long term
Iron-Chromium Flow	demo	• Not proven at utility scale • Toxicity of Chromium • Less mature than other flow batteries	• lower round trip efficiency • low energy density • requires mechanical systems	• Power and energy scale independently • small daily self-discharge • high cycle life, full DoD	**BES, AS, GIS, CEMS**	Moderate mid- to possibly long-term

Technology	Maturity	Risks/Barriers	Disadvantages	Advantages	Best Applications **	Future potential for SA utility-scale energy storage
Zinc-Bromine Flow	demo	• not proven at utility scale • Potential bromine toxicity • Limited module capacities • Dendrite formation	• lower round trip efficiency • Requires mechanical systems • Power and energy not fully independent • Requires occasional full discharge for dendrite removal	• High cycle life, full DoD • Less expensive electrolyte than Vn • Small daily self-discharge	BES, AS, GIS, CEMS	Significant near- to long-term
Flywheel	demo	• Long-term reliability unproven • expensive to manufacture	• Complex design /moving parts • short discharge duration • Very high daily self-discharge	• High cycle life / high peak power • Very fast charge / discharge and response • High round trip efficiency	AS, CEMS	Moderate mid- to long-term
Supercapacitors	commercial	High capital cost	• Low energy density • Short discharge time • High daily self-discharge	• High cycle life • Very fast charge / discharge and response	AS, CEMS	Significant now and future (hybrid apps)
CAES Adiabatic - cavern	demo	• system efficiency • environmental / permitting	• complex mechanical systems • limited geological sites • Relatively slow response time	• Eliminates need for fossil fuel • long system life, low LCOS • Small daily self-discharge	BES, AS	Moderate possibly long-term
CAES Tank Storage	demo	Expensive storage (tanks)	Complex mechanical systems	• increased siting flexibility • small daily self-discharge • high cycle life, full DoD	BES, AS, GIS, CEMS	Significant mid- to long-term
Hydrogen Fuel Cell	commercial	Low round trip efficiency	Complex mechanical systems	• Platinum is a SA resource • Small self discharge	not as a power-to-power app	none as power-to-power application
Liquid Metal	R&D	• Design challenges: battery seal • Lacking manufacturing processes	• Stationary applications, Liquid layers sensitive to motion • High temperature - requires active heating	• Long electrode life • Components self-segregate - no membrane • Low cost potential • Rapid charge/discharge	AS, GIS, CEMS	Significant in the future
Liquid Air	demo	Requires waste heat source to be competitive	• Slow ramping times / response • Complex mechanical systems	• Increased siting flexibility • Higher energy density than CAES • Small daily self-discharge • High cycle life, full DoD	BES, AS, GIS, CEMS	Significant mid- to long-term

** BES = Bulk Energy Services, AS = Ancillary Services, GIS = Grid Infrastructure Services, CEMS = Customer Energy Management Services

Three of these technologies have been identified by Eskom as the most appropriate for use at the Melkhout site. These are as follows:

- Lithium Ion (Li ion);
- Sodium Sulphur (NaS); and
- Vanadium Redox Flow Battery (VRF).

Eskom proposes to utilise either a single battery technology, or a combination of two or more of the above alternatives to make up the 160 MWh capacity.

The lifecycle of the battery technologies varies from ten to twenty-five years. Eskom will include a return to supplier clause, whereby the supplier will be responsible to recycle any hazardous waste emanating from the technology operation, maintenance and finally replacement as well as meet any legislative requirement that this may require

Certain components of the BESS such as the electrodes and electrolyte are comprised of, or contain, hazardous substances. These vary depending on the technology and are as follows for the battery technologies proposed for Melkhout:

- Lithium ion (Li ion): The components of the solid state battery include lithiated metal oxides as the cathode. While these compounds are in a solid form, and hence accidental spillage to the environment is not a significant risk factor, they are potentially dangerous (e.g. flammable, or corrosive).
- Sodium Sulphur (NaS): The components of the battery include beta-alumina solid electrolyte, sodium, and sulphur. While these materials are solid at room temperature, sodium is listed as a dangerous good in SANS 10234. These materials are intrinsic to the electric-energy storing module, are sealed within each module, are not consumed, and require no storage of additional volumes for topping up.
- Vanadium Redox Flow (VRF): Contain a vanadium electrolyte, in a strongly acidic solution. Although the dissolved vanadium is not listed as a dangerous good in SANS 10234, the medium in which it is dissolved (e.g. sulphuric acid) is listed, and the electrolyte can therefore

be considered a dangerous good. While it is noted that the electrolyte is pumped through the reactive cell from holding tanks, these tanks form an integral part of the battery system and no external tanks are required for the storage of additional volumes for topping up.

The exact volume of dangerous goods to be stored on site will vary depending on which technology option or combination of technologies is chosen. Eskom have committed to ensuring that the volume on site does not amount to more than 500 m³. A fuller discussion of technology alternatives is provided in the following section.

The BESS consists of a number of rechargeable batteries, each comprising one or more electrochemical cells. The battery cells are connected together into modules. These modules are then connected to form full battery stacks/packs (referred to as a battery panel in Figure 3).

The basic components of a BESS include the following:

- A battery stack (made up of multiple battery modules),
- The Battery Management System (BMS). This is responsible for monitoring, controlling, and protecting the battery cells, including preventing over-charge/under-charge;
- The Power Conversion System (PCS). The PCS contains the inverter to change the DC from the battery to AC for use in the grid;
- A cooling and fire suppression system; and
- External electrolyte tanks in the case of flow batteries.

These components are typically housed in containers (as seen in Figure 4) and at utility scale, as in the case of Melkhout, multiple containers are generally required. The system will be connected to the Melkhout 132 kV line via two existing 40 MVA, 132/22 kV transformers.

Network integration equipment (e.g. power cables, control cables, isolators, circuit breakers, transformers, etc.) will be required to connect the new BESS to existing infrastructure at the Melkhout substation. The site may also require additional fencing, security equipment, lighting, and/or control room upgrades. A platform (compacted fill, earth protection layer and stone chip) for the BESS will be constructed to accommodate the containers and cable trenches to connect the BESS to the grid.

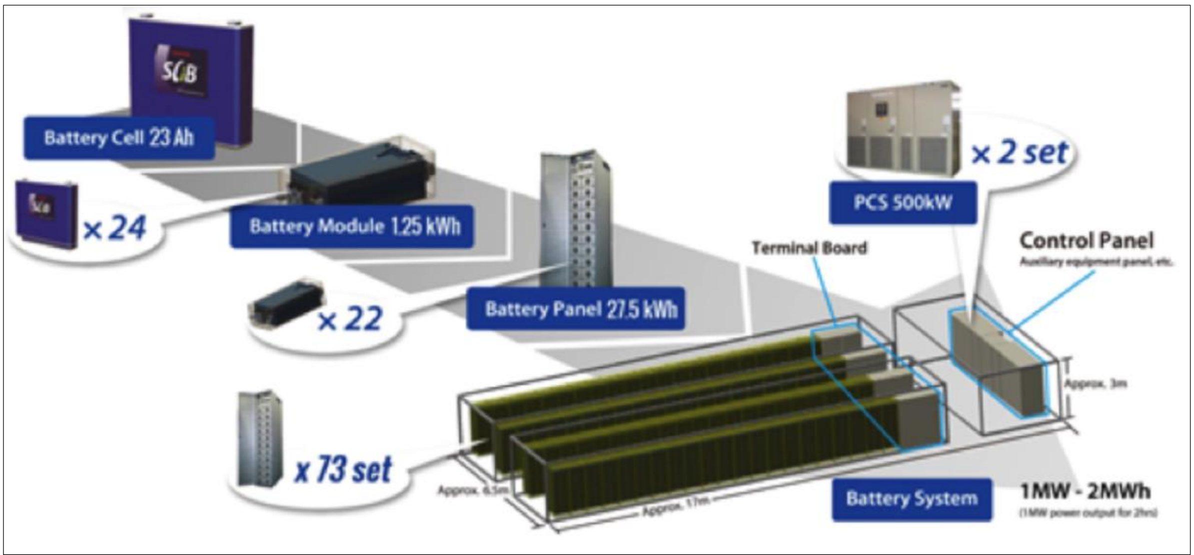

Figure 3: The Relationship between Battery Cells, Modules, and Panels (National Rural Electric Cooperative, 2018)

Figure 4: Example of a 29 MW BESS located in Aylesford, UK (Source: (Eskom, 2018)

3 Project Alternatives

3.1 Location Alternatives

Only sites where existing Eskom-owned land was available were considered for the installation of a BESS for a number of reasons. Construction of the BESS on an existing Eskom premises reduces the environmental footprint of the installation as the land has been previously disturbed. In addition, existing sites usually have security measures already in place such as fencing of the site and access control. Battery systems connect at medium voltage (11, 22 or 33 kV), and therefore require the use of transformers to step up from their connection point onto the sub-transmission network (66 or 132 kV). Choosing a site where additional transformers would have been required would have incurred additional spatial, environmental and financial impacts. In addition, the Humansdorp Melkhout site is fed by a number of WEF's and therefore provides the opportunity to assist in renewable energy smoothing. It is recognised that there are a number of separate applications at other substations, and that the selection of these substations as candidate sites for BESS technology is based on the considerations listed here. As such for this particular application, the only site alternative being considered is the Melkhout substation.

3.2 Activity Alternatives

The broader family of energy storage solutions includes pumped hydro storage, which Eskom operates at Drakensburg and Ingula power stations, compressed air energy systems flywheel energy storage, super-capacitors, molten salt, etc. (Refer to Figure 2). No activity alternatives to battery storage will be investigated in this report as feasibility studies conducted by Eskom have determined that BESS is the most practicable option.

3.3 Technology Alternatives

Eskom have evaluated several battery technologies as listed in Table 2-1. These have been narrowed down to three technologies that were considered most feasible for the Melkhout site with Li ion being the preferred technical alternative for Eskom.

Batteries may be classified as either solid state or flow batteries. Solid state batteries use solid electrodes and electrolytes. Flow batteries in the other hand use solid electrodes and liquid electrolytes. Each type has its own particular advantages and disadvantages.

The liquid electrolyte in a flow battery is typically held in tanks separate to the cell (or cells) of the reactor. Flow batteries can be recharged by replacing the electrolyte liquid. The discharge duration of flow batteries can thus be easily increased by adding more electrolyte and additional tanks without having to increase the capacity of the battery itself. This is termed scalability. The layout for flow batteries is flexible due to the separation of the electrolyte and battery stack. In addition, unlike the solid state batteries, all cells contain the same charge and therefore equalization of the cells, a process which can produce hydrogen gas, is not required. Flow batteries do however require a larger footprint than solid state batteries and have a lower energy density. Furthermore, the design is more complex than solid state batteries due to the external electrolyte tanks and their associated components. The nature of the electrolytes used pose a flammability and explosion risk. Examples of flow batteries include the NaS and VRF batteries discussed in section 3.3.2 and 3.3.3 respectively.

Solid state batteries have a greater energy density than flow batteries, they are more tolerant to high temperatures and don't store potentially flammable and toxic electrolytes as flow batteries do. The compression of the anode, cathode and electrolyte produces the added benefit of taking up less space than a flow battery. The solid state battery is however still an emerging technology and manufacturing costs are much higher than flow batteries. A solid state Li ion battery is the preferred technical alternative for Melkhout.

A description of the alternative technologies that have been selected as possibilities for the project is given below. A single battery technology, or a combination of two or more technology alternatives, may be implemented to make up the 40 MW/160 MWh required.

3.3.1 Lithium Ion

Li-ion batteries get their name from the transfer of lithium ions between the electrodes, both when energy is injected for storage purposes and when it is extracted. Within the lithium family there are a variety of different chemistries and designs from numerous suppliers.

Instead of metallic lithium, Li-ion batteries use lithiated metal oxides as the cathode, and carbon typically serves as the anode. Unlike other batteries with electrodes that change by charging and discharging, Li-ion batteries offer better efficiency because the ion movements leave electrode structures intact.

The solid state lithium ion battery differs from the conventional flow version as it uses a solid such as ceramic as the electrolyte rather than the typical lithium salt liquid (Refer to Figure 5 for a comparison). Solid-state batteries compress the anode, cathode, and electrolyte into three flat layers instead of suspending the electrodes in a liquid electrolyte. This makes for a battery with greater energy density and safer conditions.

Lithium-ion-based energy storage systems may have cycle durations up to 4 hours. The expected lifetime is related to the cycling Depth of Discharge (DoD). Li-ion batteries' lives are generally limited to less than 80% DoD to ensure an adequate life. Most utility scale applications have an approximate 10-year lifetime.

The modularity of the Li-ion cells allows them to be constructed as modules and scaled. Battery packs can then be combined with inverters and controls systems and packaged into BESS at manufacturing facilities. When packaged into standard shipping container sizes, shipping the BESS around the world via truck, rail, or ship is greatly facilitated. Containerized BESS can be sited on pads or simple foundations and electrically connected to switchgear. Containerization significantly reduced the costs for local labour and on-site construction.

The greatest maintenance issue for Li-ion batteries is generally the monitoring and replacement of individual cells/modules later in life as replacement is required. Modularized and packaged systems offer ease of system removal from site for disposal at end of life. Site contamination is unlikely, and site restoration would include infrastructure removal and revegetation. The materials used in Li-ion batteries are typically considered non-hazardous waste. The metals in the system can be recycled, but they do not represent a high salvage value.

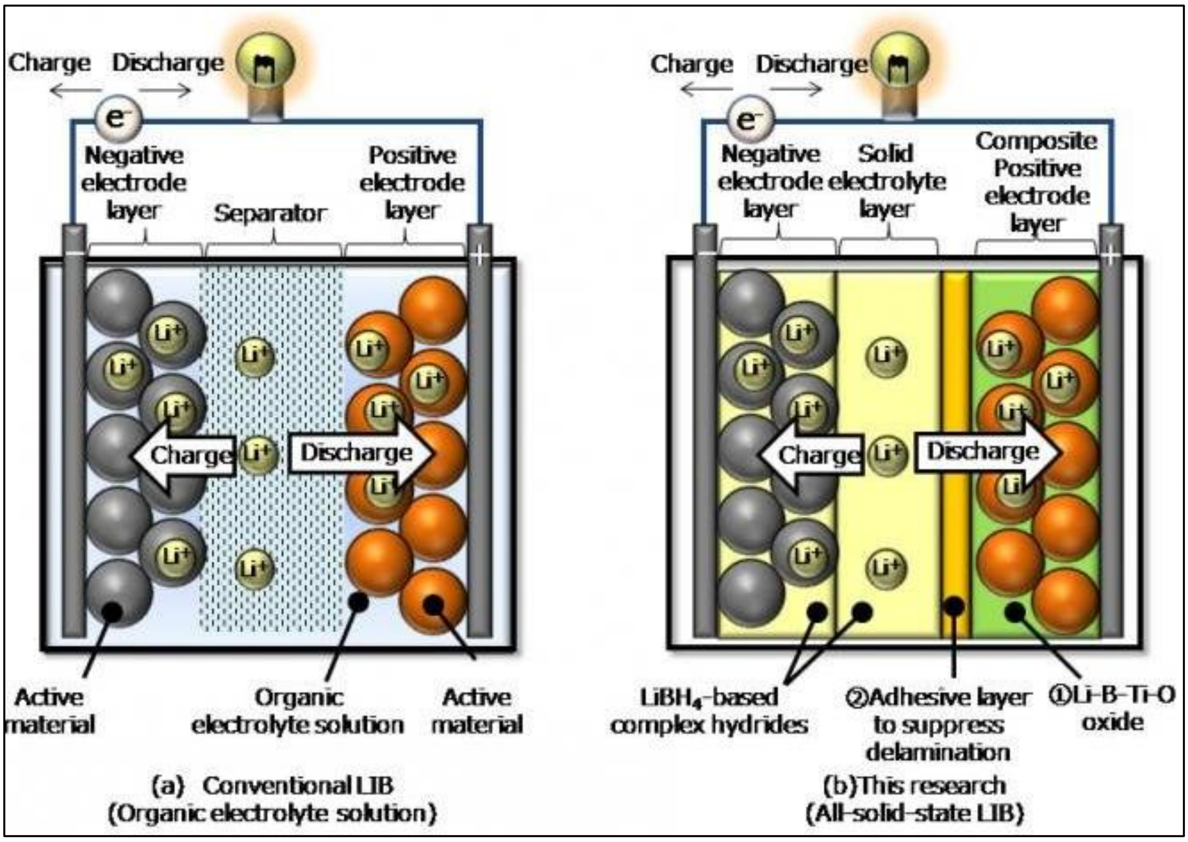

Figure 5: Schematic illustration of a Li ion battery (Source: (Tohoku University, 2015))

3.3.2 Sodium Sulphur

The Sodium Sulphur (NaS) battery is a relatively mature technology originally developed in the 1960's and commercially released since 2002. The active materials in a NaS battery are molten sulphur as the positive electrode and molten sodium as the negative. The electrodes are separated by a solid ceramic, sodium alumina, which also serves as the electrolyte. During discharge, sodium ions move from the negative electrode to the positive electrode through the beta-alumina, creating sodium polysulfide. When charging, the sodium ions return to the negative electrode. The internal temperature of the battery module needs to be kept at around 300°C by the electric heaters equipped in the thermal insulated enclosure, to maintain all active materials (sodium and sulphur) in a liquid state.

NaS batteries use hazardous materials, including metallic sodium, which is combustible if exposed to water. Therefore, NaS batteries have airtight, double-walled stainless-steel enclosures that contain the NaS cells. Common failures include electrical shorts due to corrosion of the insulators, which then become conductive, as well as the growth of dendrites, which increases self-discharge.

NaS batteries are robust and suited for utility scale use. They are able to charge and discharge the battery each day in a full cycle from 100% state-of-charge to 0% i.e. a full 100% depth of discharge. The batteries have a large capacity and can provide power for approximately six hours.

The round-trip AC-to-AC efficiency of sodium-sulphur systems is approximately 80%. The estimated life of a sodium-sulphur battery is approximately 15 years after 4,500 cycles at 90% depth of discharge. The sodium, sulphur, beta-alumina ceramic electrolyte, and sulphur polysulfide components of the battery are disposed of by routine industrial processes or recycled at the end of the NaS battery life.

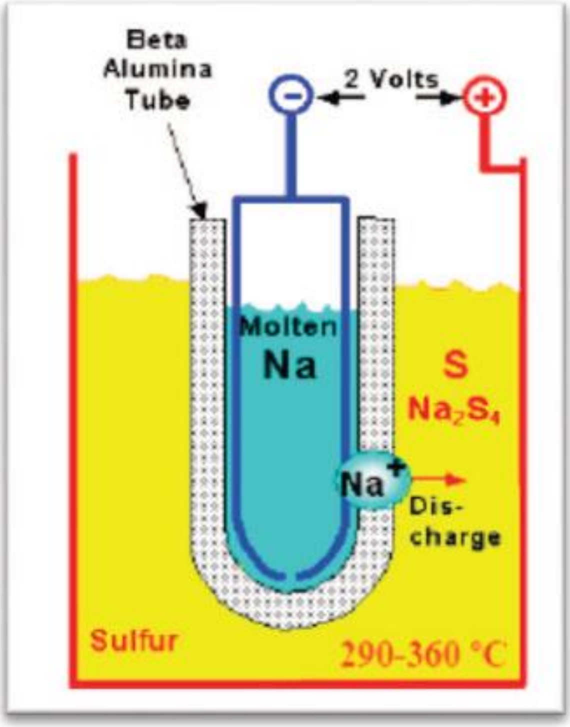

Figure 6: Schematic of a NaS cell (Source: (State Utility Forecasting Group., 2013)

3.3.3 Vanadium Redox Flow

The VRF is based on redox reactions of different ionic forms of vanadium. During battery charge, V^{3+} ions are converted to V^{2+} ions at the negativeelectrode through the acceptance of electrons. Meanwhile, at the positive electrode, V^{4+} ions are converted to V^{5+} ions through the release of electrons. Both of these reactions absorb the electrical energy put into the system and store it chemically. During discharge, the reactions run in the opposite direction, resulting in the release of the chemical energy as electrical energy;

Both electrolytes in the VRF are composed of vanadium ions in an aqueous sulphuric acid solution at very low pH. The acidity of the sulphuric acid is comparable to that of the electrolyte found in lead-acid batteries, with a pH of between 0.1 and 0.5.

The electrodes used in VRF are composed of high-surface area carbon materials. The membrane physically separates the two vanadium-based electrolyte solutions, preventing self-discharge while allowing for the flow of ions to complete the circuit. The vanadium electrolytes are stored in separate large electrolyte tanks outside the cell stack.

The electrolyte tanks and associated pipes, valves etc. must be composed of materials that are resistant to corrosion in the very low pH environment. The cell stack is generally environmentally benign. The only material in the stack that might be considered toxic is the ion exchange membrane, which is composed of highly acidic (or alkaline) material.

The VRF is the most technically mature of the flow-type battery chemistries. The first operational VRF was successfully demonstrated in the late 1980s.

The VRF offers a relatively high cell voltage, which is favourable for higher power and energy density Cross-transport of vanadium ions across the membrane is also reported as a challenge. These membranes can be vulnerable to fouling, wherein vanadium ions become irreversibly trapped in the membrane and increase resistive losses in the cell.

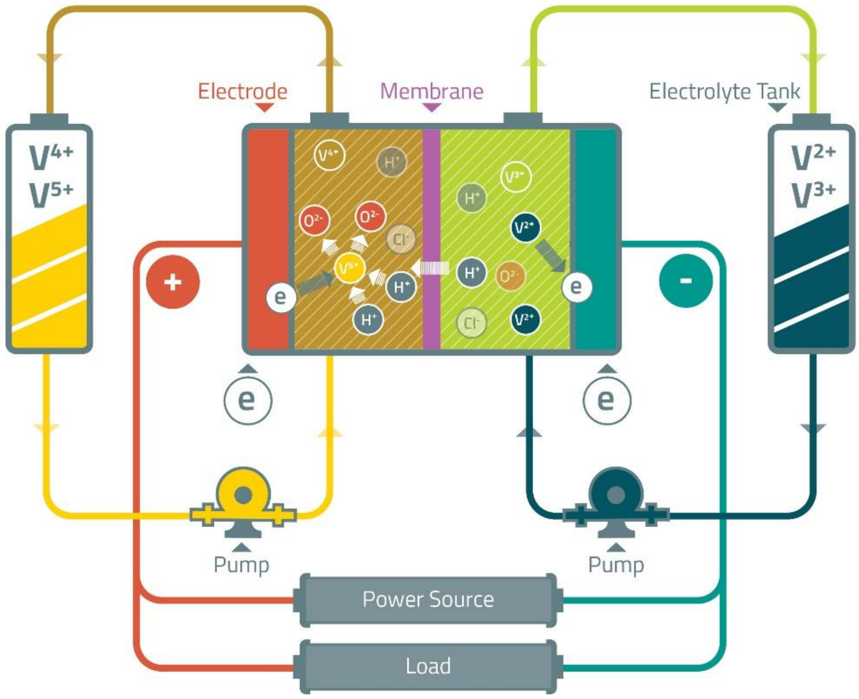

Figure 7: Schematic of Vanadium Redox Flow Battery (Source: (Vsun Energy Pty Ltd, 2019)

3.4 No-go Alternatives

A condition of the World Bank loan for construction of Eskom's Medupi and Kusile power stations was that Eskom would implement an agreed to "clean technology" i.e. BESS. Should Eskom not be able to complete the BESS project by the closing date for the for the loan, this would result in the automatic cancellation of any undisbursed funds from the loan. This will have a negative impact on future funding for Eskom and the Government of SA as guarantor to the loan. Eskom would still have to complete the project at its own cost, which would be extremely difficult considering current liquidity constraints. It is therefore crucial that this target date is met.

The socio-economic benefits of the proposed development would also be lost should the BESS project not be implemented. Economic benefits could be experienced across the entire value chain (e.g., materials, manufacturing, construction and systems installation, operations and maintenance, and employment. The potential exists for South Africa to fabricate major system components (including electrolyte) for flow batteries. Beyond the direct impact associated with the manufacturing, installation and operation of a BESS economic development would be increased through increased system reliability and the reduced cost of energy.

Environmentally, the no development option assumes the site remains in its current state, i.e. unutilized land. This would mean no negative environmental impacts such as vegetation loss or contamination of surface and groundwater. Specifics around the exact contribution of the BESS to the energy network have not been quantified, however all three technologies will contribute to a reduced usage of fossil fuel plants and will support increased renewable energy generation through the smoothing of renewables. This is in line with the objectives of the 2011 Integrated Resource Plan for Electricity (2010-2030) to reduce carbon emissions and invest in carbon offset technologies

4 Relevant Legislation and Legal Requirements

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

NEMA provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of the State, as well as to provide for matters connected therewith. Section 2 of NEMA establishes a set of principles that apply to the activities of all organs of state that may significantly affect the environment. These include the following:

- Development must be sustainable;
- Pollution must be avoided or minimised and remedied;
- Waste must be avoided or minimised, reused or recycled;
- Negative impacts must be minimised; and
- Responsibility for the environmental health and safety consequences of a policy, project, product or service exists throughout its life cycle.

Section 28(1) states that:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring."

If such degradation/ pollution cannot be prevented, then appropriate measures must be taken to minimise or rectify such pollution. These measures may include:

- Assessing the impact on the environment;
- Informing and educating employees about the environmental risks of their work and ways of minimising these risks;
- Ceasing, modifying or controlling actions which cause pollution/degradation;
- Containing pollutants or preventing movement of pollutants;
- Eliminating the source of pollution; and
- Remedying the effects of the pollution.

Legal requirements for this project

Eskom has a responsibility to ensure that the BESS development and associated construction activities and the Basic Assessment process conform to the principles of NEMA. The proponent is obliged to take action to prevent pollution or degradation of the environment in terms of Section 28 of NEMA.

4.2 NEMA 2014 EIA Regulations (as amended)

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation (EA) issued by the competent authority. In this context, the EIA Regulations that came into effect on 8 December 2014 and amended in April 2017, promulgated in terms of NEMA, govern the process, methodologies and requirements for the undertaking of EIAs in support of EA applications. Listing Notices 1-3 in terms of NEMA listed activities that require EA (called "NEMA listed activities").

GN R 982 of the EIA Regulations lays out two alternative authorisation processes. Depending on the type of activity that is proposed, either a Basic Assessment (BA) process or a Scoping & Environmental

Impact Report process is required to obtain EA. Listing Notice 1[1] lists activities that require a BA process, while Listing Notice 2[2] lists activities that require Scoping & Environmental Impact Report (S&EIR). Listing Notice 3[3] lists activities in certain sensitive geographic areas that require a BA process.

The regulations for both processes – BA and S&EIR - stipulate that:

- Public participation must be undertaken as part of the assessment process;
- The assessment must be conducted by an independent EAP;
- The relevant authorities must respond to applications and submissions within stipulated time frames;
- Decisions taken by the authorities can be appealed by the proponent or any other Interested and Affected Party (IAP); and
- A draft EMP must be compiled and released for public comment.

GN R 982 sets out the procedures to be followed and content of reports compiled during the BA and S&EIR processes.

The NEMA National Appeal Regulations[4] make provision for appeal against any decision issued by the relevant authorities. In terms of the Regulations, an appeal must be lodged with the relevant authority in writing within 20 days of the date on which notification of the decision (EA) was sent to the applicant or IAP (as applicable). The applicant, the decision-maker, interested and affected parties and organ of state must submit their responding statement, if any, to the appeal authority and the appellant within 20 days from the date of receipt of the appeal submission.

Legal requirements for this project

In light of the above, SRK has reviewed the legal requirements associated with the BESS at the Melkhout substation. Listed activities identified during the legal review process are listed in Table 4-1.

Table 4-1: NEMA Listed Activities relevant to the proposed project

No.	Listed Activity	Project activities or infrastructure triggering the activity
GN R 983 (Listing Notice 1):		
27	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for – (i) the undertaking of a linear activity	Indigenous vegetation will be cleared to accommodate the BESS. It is anticipated that approximately 7 Ha of indigenous vegetation will be cleared.
14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic meters or more but not exceeding 500 cubic meters	The DEA has confirmed that electrolyte within the batteries is considered storage of a dangerous good. The exact amount of electrolyte to be stored at Melkhout cannot be calculated at this stage as the technology has not yet been chosen. Eskom has, however, confirmed that the total amount of hazardous materials stored on site, as a result of this development, will not exceed 500 m³.
GN R 984 (Listing Notice 2):		
	N/A	

[1] GN R983 of 2014, as amended by GN327 of 2017.
[2] GN R984 of 2014, as amended by GN325 of 2017.
[3] GN R985 of 2014, as amended by GN324 of 2017.
[4] GN R993 of 2014, as amended by GN R2015 of 2015

No.	Listed Activity	Project activities or infrastructure triggering the activity
GN R 985 (Listing Notice 3):		
12	The clearance of an area of 300 square meters or more of indigenous vegetation a. Eastern Cape ii. Within critical biodiversity areas identified in bioregional plans.	The Melkhout site is located within a CBA and indigenous vegetation will be cleared to accommodate the containers. It is anticipated that approximately 7 Ha of indigenous vegetation will be cleared.

4.3 Other environmental legislation

In addition to the EIA regulations, a number of laws are relevant to the proposed development. Typically this is either because they have bearing on the project's need & desirability, or alternatively because define the need for the competent authority (DEA) to obtain input from other licensing / permitting authorities prior to making a decision on whether or not to authorise the proposed development.

This section provides a summary of the key legislation that is relevant to this proposed development and the practical implications thereof.

4.3.1 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA)

This Act provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 107 of 1998. In terms of the Biodiversity Act, the developer has a responsibility for:

a. The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

b. Application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all developments within the area are in line with ecological sustainable development and protection of biodiversity.

c. Limit further loss of biodiversity and conserve endangered ecosystems.

The objectives of this Act are:

a To provide, within the framework of the National Environmental Management Act, for –

i The management and conservation of biological diversity within the Republic;

ii The use of indigenous biological resources in a sustainable manner.

The Act's permit system is further regulated in the Act's Threatened or Protected Species Regulations (GN 255), which were promulgated in March 2015, the National List of threatened ecosystems (GN 1002) promulgated in December 2011 and the Alien Invasive Species regulations (GNR 598) of August 2014.

Legal requirements for this project

No protected species may be removed or damaged without a permit, and the proposed site must be cleared of alien vegetation using appropriate means.

4.3.2 National Heritage Resources Act No. 25, 1999

The protection and management of South Africa's heritage resources is controlled by the National Heritage Resources Act 25 of 1999. The enforcing authority for this act is the South African Heritage Resources Agency (SAHRA).

In terms of the Act, historically important features such as graves, trees, archaeological artefacts/sites and fossil beds are protected. Similarly, culturally significant symbols, spaces and landscapes are also afforded protection. In terms of Section 38 of the National Heritage Resources Act, SAHRA can call for a Heritage Impact Assessment (HIA) where certain categories of development are proposed. The Act also makes provision for the assessment of heritage impacts as part of an EIA process and indicates that if such an assessment is deemed adequate, a separate HIA is not required.

The Act requires that:

"…any person who intends to undertake a development categorised as the ...

a. the construction of a road, wall, powerline, 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 50 m in length;
c. any development or other activity which will change the character of a site— (i) exceeding 5 000 m² 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 or a provincial heritage resources authority;
d. the re-zoning of a site exceeding 10 000 m² 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..."

Legal requirements for this project

A Phase 1 heritage assessment (archaeological and palaeontological studies) has been undertaken and the executive summary of the DBAR will be distributed to the Eastern Cape Provincial Heritage Resource Association (ECPHRA). No further action is required.

4.3.3 National Water Act No. 36 of 1998

The National Water Act (NWA) recognises that the protection of water resources, including not only the water itself but the entire aquatic ecosystem, is necessary to achieve sustainable use of water for the benefit of all water users. In section 1 of the NWA a water resource is defined as being all water found in the various phases of the hydrological cycle, including that portion of water that is found underground. This definition ensures that the entire water resource is treated in an integrated fashion and as a resource that is common to all. The DWS has regulated that no activity may take place within a watercourse without authorisation from DWS therefore no development activities may occur within any wetland or riparian zone unless authorisation is granted by DWS in terms of section 21 of the NWA.

A General Authorisation (GA) in terms of Section 39 of the NWA, which is an authorisation for water uses as defined in Section 21(c) and section 21(i) without a license provided that the water use is within certain limits and complies with conditions as set out in the GA, was issued by DWS for prescribed water uses as contained in General Notice 509 of 2016 as published in the Government Gazette No. 40229 of 26 August 2016. However, according to section 3 of the Notice, it must be noted that the GA does not apply:

- to the use of water in terms of section 21(c) or (i) of the Act for the rehabilitation of a wetland as contemplated in General Authorisation 1198 published in Government Gazette 32805 dated 18 December 2009;
- to the use of water in terms of section 21(c) or (i) of the Act within the regulated area of a watercourse where the Risk Class is Medium or High as determined by the Risk Matrix;
- in instances where an application must be made for a water use license for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity;

Legal requirements for this project

An Aquatic Impact Assessment was conducted and it was determined that the development may include activities that are listed under section 21 of the National Water Act, in which case a Water Use Application (WUA) will be required. Construction may not commence until authorisation from DWS has been received.

5 Need and Desirability

BESS offers several benefits to Eskom and solutions to some of the challenges it faces:

- Reduction in carbon emissions in the country's power generation infrastructure;
- Unlocking constrained networks (Reduction in loading/ congestion of upstream High Voltage networks);
- Reducing voltage drops and improve quality of supply;
- Deferment or replacement of future capital expansion projects;
- Supports mini-grids in areas with limited access to bulk power; and
- Peak load reduction - 4 hours of battery storage increases dispatch time (thereby extending baseload and offset carbon emissions).

As part of the Build Programme which includes the coal fired Medupi and Kusile power stations, Eskom committed to implementing technologies such as more efficient boilers and better emissions control, and to rolling out cutting edge clean technologies. The objective was to facilitate accelerated development of large scale renewable energy capacity in support of the long-term carbon mitigation strategy of South Africa.

The BESS project has the potential to reduce carbon emissions in South Africa's power generating infrastructure. BESS can achieve this in two ways, (a) by reducing the reliance on fossil fuel powered peaking plants that are used to managed variability on the power from renewable energy installations, and (b) by storing excess power generated by renewable energy projects when demand is low, but wind (for example, is high) and feeding this back into the grid when demand is high and power generation from renewables is low. The use of batteries is preferred as a greener energy alternative to fossil-fuel plants to reduce carbon dioxide emissions. A further advantage is that a BESS can respond in milliseconds to increased grid demand, which can usually take up to a few hours to ramp up if fossil fuel plants are used.

6 Description of the Environment

This chapter provides a description of the biophysical and socio-economic environments that could potentially be impacted by the proposed project.

Descriptions of the environment are based on a combination of on-site observations, GIS information, specialist studies, and a survey of the relevant literature to determine what could be expected on or near the site of the proposed development.

6.1 Climate

The Humansdorp area (closest town to the site) receives an average annual rainfall of 474 mm. The greatest rainfall is received during the month of August (48 mm) and the lowest during January (27 mm). The average midday temperatures range between 18.6°C during winter (July) and 25°C in summer (February). The coolest night time temperatures are experienced July when the temperature drops to an average of 7.4°C (SA Explorer, 2000-2018).

6.2 Hydrology and Aquatic System

An Aquatic Impact Assessment (AIA) was done by SRK Consulting (November 2018). A copy of this report can be found Appendix D. The site is located within the Fish to Tsitsikamma Water Management Area (WMA), specifically within the Tsitsikamma Sub-Water Management Area. The quaternary catchment applicable to the development is K90F. The latest 1:50,000 topographical data shows no drainage lines occur within 500 m of the development site. A few farm dams have been built in the area (mostly along drainage lines), to provide domestic and stock water. The Swart River, located approximately 740 m to the north, and the Seekoei River, approximately 6.2 km to the south, are the predominant perennial rivers within the quaternary catchment.

The hydrology of the area appears to include subsurface sheet-flow on a shallow impermeable rock layer for most of the site and surrounding areas. Soil samples taken in the surrounding areas indicate regular water flow. It appears that water received within the surrounding catchment flows along the shallow rock layer (under the soil surface) in a south-south-western direction collecting in depressions where the wetland features are located (as mentioned below). Disturbances, such as the Melkhout Substation and the adjacent windfarm access road, have altered/ blocked the sheet-flow in areas, causing changes in the hydrology of the area.

According to the Aquatic Impact Assessment several wetlands are located within the DWS Regulated Area of the site. A total of six wetlands were assessed which could potentially be affected as a result of the development.

The Ecological Importance and Sensitivity (EIS) of Wetland 1, 2, 3, 4 & 5 was assessed to be Moderate, which implies that this system has moderate ecological importance and sensitivity, due mostly to the diversity of vegetation, the occurrence of unique species and conversely the presence of invasive alien species. Wetland 6 has a Low/Marginal EIS and is not ecologically important and sensitive at any scale.

All six wetlands were classified as seeps using the hydrogeomorphic (HGM) approach to the classification system. It is considered likely that these systems are artificial naturalised systems that formed after the construction of the N2 National Road directly down-stream of these systems.

The Present Ecological State (PES) derived for Wetlands 1-4 is Category A. The condition of a wetland in Category A is described as unmodified or natural. The PES for both Wetlands 5 & 6 was rated as Category D. The condition of a wetland in Category D is described as largely modified, meaning that a large loss of natural habitat, biota and basic ecosystem functions has occurred.

A summary of the information and assessments conducted for all aquatic systems appear in Table 6-1 below. Based on the findings of the assessment, it was recommended that a 50 m area be maintained around all delineated wetlands as identified in the aquatic assessment report.

Table 6-1: Summary of aquatic systems identified and their classification, PES, EIS & REC

Watercourse ID	Area (ha)	Natural/ Artificial	HGM Type	PES	EIS	REC
Wetland 1	7.27	Natural (modified)	Seep	Class A	Moderate	C
Wetland 2	2.18	Natural (modified)	Seep	Class A	Moderate	C
Wetland 3	0.51	Natural (modified)	Seep	Class A	Moderate	C
Wetland 4	0.89	Natural (modified)	Seep	Class A	Moderate	C
Wetland 5	9.05	Natural (modified)	Seep and Depression	Class D	Moderate	C
Wetland 6	0.60	Natural (modified)	Seep	Class D	Low/ Marginal	D

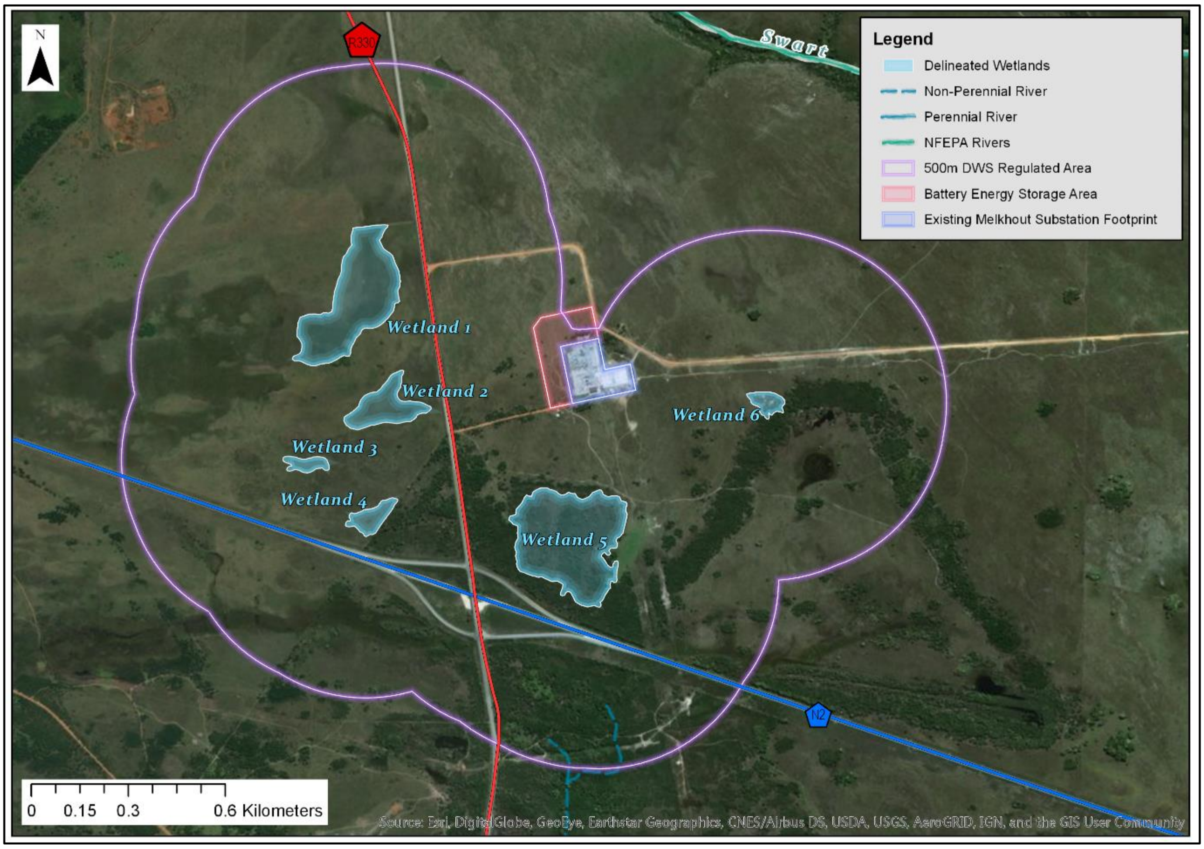

Figure 8: Overview of identified wetlands within 500 m of the proposed development.

6.3 Vegetation

A Vegetation Assessment was done by SRK Consulting (November 2018). A copy of this report can be found in Appendix D.

According to the National Vegetation Map (Mucina & Rutherford, 2012), the site is located within the Kouga Grassy Sandstone Fynbos listed as *Least Concern* (conservation target of 23%). Kouga Grassy Sandstone Fynbos (FFs 28) is described as low shrubland with sparse emergent tall shrubs and dominated by grasses in the undergrowth, or grassland with scattered ericoid shrubs. The lower dry slopes (where leeching is less severe) support a higher grassy cover.

Findings of the vegetation assessment noted that the vegetation on site consists of a mix of species related to Kouga Grassy Sandstone Fynbos as well as Humansdorp Shale Renosterveld. It is therefore likely that the site is located within a transitional zone between the two vegetation types. Humansdorp Shale Renosterveld is classified as Endangered (conservation target of 29%) according to Mucina and Rutherford (2012). Eighteen plant species of special concern were growing within the study area.

The majority of the vegetation on the proposed site is moderately intact. It consists of a matrix of fynbos shrubs, restiads, grasses, scattered succulent species and bulbous geophytes. During the site visit, 110 indigenous species were identified within the study area. The dominant species on site consists mostly of graminoids and ericoid shrubs and include *Brachiaria serrata, Cliffortia linearifolia, Disparago ericoides, Eragrostis curvula, Eragrostis capensis, Passerina obtusifolia, Montinia caryophyllacea, Syncarpha striata, Elytropappus rhinocerotis, Thamnochortus glaber, Trilobium hispidum,* and *Tristachya leuocthrix*. There are several rocky outcrops within the site boundary, although the majority of which contain vegetation similar to the surrounding vegetation and are not considered particularly sensitive. However, one of the rocky outcrops situated towards the north of the site contains vegetation which was only observed on the rocky outcrop and is therefore considered sensitive and should be protected from disturbance during construction.

Alien invasive vegetation was observed within and adjacent to the proposed BESS area. Some of the alien invasive species included *Acacia cyclops*, *Acacia saligna* and *Acacia melanoxylon* and *Acacia mearnsii*. The sections of the site on and directly adjacent to areas of disturbance are largely infested with Acacia mearnsii. Isolated clumps and individuals of Acacia cyclops (Rooikrans), A. saligna (Port Jackson Willow) and *A. melanoxlyon* (Australian Blackwood) are scattered around the site. The surrounding area is also infested with large stands of *Acacia mearnsii* (most prominently within the surrounding wet areas).

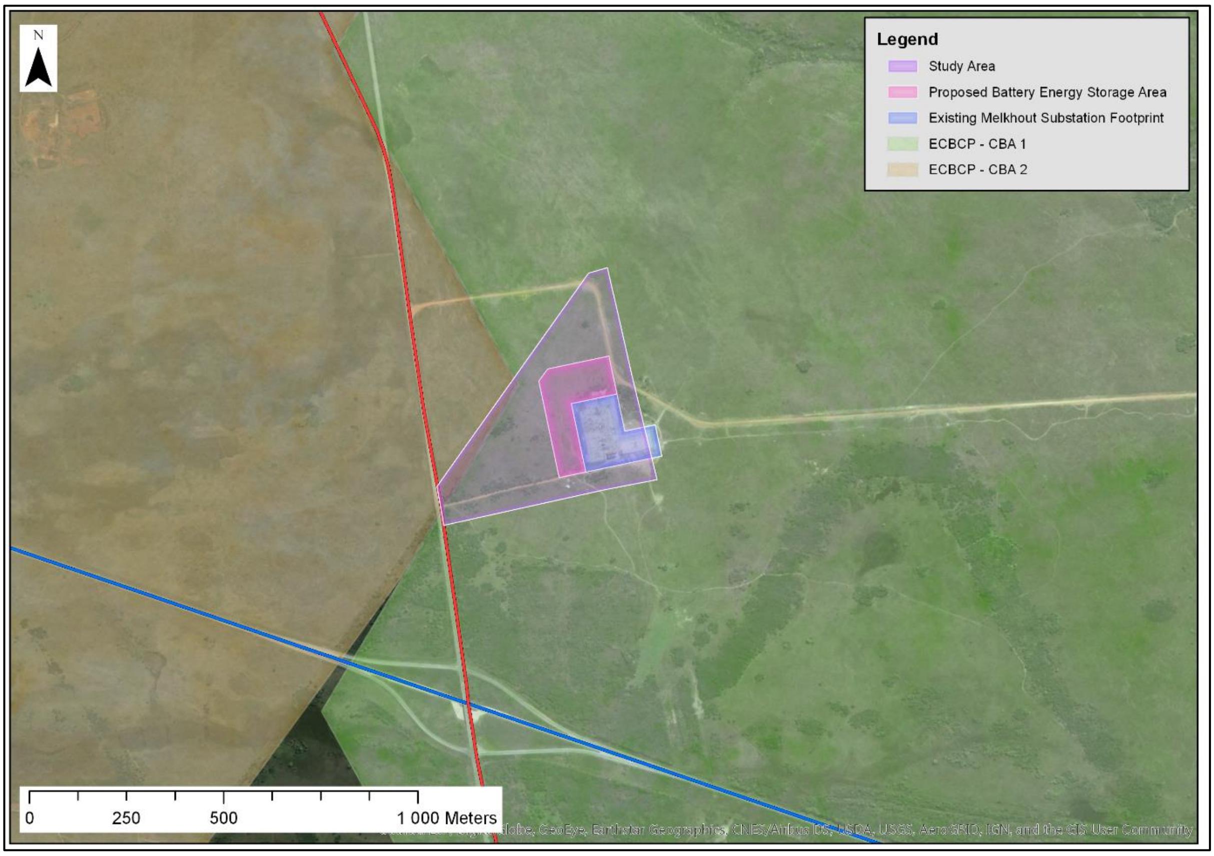

Figure 9: ECBCP Terrestrial Critical Biodiversity Area (CBA) map

6.4 Fauna

During the vegetation assessment a pair of Blue Crane (*Anthropoides paradise*) were observed within the site boundary (possibly nesting within the site), as well as evidence of antelope droppings scattered around the site.

6.5 Archaeological Features

A Phase 1 Archaeological Impact Assessment (Refer to Appendix D for a copy) was conducted by Ms Celeste Booth of Albany Museum to determine the age and importance of the exposed and *in situ* archaeological heritage material remains sites and features; to establish the potential impact of the development; and to make recommendations to minimise the possible damage to the archaeological heritage. An executive summary of the DBAR referencing these specialist findings will be sent to the ECPHRA.

The general landscape for the proposed extension of the substation as well as the extended 50 m survey area is mainly of dense grass vegetation cover. This obscured archaeological visibility. No archaeological heritage remains were observed within the surface disturbed areas such as the dug-out burrow holes and eroded areas.

One stone artefact was encountered, *ex situ*, outside the boundary of the proposed development along the gravel access road to the adjacent wind farm. It is, however, possible that stone artefacts may occur below the vegetation cover between the surface and 50 – 80 cm below the ground.

According to the Archaeological Impact Assessment, no archaeological/historical heritage resources were identified within the area of the proposed development. One stone artefact was encountered along the gravel road adjacent to the wind farm *ex situ*, outside of the boundary of the proposed development. The area is considered as having a low archaeological heritage significance.

6.6 Palaeontological Features

SRK subcontracted Rob Gess Consulting to conduct a Palaeontological Assessment for the BESS development. A copy of this report can be found in Appendix D. An executive summary of the DBAR referencing these specialist findings will be sent to the ECPHRA

The study area is situated within strata of the Cape Supergroup. More specifically portions of the Table Mountain Group exposed due to horizontal truncation of an anticline, and flanked by strata of the stratigraphically higher Bokkeveld Group. These rocks represent sediments deposited in the Agulhas Sea, which had opened to the south of the current southern African landmass in response to early rifting between Africa and South America. The Table Mountain Group constitutes the first of three subdivisions of the Cape Supergroup. It consists of quartzitic sandstones derived from coarse sands deposited within the Agulhas Sea, and along its coastal plane. It was deposited during the Ordovician, Silurian and earliest Devonian Periods, approximately 500-400 million years ago.

The Development is planned to be constructed overlying strata of the Silurian aged Goudini Formation, the lowermost formation of the Nardouw Subgroup, which forms the upper portion of the Table Mountain Group. This Formation comprises a series of thin reddish to brownish weathering quartzose sandstone interbedded with siltstone or shale units. Around Humansdorp it reaches approximately 250 metres in overall thickness and frequently (though not in this case) weathers to form valleys. The quartzites have been interpreted as fluvially deposited, though the siltstones suggest intermittent marine incursions. Trace fossils have been recorded from this unit in the Western Cape, however body fossils are yet to be located.

The proposed development site was visited and surveyed by the palaeontologist, on foot, on 20 October 2018. Mapping of the area as overlying the Goudini Formation was confirmed. Strata in the area are near vertically tilted due to the folding and weathering has reduced the natural outcrop to a series of parallel approximately north-south trending low quartzitic outcrops. These are separated by negatively weathering heathy areas overlying the more mud rich units. Patchy development of iron rich silcrete was noted over the mud-rich units, particularly adjacent to the quartzitic ridges.

The study found that it is unlikely that fossils will be disturbed, however the possibility exists, and any fossils recovered would be of great significance.

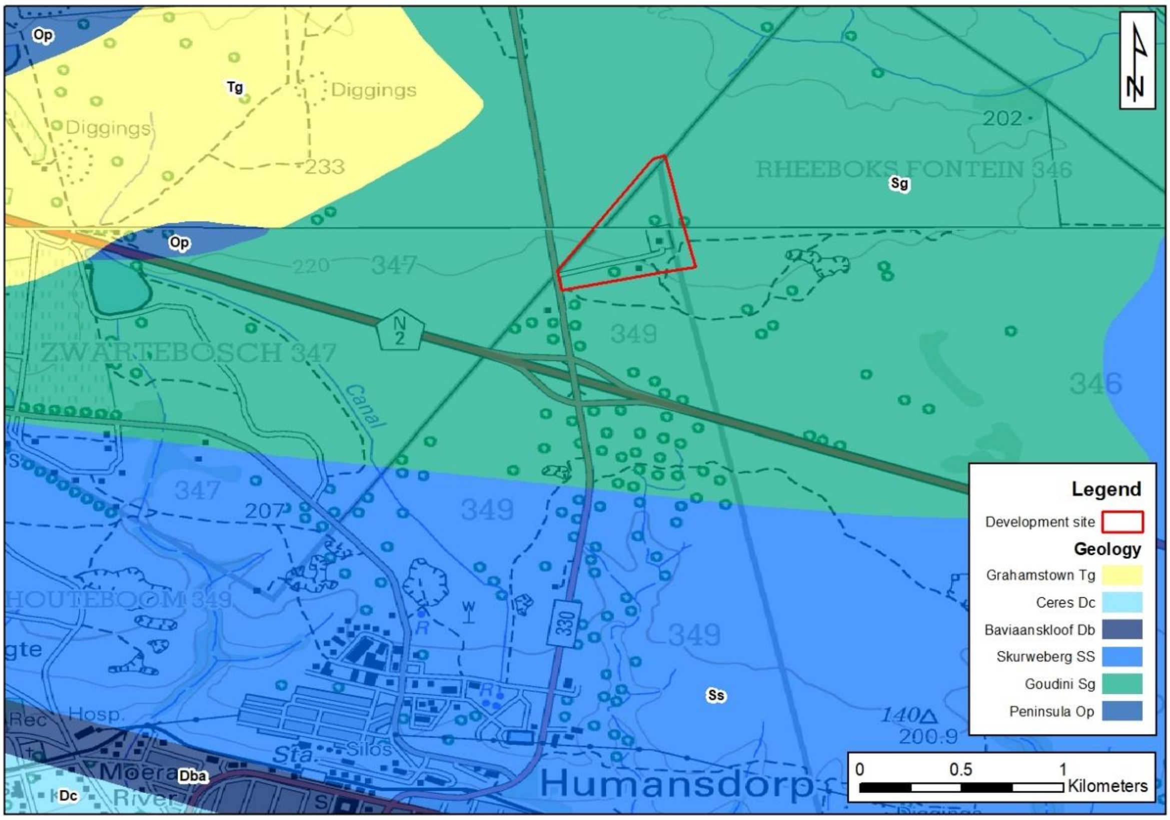

Figure 10: Geology of the site

7 Public Participation

A Public Participation Process (PPP) was undertaken with the intent of informing key local communities (directly affected people) about the proposed activities and the Basic Assessment process underway. Public participation plays an important role in the compilation of environmental reports as well as the planning, design, and ultimately the implementation of the project. Public participation is a process leading to informed decision-making, through joint effort by the proponent, technical experts, governmental authorities, and systematically identified interested and affected parties (IAPs).

The overall aim of the PPP is to ensure that all Interested and Affected Parties (IAPs) have adequate opportunities to provide input into the process. More specifically, the objectives of the PPP are as follows:

- Identify IAPs and notify them of the proposed project and of the EIA process;
- Provide an opportunity for IAPs to raise issues and concerns;
- Provide an opportunity for IAPs to review and comment on all reports before they are finalised; and
- Provide a record of responses to comments and concerns available to IAPs.

7.1 Identification of Interested and Affected Parties

The PPP for the project was initiated with the development of a comprehensive IAP database (refer to Appendix E). The IAP database included:

- Commenting authorities;
- Landowners and adjacent landowners
- The Kouga Local Municipality;
- The Sarah Baartman District Municipality; and
- Councillors for Ward 7 and Ward 15.

7.2 Public Participation Activities

The Public Participation Process that was undertaken to solicit public opinion regarding the proposed activity has included the following activities so far (for proof of the activities below, please refer to Appendix E):

- Distribution of the Background Information Document (BID) on 15 October 2018 informing identified Interested and Affected Parties (IAPs), authorities and stakeholders of the proposed Basic Assessment Process and inviting them to register as IAPs.;
- Provision of a 30-day comment period on the BID (16 October – 14 November 2018);
- Placement of an onsite poster of the proposed activities on 24 October 2018 affixed to the entrance gate of the site:
- Advertisement of the Basic Assessment Process in the newspaper “The Kouga Express” on 15 November 2018;
- Compilation of the Draft Basic Assessment Report (DBAR)
- Distribution of a hard copy of the complete DBAR to all the relevant authorities, stakeholders and the Humansdorp Public Library for review by IAPs;
- Making an electronic copy of the complete DBAR available from SRK Consulting upon request;
- Distribution of the Executive Summary to all Stakeholders and IAPs registered for this process; and
- Provision of a 30-day comment period on the DBAR (17 July – 19 August 2019)

- Inclusion of original correspondence from IAPs on the DBAR and incorporation of these into the Final Basic Assessment Report (FBAR)(this report);
- Distribution of a hard copy of the complete FBAR to all the relevant authorities and the Humansdorp Public Library for informational purposes;
- Making an electronic copy of the FBAR available from SRK Consulting upon request;
- Distribution of the Executive Summary to all Stakeholders and IAPs registered for this process for informational purposes; and
- Submission of the FBAR to DEA for a decision regarding environmental authorisation.

Activities that will still be undertaken as part of the public participation process are:

- IAP notification of DEA's decision and appeal process once received.

7.3 Comments Received from I&APs

Comments received to date in response to the content of the onsite poster, newspaper notice and BID is summarised in Table 7-1 below. Original comments are included in Appendix E.

Table 7-1: Comments and Responses Table on the content of the onsite poster, newspaper notice and BID

Commentator	Issue Raised	Response (by SRK unless otherwise noted)
WJ Kruger (Adjacent Landowner) Nelly de Sousa (Adjacent Landowner) K Reichert (Gamtwa Khoisan Council)	Request for registration as IAP.	Registration effected.
Chumisa Njingana (SANRAL)	All building / structures should be erected at least 62 metres from any intersection.	The closest infrastructure will be located approximately 300 m from the intersection of the substation access road with the R330.
Chumisa Njingana (SANRAL)	No access from the National Road N2 shall be permitted, access shall be obtained from existing access of Route R330.	Access is to be via the existing dirt road which connects onto the R330.
Chumisa Njingana (SANRAL)	No installation of any infrastructure inside the road reserve.	No installations within the road reserve are planned.

Table 7-2: Comments and Responses Table on issues raised by DEA on the content of the DBAR

Commentator	Issue Raised	Response (by SRK unless otherwise noted)
Herman Alberts	Listed activities	
	All relevant listed activities must be applied for, be specific and be able to be linked to development activity or infrastructure as described in project description.	Please refer to Table 4-1 which lists activities and their applicability to the project.

	If activities listed in application form differ from those mentioned in FBAR, an amended application form must be submitted.	The listed activities in the FBAR are the same as those contained within the application form.
	EAP must provide detailed information regarding specifications of dangerous goods. Impact associated with relevant activity must be identified, described and assessed in BAR.	Eskom is not able to provide specifics such as the quantities and type of electrolyte as this will only be determined once a supplier has been selected through the tendering process. Eskom has however confirmed that the electrolyte volumes on site will be below the threshold of 500 m^3. Impacts related to the loss of containment of these dangerous goods are discussed and rated under Section 8.2.
	Alternatives	
	Provide a description of any feasible and reasonable alternatives, including advantages and disadvantages on environment and on community that may be affected. Alternatively submit written proof of investigation and motivation if no alternatives exist.	Alternatives are discussed under Section 3. Three technology alternatives are proposed and discussed under Section 3.3 and rated under Section 8.2.
	Specialist Declaration of Interest	
	Original signed Specialist Declaration of Interest for each specialist study must be attached to FBAR.	The original declarations have been included with this FBAR submission to DEA.
	Risk Assessment for each proposed technology alternative proposed must be conducted and included in FBAR.	The Risk Assessment is included in Appendix G.
	Undertaking of an Oath	
	Undertaking under oath by EAP was not included in DBAR, only the application form as an appendix. EAP Undertaking must be included in FBAR.	The EAP undertaking is included in Appendix G.
	Details and Expertise of EAP	
	Details and expertise of the EAP, including a CV, must be included in the BAR.	The CV of the EAP can be found in Appendix H.
	Public Participation Process	
	A list of IAPs must be included in the FBAR.	The IAP Register is included as Appendix E3.
	Copies of all comments received on the DBAR must be included in the FBAR.	DEA's correspondence on the DBAR is included in Appendix E5(ii).
	Comments and Response Report must be compiled and include DEA's comments.	The Comments and Responses Tables are included in the FBAR as Tables 7-1, 7-2 and 7-3 respectively.
	Issues and comments received from IAPs and authorities (including DEA: Biodiversity) must be adequately addressed in the FBAR.	Comments were received from DEA, DEA:Biodiversity and DWS and have been addressed in the FBAR.
	Proof of correspondence with stakeholders must be included in FBAR. If no comments	All IAP correspondence is included in Appendix E5.

	received, attempts to obtain comments must be submitted.	
	Environmental Management Programme	
	Must include all recommendations and mitigation measure recorded in the BAR and specialist studies.	All recommendations included in the BAR and specialist studies have been included in the EMPr.
	Must include an environmental sensitivity map indication environmental sensitive areas and features identified.	An environmental sensitivity map can be found in Appendix A.
	Must include measures to protect hydrological features and other environmental sensitive areas from construction impacts including direct or indirect spillage of pollutants.	Mitigation measures for hydrological features have been included in the aquatic specialist report in Appendix D. These measures have further been repeated in Section 8.2 of the FBAR and in the EMPr.
	Must include a detailed fire management and protection plan.	A detailed Fire and management plan will be compiled once the technology and supplier have been selected however the requirement for such a plan is stipulated in the EMPr including management measures to be covered by this plan.
	Must comply with Appendix 4 of EIA Regulations.	The EMPr has been compiled to comply with Appendix 4.
	General	
	FBAR must include period for which Environmental Authorisation is required and the date on which the activity will be concluded	It is anticipated that if construction and installation of the BESS commences in January 2021, the construction activities should be concluded by February 2022.
	FBAR must comply with Regulation 19(1)(a) of NEMA Regulations.	The FBAR has been submitted within the prescribed timeframes.
	FBAR must comply with Regulation 19(1)(b) of NEMA Regulations.	No new information has been added.
	Failure to comply with regulated timeframes will result in application lapsing.	Noted.

Table 7-3: Comments and Responses Table on issues raised by Commenting Authorities and IAPs on the content of the DBAR

Commentator	Issue Raised	Response (by SRK unless otherwise noted)
M Bloem (DWS)	A Water Use Authorisation is required for any activity taking place within the regulated area. Appendix D1 of the DBAR states that 6 potential wetlands were identified during the site visit. These wetlands occur within 500 m of the proposed site and could potentially be affected by contaminated runoff from construction activities. Recommended that a 50 m buffer be maintained around all wetlands mentioned in D1.	A WUA has been lodged with DWS and is currently at the pre-application phase. The buffer area has been included as part of the mitigation measures in the EMPr.

Commentator	Issue Raised	Response (by SRK unless otherwise noted)
M Bloem (DWS)	Risk Matrix must be done for Wetlands 5 and 6 to determine extent of impacts before and after mitigation measures have been implemented.	A risk matrix has been done and will be submitted as part of the Water Use Application.
S Tshitwamulomoni (DEA: Biodiversity)	The Directorate is not in support of the proposed development as it will pose a threat to biodiversity sensitive areas.	A vegetation specialist assessment was conducted for the project. A copy of the report is included in Appendix D. One rocky outcrop of a sensitive nature was observed and will require protection. The findings of the specialist assessment suggest that with the implementation of the recommended mitigation measures the project will have a low to insignificant long term impact on vegetation in the area.
S Tshitwamulomoni (DEA: Biodiversity)	Request a site visit to be conducted with the biodiversity specialist after submission of the FBAR in order to issue a final informative decision.	The vegetation specialist will avail themselves for a site visit once a date is proposed by DEA: Biodiversity.

8 Identification and Assessment of Potential Environmental Impacts

This section provides a brief indication of the significant potential positive and negative environmental impacts relating to the proposed road upgrade. Once a potential issue and/or potential impact has been identified it is necessary to identify which activity or aspect of the development would result in the impact. By considering the cause of the issue, the probability of the activity resulting in an impact can be determined. The associated impact can then be assessed to determine the significance and to define mitigation or management measures to address the impact.

The impact assessment methodology and the potential issues or impacts identified by the EAP and various specialists are detailed in the sub-sections to follow. Copies of all specialist reports are included in Appendix D. Specific measures for the mitigation of impacts are included in the EMPr, which can be found under Appendix F of the report.

8.1 Impact Rating Methodology

The assessment of impacts will be based on the professional judgement of the Environmental Assessment Practitioners (EAPs) as well as that of external specialists, fieldwork, and desktop analysis. The significance of potential impacts that may result from the proposed development will be determined in order to assist the competent authority in making a decision.

The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The criteria that have been used to determine impact consequences are presented in Table 8-1 below.

Table 8-1: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. Extent– the area over which the impact will be experienced		
None		0
Local	Confined to project or study area or part thereof (e.g. site)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment		
None		0
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration– the time frame for which the impact will be experienced		
None		0
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a Consequence Rating, as follows:

Table 8-2: Method used to determine the Consequence Score

Combined Score (A+B+C)	0 – 2	3 – 4	5	6	7	8 – 9
Consequence Rating	Not significant	Very low	Low	Medium	High	Very high

Once the consequence was derived, the probability of the impact occurring was then considered using the probability classifications presented in Table 8-3.

Table 8-3: Probability Classification

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall significance of impacts were determined by considering consequence and probability using the rating system prescribed in the table below.

Table 8-4: Impact Significance Ratings

Significance Rating	**Possible Impact Combinations**		
	Consequence		**Probability**
Insignificant	Very Low	&	Improbable
	Very Low	&	Possible
Very Low	Very Low	&	Probable
	Very Low	&	Definite
	Low	&	Improbable
	Low	&	Possible
Low	Low	&	Probable
	Low	&	Definite
	Medium	&	Improbable
	Medium	&	Possible
Medium	Medium	&	Probable
	Medium	&	Definite
	High	&	Improbable
	High	&	Possible
High	High	&	Probable
	High	&	Definite
	Very High	&	Improbable
	Very High	&	Possible
Very High	Very High	&	Probable

Significance Rating	Possible Impact Combinations		
	Consequence		Probability
	Very High	&	Definite

Finally, the impacts were considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The system for considering impact status and confidence (in assessment) is laid out in the table below.

Table 8-5: Impact status, reversibility and confidence classification

Status of impact		
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')	
	– ve (negative – a 'cost')	
Confidence of assessment		
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low	
	Medium	
	High	
Reversibility of impact		
Indication whether the impact is reversible or irreversible.	High	Reversible within the short-term
	Medium	Reversible within the medium to long term
	Low	Will never return to pre-impacted state

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below, as well as the reversibility of each potential impact which is the ability of the impacted environment to return to its pre-impacted state (see Table 8-5):

- *Insignificant:* the potential impact is negligible and will not have an influence on the decision regarding the proposed activity/development.
- *Very Low:* the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity/development.
- *Low:* the potential impact may not have any meaningful influence on the decision regarding the proposed activity/development.
- *Medium:* the potential impact should influence the decision regarding the proposed activity/development.
- *High*: the potential impact will affect the decision regarding the proposed activity/development.
- *Very High:* The proposed activity should only be approved under special circumstances.

Practicable mitigation measures will be recommended, and impacts will be rated in the prescribed way both with and without the assumed effective implementation of mitigation measures. Mitigation measures will be classified as either:

- *Essential:* must be implemented and are non-negotiable; or
- *Optional:* must be shown to have been considered, and sound reasons provided by the proponent, if not implemented.

8.2 Assessment of Potential Impacts

8.2.1 Construction Impacts

With the exception of the amount of space required for the footprint of the development[5], construction impacts are common to all of the technology alternatives and are discussed and rated independently from the technology alternatives.

i) W1: Waste management impacts during construction

Construction waste, as well as small amounts of domestic waste, will be generated during the construction phase and must be removed off site, and either taken to a registered waste disposal facility, or to a recycling facility. Lack of proper management of the waste on the site may lead to wind-blown litter and dumping creating a negative visual impact and potentially impact on aquatic ecosystems, and/or contamination of soil.

In the absence of mitigation, impacts from waste management are unlikely to extend beyond the site and its immediate surroundings and are therefore considered 'Local' in spatial extent. The volumes of waste generated during construction are unlikely to be substantial and, as a realistic worst case scenario, are rated as having a 'Medium' intensity. As incorrectly disposed of waste will remain in the environment indefinitely, the duration is rated as 'Long-term'. Poor waste management practices on unsupervised construction sites occur frequently and probability is therefore rated as 'Probable'.

Impacts during construction before mitigation will be MEDIUM (-VE) but can be reduced to VERY LOW (-VE) after the application of standard waste management practices, e.g. regular removal of waste, prevention of littering. This will reduce the intensity of impacts to 'Low' and the probability of an impact occurring to 'Improbable'. This implies that should mitigation measures be followed, the potential impact would be negligible and will not have an influence on the decision regarding the proposed development. The outcome of the impact significance rating is given in Table 8-6.

Table 8-6: Significance rating of waste management impacts during construction (W1)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Local	Medium	Long - term	Medium	Probable	**Medium**	-	Medium	High
Management Measures									
The following measure is recommended for the *construction phase:* • Standard waste management practices should be implemented; • All waste should be removed from the site on a regular basis and disposed of at a registered landfill site; • No dumping within the surrounding area shall be permitted, and no waste may be buried or burned on site; and • The Contractor must identify and separate materials that can be reused or recycled to minimise waste, e.g. metals, packaging and plastics, and provide separate marked bins/ skips for these items. These wastes must then be sent for recycling and records kept of recycling.									
After Management	Local	Low	Long-term	Low	Improbable	**Very Low**	-	Medium	High

[5] Space requirements for each of the technology alternatives, for a 40MW/160MWh BESS, are as follows:

- Li ion requires 3 600 m² to 7 500 m²;
- NaS requires ±6 800 m²; and
- VRF requires ±6 000 m²

ii) V1: Loss of vegetation and habitat due to construction

The rating of impacts on loss of vegetation is detailed in the specialist study (Appendix D) and summarised here.

Permanent loss of indigenous vegetation will occur during construction due to the footprint of the development. There will also be temporary loss of vegetation due to construction activities, e.g. site camps and lay down areas. The permanent footprint of the development is likely to be in the order of four to seven hectares. The vegetation type on the site is a transition zone from Kouga Grassy Sandstone Fynbos (Least concern), and Humansdorp Shale Renosterveld (Endangered). Development of the site could potentially result in loss of habitat for endemic species as well as the irreversible loss of possible species assemblages within the site boundary. In addition, if rehabilitation of disturbed areas is not adequately conducted, further impacts to areas outside the site boundary could occur due to erosion or fires.

Mitigation is important for the areas that are not part of the permanent footprint, and to minimise the longer term off-site impacts such as fires and the spread of alien invasive plants. These measures reduce the duration (for these specific impacts) to 'Medium term'.

Impacts before mitigation will be MEDIUM (-VE) but can be reduced to LOW (-VE) if the recommended mitigation measures are applied.

Table 8-7: Significance rating of habitat and vegetation loss during construction (V1)

	Spatial Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**+-**	**Confidence**	**Reversibility**
Before Management	Regional	Low	Long term	Medium	Definite	**Medium**	-	High	Low
Management Measures									

- During the construction phase, the construction area (including site camp, laydown areas and access tracks) must be clearly demarcated and all other areas deemed as no-go areas for the duration of construction;
- The position of the construction site camp should be on an already disturbed area and should be identified in consultation with the Environmental Control Officer (ECO);
- Stripping of topsoil during the site clearing activities at the commencement of construction and appropriate storage for the duration of construction;
- Harvesting and collection of any flora, other than that performed under a permit from the Department of Economic Development, Environmental Affairs & Tourism, must be strictly prohibited A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire;
- No burning of vegetation, whether to clear the vegetation, or of cleared vegetation, shall be permitted;
- No open fires should be allowed on site;
- A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area;
- Sufficient fire-fighting equipment shall be maintained and be accessible on sites at all times. In particular, such firefighting equipment shall be readily on hand in areas where hot work may be required;
- The objective of rehabilitation of natural areas must be to re-establish indigenous vegetation (coverage of at least 80% should be attained);
- Rehabilitation of disturbed areas must commence immediately after construction has been completed in that area. General rehabilitation measures include:
  - Loosen compacted soils within construction footprint which do not form part of the BESS footprint (e.g. access roads, site camp area, stockpile and laydown areas, etc.);
  - Spread stored topsoil over disturbed areas and water regularly until vegetation has sufficiently established; and
  - All area undergoing rehabilitation must be demarcated as no-go areas;
- During construction, erosion control measures must be implemented in areas sensitive to erosion such as exposed soil, areas with dispersive soils, etc. These measures include but are not limited to the use of sand bags, hessian sheets, silt fences and/ or replacement of vegetation.

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
After Management	Regional	Low	Medium – term	Low	Definite	**Low**	-	High	Low

iii) V2: Loss of Species of Special Concern (SSC) during construction

The rating of impacts on SSC is detailed in the specialist study (Appendix D) and summarised here.

Species of special concern (SSC) in this area are species which are endemic to this region and occur within an isolated habitat type and/or are provincially protected species. SSC are detailed in 6.3.

The proposed development and associated works could result in the complete loss of SSC on site if no species are rescued before construction commences. If construction activities extend to outside the construction footprint boundaries, this would have further impacts.

The impact for the development is rated as LOW (-VE) but can be reduced to VERY LOW (-VE) should proper mitigation measures be implemented, including a Search and Rescue exercise.

Table 8-8: Significance rating of loss of SSC during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Local	Medium	Medium term	Low	Definite	**Low**	-	High	Medium
Management Measures									
• Apply for relocation and destruction permits from the relevant authority (DEDEAT); • Conduct a Search and Rescue exercise before the start of construction, ahead of any clearing of vegetation; • A suitably qualified and experienced individual should oversee the Search and Rescue operation; • Sufficient time for Search and Rescue must be allowed before construction commences; • Replant rescued SSCs in adjacent similar habitat on site preferably within a nearby reserves such as Lombardini Game Farm or African Whisper Private Game Reserve; • A construction width of 15 m adjacent to the BESS area must be maintained in order to restrict the width of disturbance (site camp, laydown areas and access tracks outside of the proposed battery storage facility area) that may infringe upon the populations of SSC; and • Demarcate a no-go area around the rocky outcrop. No construction related activities should be allowed to take place within the demarcated no-go areas.									
After Management	Local	Low	Short-term	Very Low	Probable	**Very Low**	-	High	High

iv) V3: Spread of invasive alien species

The rating of impacts from the spread of alien vegetation is detailed in the specialist study (Appendix D) and summarised here.

A major change in plant communities where development is concerned is generally the result of invasion of alien weeds and invasive plants. The proposed development will result in an increase in the risk of invasive alien plants establishing in the disturbed sites and spreading to the surrounding areas during and after construction. The potential for invasive alien plants infestation is relatively high due to the presence of large infestations of invasive species (predominantly *Acacia mearnsii*) within the surrounding area as well as existing infestations within the site boundary.

The impact is rated with a MEDIUM (-VE) significance without mitigation but can be reduced to *Very* LOW (-VE) if the recommended measures are applied. Table 6-4 illustrates the extent to which this impacts the environment.

Table 8-9: Significance rating of spread of invasive alien impacts during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Manage ment	Regional	Medium	Medium term	Medium	Probable	**Medium**	-	High	Medium
Management Measures									
• All invasive alien species cleared for the construction of the battery storage facility must be collected and disposed of as waste. Care must be taken not to disperse seeds or seed pods in the surrounding environment during the removal thereof; • Remove any new alien invasive plant species in the construction footprint as soon as they are detected, preferably by physical removal or by spraying herbicides should physical removal not be feasible (to be conducted in conjunction with the ECO); • Monitoring and removing of alien invasive plants should be conducted from the start of the construction phase, during clearing, until rehabilitation has been complete at the end of the liability period; • An item should be included in the Bill of Quantities for the contractor for control of alien species. In addition, allowance should be made for multiple site visits by the ECO for the duration of the construction contract, including the defects liability period, to assess and assist in all invasive alien plant eradication and control activities; and • After construction, ongoing control of invasive alien plants must be addressed by the property owner.									
After Manage ment	Local	Low	Medium-term	Very Low	Probable	**Very Low**	-	High	Medium

v) A1: Wetland degradation due to decreased water quality during construction

This section describes the impacts on wetlands and aquatic systems associated with the proposed development, the significance thereof and the recommended mitigation measures, as assessed and rated by the Aquatic Specialist in the Aquatic Impact Assessment Report in Appendix D.

Construction activities could cause contamination of wetlands, watercourses, and groundwater if proper management is not practiced. Accidental spills of hydrocarbons (oils, diesel, etc.) or leakage of such substances from construction machinery may enter wetlands directly, through surface runoff during rainfall events or subsurface movement (through groundwater) and then migrate to downstream systems. Such chemicals, fuels or pollutants would alter the water quality within the watercourse, having an effect on aquatic ecology in the form of biodiversity loss, i.e. the loss of vegetation and wetland fauna that are sensitive to changes in water quality (especially from toxicant inputs).

Wetlands 5 & 6 could be affected by contaminated runoff from the construction activities as they occur down-gradient from the proposed site. Wetlands 1, 2, 3 & 4 should not be directly affected by contaminated runoff due to the location of the wetlands to the west of the R330.

The impact is rated with a VERY LOW (-VE) significance without mitigation but can be reduced to INSIGNIFICANT (-VE) if the recommended measures are applied.

Table 8-10: Significance rating of wetland degradation due to water quality impacts during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversi bility
Before Manage ment	Regional	Medium	Short term	Low	Possible	**Very Low**	-	High	Mediu m

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Management Measures									
• The construction site camp and laydown areas for stockpiles etc. should be located on higher ground and not within the sensitivity buffers **(50 m)** recommended for wetlands; • The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be administered on site and at the construction camp site. If hazardous liquids are stored/ used on site, spill kits must be available; • Hazardous materials must be stored on an impermeable, bunded surface within a weather-proof structure; • Storage and maintenance of machinery and construction-related equipment should be done in the construction site camp and preferably on an impermeable surface; • No wash water from washing of mechanical plant or equipment may be discharged into the surrounding environment. All wastewater must be collected in a container and allowed to evaporate. The resultant material must be disposed of as hazardous waste; • Appropriate solid waste disposal facilities must be provided on-site during construction and adequate signage be provided; • Spillages should be cleaned up immediately and contaminants properly contained and disposed of using appropriate waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and disposed of appropriately; • Cement batching activities should occur in the construction camp, as far as possible, and conducted on an impermeable surface. Cement products/ wash may not be disposed of into the natural environment; • Drip-trays must be provided beneath standing vehicles and machinery, and routine checks should be done to ensure that these are in a good condition; • Portable toilets must be provided where construction is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Disposal slips should be kept for auditing purposes; and • All construction plant equipment, general waste, surplus rock, and other foreign materials must be completely removed from site once construction has been completed.									
After Management	Local	Low	Short-term	Very Low	Possible	**Insignificant**	-	High	Medium

vi) A2: Increased sedimentation of wetlands and watercourses during construction

The rating of impacts on sedimentation if wetlands is detailed in the specialist study (Appendix D) and summarised here.

During the construction phase when vegetation is cleared, large quantities of loose earth may easily be washed from the construction zone or be transported down slope during high rainfall events, resulting in increased sedimentation of aquatic systems occurring downstream. This would impact on aquatic biota, but could also influence the geomorphology of aquatic systems and overall functioning in severe circumstances.

Construction of the BESS is most likely to affect the wetlands in close proximity to the site, such as Wetlands 5 & 6. Wetlands 1, 2, 3 & 4 should not be directly affected by sedimentation in runoff as the stormwater from the site will be cut off and redirected by the R330 to the west.

The impact is rated INSIGNIFICANT (-VE) with or without mitigation.

Table 8-11: Significance rating of wetland sedimentation due to water quality impacts during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Local	Low	Medium term	Very Low	Possible	**Insignificant**	-	High	Low
Management Measures									
• Clearing of vegetation should be kept to a minimum as per the agreed design parameters;									

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
• Excavated or spoil material (including any foreign materials) as well as topsoil stockpiles should not be placed within the recommended 50 m buffers (preferably further away) of the wetlands or drainage line in order to reduce the possibility of material being washed downstream; • Disturbed areas should be rehabilitated immediately after construction in the relevant area (with indigenous vegetation or using topsoil); • Rehabilitated areas should be monitored well and measures must be implemented to ensure that topsoil does not wash away, e.g. using swales; and • Any erosion gullies/ channels created during construction should be filled immediately to ensure silt does not drain into aquatic systems and the area revegetated.									
After Management	Local	Low	Short-term	Very Low	Possible	**Insignificant**	-	High	Low

i) P1: Damage to paleontological resources during construction

This section describes the potential paleontological impacts associated with the proposed development, the significance thereof and the recommended mitigation measures, as assessed and rated by the Palaeontologist (Dr Rob Gess) in the Paleontological Impact Assessment Report (Appendix D).

The Development is planned to be constructed overlying strata of the Silurian aged Goudini Formation, the lowermost formation of the Nardouw Subgroup, which forms the upper portion of the Table Mountain Group. Piles of rock waste from previous construction phases, adjacent to the existing substation indicate that fairly fresh mudstone is likely to be disturbed. None of the material currently available for examination bore any evidence of palaeontological material. Palaeontological material is not known to be abundant in the Nardouw Subgroup and has previously been confined to trace fossils associated with the quartzites. Ongoing research by the author has, however, revealed important palaeontological assemblages in units of the Cape Supergroup formerly considered to be devoid of fossils. This is often far more important that their collection from units well-known for their palaeontological heritage.

In conclusion it is considered unlikely that fossils will be disturbed, however the possibility exists, and any fossils recovered would be of great significance.

The impact was rates as LOW (-VE) without mitigation, but can be reduced to VERY LOW (-VE) if the recommended measures are applied

Table 8-12: Significance rating of paleontological impacts during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Local	Medium	Long-term	Medium	Possible	**Low**	-	High	Low
Management Measures									
No project specific mitigation measures are proposed, however, should any paleontological findings be uncovered the following applies: • All workers on site should be informed of the types of paleontological resources that may be found and the correct procedure to follow should any paleontological resources be found; • The Environmental Officer is to pay particular attention to mudstone removed from the excavation site and to examine it carefully for any impressions of marine invertebrates (such as brachiopods and other sea shells as well as, for example trilobite segments and heads). Any suspected fossils should be put to one side and photographed. Photos should be sent to an appropriate palaeontologist for evaluation; • Should fossil remains be discovered during construction, these should be safeguarded (preferably in situ) and the Designated Environmental Officer should alert the Eastern Cape Provincial Heritage Resources Authority (ECPHRA. Contact details:									

Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.									
Before Management	Local	Low	Long-term	Low	Possible	**Very Low**	-	High	Low

ii) Ar1: Damage to archaeological resources during construction

This section describes the potential archaeological impacts associated with the proposed development, the significance thereof and the recommended mitigation measures, as assessed and rated by the Archaeologist (Ms Celeste Booth) in the Archaeological Impact Assessment Report (Appendix D).

No archaeological / historical or other heritage resources were identified within the proposed development area. However, one stone artefact was encountered, ex situ, outside the boundary of the proposed development along the gravel access road to the adjacent wind farm. The survey was limited to surface and exposed area observations and does not eliminate the possibility that archaeological heritage remains may occur below the surface. It is possible that stone artefacts may occur below the vegetation cover between the surface and 50 – 80 cm below the ground. The potential impact of the proposed extension of the existing substation on the archaeological heritage remains, sites, and features is regarded as low; however, the recommendations and mitigation measures must be taken into consideration before the commencement of the proposed development activities.

The impact was rated as VERY LOW (-VE) with and without mitigation.

Table 8-13: Significance rating of archaeological impacts during construction

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Local	Low	Long term	Low	Possible	**Very Low**	-	High	Medium
Management Measures									
• If concentrations of pre-colonial archaeological heritage material (such as shell middens and associated material) and/or human remains (including graves and burials) are uncovered during construction, all work must cease immediately and be reported to the Albany Museum (046 622 2312) and/or the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) (043 745 0888) so that systematic and professional investigation/excavation can be undertaken. Phase 2 mitigation in the form of test-pitting/sampling or systematic excavations and collections of the archaeological / heritage site will then be conducted to establish the contextual status of the sites and possibly remove the archaeological deposit before development activities continue; and • A person must be trained as a site monitor to report any archaeological sites found during the development. Construction managers/foremen and/or the Environmental Control Officer (ECO) should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.									
After Management	Local	Low	Long term	Low	Improbable	**Very Low**	-	High	Medium

8.2.2 Operational Impacts

Operational impacts are largely dependent on the type of technology selected and therefore most impacts have been rated according to the various alternatives with the exception of impacts on the hydrology of wetlands which is common to all.

8.2.2.1 Technology Alternative 1 (Lithium Ion)

i) S1: Safety Impacts due to the risk of explosion/fire during operation

Overcharging, deep discharging, high temperatures and physical stress to Li-ion battery cells can cause a thermal runaway reaction, which can lead to fires and explosion. Most battery packs contain several cells and the heat of one burning cell can trigger thermal runaways in neighbouring cells. The burning of the cells will also release gases such as carbon monoxide, hydrogen fluoride, hydrogen chloride, methane, ethane, ethylene, and propylene. Utility scale Li ion batteries are commercially available but are not yet considered a mature technology. Utility scale solid state Li ion batteries might not yet have a commercially demonstrated track record. This means there is limited data to demonstrate failure rates in these BESS.

The probability of a fire in one battery module causing a fire in a second battery module is unknown. It is recognised that battery modules are physically separated from one another and it is almost certain that a fire of one battery module would damage neighbouring modules. It is less certain that neighbouring modules would also catch fire.

Although in closer proximity to the facility, site staff are likely to be better prepared for emergencies and may more readily be able to avoid injury. The closest structure is located at a distance of ±800 m to the west of the facility. Motorists on the N2 and R330 would be in closer proximity (±300 m to the R330 at its closest point) but would be travelling and assuming this travel is not interrupted, exposure times would potentially be short.

Due the potential spread of harmful gases from a fire, the spatial extent is ‘Regional’, and as the emissions have the potential to result in impacts on health of motorists or neighbouring farmers. Impacts on health may be similar to smoke inhalation and include respiratory irritation, asthma, and aggravating heart conditions, and are rated as being of ‘Medium’ intensity. Given than the combustion products would, in the main, probably not be specifically toxic, most impacts are likely to be short term in nature. The probability of an impact occurring is rated as ‘Improbable’[6]. Confidence is rated as ‘Low’ as this is a relatively untested technology.

Impacts before mitigation will be VERY LOW (-VE) but can be reduced to INSIGNIFICANT (-VE), specifically if the extent of gases emitted is reduced, which in turn should reduce the intensity of the impact.

Table 8-14: Significance rating of safety impacts due to the risk of explosion/fire during operation for a Li ion BESS (S1)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	Medium	Short-term	Low	Improbable	**Very Low**	-	Low	Medium
Management Measures									
Eskom to develop and implement a Fire Protection Plan for the facility and that the following management measures would be addressed in this Fire Protection Plan: • A fire monitoring system with early warning smoke detection;									

[6] It is noted that the standard rating scale used in this assessment is insensitive to probability of catastrophic events, with the lowest probability sore of <40% probability of an impact occurring. This is a vast over estimation of probability for catastrophic failures and should not be viewed as a realistic worst case scenario. More systematic studies, e.g. HAZOP or MHI would produce more realistic probabilities and enable a differentiation of the technology alternatives.

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
• A suitable fire suppression system; • The plan to be developed with the Kouga fire department, and to include training of the Kouga fire department on site specific risks; • Cell level temperature monitoring devices; • Short circuit detection and protection devices; • Battery modules to include dividers to protect a failing cell from spreading to the neighbouring one; • Li ion batteries to have overcharge protection devices to avoid thermal runaway reactions; and • A maintenance schedule to be developed and implemented prior to operation.									
After Management	Regional	Low	Short - term	Very low	Improbable	**Insignificant**	-	Low	Medium

ii) V2: Loss of vegetation due to fire

The potential for fire from Li-Ion batteries is described above in Section 8.2.2.1(i). If fire were to spread to the surrounding vegetation, vegetation and habitat would be temporarily lost with potentially detrimental impacts to the associated fauna. Subsequently, in the period after the fire, invasive alien vegetation could potentially invade the area inhibiting the indigenous vegetation from re-establishing. Scale of impact is therefore 'Regional' (extending beyond the boundary of the site), intensity is 'High' as this vegetation would be temporarily lost. Although vegetation would re-establish quickly, the potential for an increase of alien invasive species, which would then require longer term management, results in a duration rating of 'Medium-term'. The probability of a fire on the site, and one that has the potential to jump the firebreak is higher than the probability of a catastrophic fire as assessed for S1. This difference in probabilities is not readily apparent on this particular impact raring scale, and although the probability is considered higher than in S1, the probability rating is nevertheless 'Improbable'.

The impact is rated with a MEDIUM (-VE) significance without mitigation but can be reduced to INSIGNIFICANT (-VE) if the recommended measures are applied.

Table 8-15: Significance rating of loss of vegetation due to fire during operation for a Li ion BESS (V2)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	High	Medium-term	High	Improbable	**Medium**	-	Medium	Medium
Management Measures									
• All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site; • Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; • No smoking shall be allowed in the vicinity of flammable substances and relevant signage must be displayed; and • It is recommended that an 8 m firebreak be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.									
After Management	Local	Medium	Short-term	Very low	Improbable	**Insignificant**	-	Medium	Medium

iii) A3: Wetland degradation due to fire

The potential for fire from Li-Ion batteries is described above in Section 8.2.2.1(i).

If fire were to spread to the surrounding wetlands, the wetland (particularly during a dry period) the wetland vegetation and dependent biota could be significantly disturbed. Subsequently, in the period after the fire, invasive alien vegetation could potentially invade the area inhibiting the indigenous vegetation from re-establishing. Scale of impact is therefore 'Regional' (due to the wetland being off site), intensity is 'Medium' as this vegetation would merely be disturbed, and duration is rated as 'Short-term' because wetland would not be as affected as fynbos vegetation.

The probability of a fire on the site, and one that has the potential to jump the firebreak is higher than the probability of a catastrophic fire as assessed for S1. This difference in probabilities is not readily apparent on this particular impact raring scale, and although the probability is considered higher than in S1, the probability rating is nevertheless 'Improbable'.

The impact is rated with a VERY LOW (-VE) significance without mitigation but can be reduced to INSIGNIFICANT (-VE) if the recommended measures are applied.

Table 8-16: Significance rating of wetland degradation due to fire during operation for a Li ion BESS (A3)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	Medium	Short-term	Low	Improbable	**Very Low**	-	High	Medium
Management Measures									
• A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire; • No burning of vegetation, whether to clear the vegetation and specifically invasive alien plant species, or of cleared vegetation, shall be permitted; • No open fires should be allowed on site; • A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area; • All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site; • An appropriate fire management system, as per the MSDS and the onsite Emergency Response Plan, should be implemented; • Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; and • It is recommended that an 8 m fire break be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.									
After Management	Local	Low	Short-term	Very Low	Improbable	**Insignificant**	-	High	Medium

8.2.2.2 Technology Alternative 2 (Sodium Sulphur)

i) S1: Safety Impacts due to the risk of explosion/fire during operation

The NaS battery is composed of highly reactive components that produce corrosive and flammable substances. Pure sodium presents a hazard, because it spontaneously burns in contact with moisture and the molten sodium and sulphur together are a fire hazard. In addition, if the battery leaks, there is an explosion risk due to the emission of hydrogen. Most battery packs contain several cells and the heat of one burning cell can trigger thermal runaways in neighbouring cells. The burning of the cells will also release harmful gases, specifically sulphur dioxide, and potentially an aerosol of sodium hydroxide. Utility scale NaS batteries are a mature technology and there are some reports of these batteries having caught fire. No attempt has been made in this assessment to source quantified failure rates and it is possible that these are not available.

The probability of a fire in one battery module causing a fire in a second battery module is unknown. It is recognised that battery modules are physically separated from one another and it is almost certain that a fire of one battery module would damage neighbouring modules. It is less certain that neighbouring modules would also catch fire.

Although in closer proximity to the facility, site staff are likely to be better prepared for emergencies and may more readily be able to avoid injury. The closest structure is located at a distance of ±800 m to the west of the facility. Motorists on the N2 and R330 would be in closer proximity (±300 m to the R330 at its closest point) but would be travelling and assuming this travel is not interrupted, exposure times would potentially be short.

Due the potential spread of harmful gases, the spatial extent is 'Regional', and as the emissions from a fire, and potentially the fire itself, have the potential to result in loss of life, the intensity is rated as 'High' and the duration as 'Long-term'. The probability of an impact occurring is rated as 'Improbable'[6]. Confidence is rated as 'Low' as this is a relatively untested technology.

Impacts before mitigation will be HIGH (-VE) but can be reduced to LOW (-VE) after mitigation.

Table 8-17: Significance rating of safety impacts due to the risk of explosion/fire during operation for a NaS BESS (S1)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	High	Long-term	Very High	Improbable	**High**	-	Low	Low
Management Measures									
It is assumed that Eskom would implement a Fire Protection Plan for the facility and that the following management measures would be addressed in this Fire Protection Plan: • A fire monitoring system with early warning smoke detection and a fire suppression system; • A fire suppression system that will not aggravate a fire (e.g. prevent the application of water to metallic sodium); • Cell level temperature monitoring devices; • Short circuit detection and protection devices; • The plan to be developed with the Kouga fire department, and to include training of the Kouga fire department on site specific risks; • Battery modules to include dividers to protect a failing cell from spreading to the neighbouring one; • A maintenance schedule to be developed and implemented prior to operation.									
After Management	Regional	Low	Long-term	Medium	Improbable	**Low**	-	Low	Low

ii) V2: Loss of vegetation due to fire

The potential for fire from Li-Ion batteries is described above in Section 8.2.2.2 (i). If fire were to spread to the surrounding vegetation, vegetation and habitat would be temporarily lost with potentially detrimental impacts to the associated fauna. Subsequently, in the period after the fire, invasive alien vegetation could potentially invade the area inhibiting the indigenous vegetation from re-establishing. Scale of impact is therefore 'Regional' (extending beyond the boundary of the site), intensity is 'High' as this vegetation would be temporarily lost. Although vegetation would re-establish quickly, the potential for an increase of alien invasive species, which would then require longer term management, results in a duration rating of 'Medium-term'. The probability of a fire on the site, and one that has the potential to jump the firebreak is rated as possible due to the perceived more aggressive fire (compared with the other technology alternatives) that might result from a NaS battery.

The impact is rated with a MEDIUM (-VE) significance without mitigation but can be reduced to VERY LOW (-VE) if the recommended measures are applied. Table 6-4 illustrates the extent to which this impacts the environment.

Table 8-18: Significance rating of loss of vegetation due to fire during operation for a NaS BESS (V2)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	High	Medium-term	High	Possible	**Medium**	-	Medium	Medium
Management Measures									
• All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site; • Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; • No smoking shall be allowed in the vicinity of flammable substances and relevant signage must be displayed; and • It is recommended that an 8 m firebreak be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.									
After Management	Local	Medium	Short-term	Very low	Possible	**Insignificant**	-	Medium	Medium

iii) A2: Wetland degradation due to fire

The potential for fire from Li-Ion batteries is described above in Section 8.2.2.2 (i).

If fire were to spread to the surrounding wetlands, the wetland (particularly during a dry period) the wetland vegetation and dependent biota could be significantly disturbed. Subsequently, in the period after the fire, invasive alien vegetation could potentially invade the area inhibiting the indigenous vegetation from re-establishing. Scale of impact is therefore ‘Regional’ (due to the wetland being off site), intensity is ‘Medium’ as this vegetation would merely be disturbed, and duration is rated as ‘Short-term’ because wetland would not be as affected as fynbos vegetation.

The impact is rated with a VERY LOW (-VE) significance without mitigation but can be reduced to INSIGNIFICANT (-VE) if the recommended measures are applied.

Table 8-19: Significance rating of wetland degradation due to fire during operation for a NaS BESS (A2)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	Medium	Short-term	Low	Possible	**Very Low**	-	High	Medium
Management Measures									
• A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire; • No burning of vegetation, whether to clear the vegetation and specifically invasive alien plant species, or of cleared vegetation, shall be permitted; • No open fires should be allowed on site; • A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area; • All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site; • An appropriate fire management system, as per the MSDS and the onsite Emergency Response Plan, should be implemented;									

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
• Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; and • It is recommended that an 8 m firebreak be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.									
After Management	Local	Low	Short-term	Very Low	Possible	**Insignificant**	-	High	Medium

iv) C1: Surface and groundwater contamination

The NaS batteries use hazardous materials including metallic sodium, which is combustible if exposed to water. When sodium reacts with water this produces sodium hydroxide which is considered ecotoxic. In the event of containment failure, or in the event of a fire, the molten electrolyte may contaminate the soil and groundwater.

It is recognised that battery modules are separate modules and that a loss of containment in more than one module would be significantly less probable than a loss of containment from a single module.

Soil contamination is unlikely to occur off site, however, groundwater contamination, particularly from sodium hydroxide, has the potential to migrate off site and a spatial rating of 'Regional' is therefore assigned. From the available information, it is not known what quantity of sodium would be contained in any specific NaS battery module. In order to estimate intensity, the release of 20 tons of sodium hydroxide has been used as a realistic worst-case scenario. This results in an intensity of rating of 'High'. The duration of an impact occurring is rated as 'Medium-term' as the impact of sodium hydroxide can be attenuated over a 15 year period (under the right conditions).

The probability of an impact occurring is rated as 'Improbable'[6]. The impact is readily reversible when the loss of containment is localised but becomes less reversible once it has migrated outside the site boundary. A reversibility rating on 'Medium' is assigned.

With management measures, the significance can be reduced from MEDIUM (-VE) to LOW (-VE).

Table 8-20: Significance rating of surface and groundwater contamination during operation for a NaS BESS (C1)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	High	Medium-term	High	Improbable	**Medium**	-	Medium	Medium
Management Measures									
• The fire protection system referred to above must be implemented; • A leak detection system to be installed; • Secondary containment systems to be in place for the BESS; • All spills to be cleaned immediately and workers on site to be trained on correct procedures; • A maintenance schedule to be developed and implemented prior to operation. • Adequate spill kits must be kept on site for small spills and must be accessible at all times; • In the event of a spillage or leaks, the spilled liquid must be collected in a suitable container and disposed of at a licensed hazardous waste site. The general area should be treated with an absorbing agent if necessary; • Regular visual inspections of all battery storage cells and the chemical storage area must be conducted to check for wear and/or damage; and • The correct chemical MSDS must be available on sit at all times.									
After Management	Local	High	Medium-term	Medium	Improbable	**Low**	-	Medium	Medium

8.2.2.3 Technology Alternative 3 (Vanadium Redox Flow)

i) C1: Surface and groundwater contamination

The electrolyte within the VRF is not flammable, it is however, corrosive as it contains a sulphuric acid based solution. Large tanks of electrolyte will be stored separately to the battery and should these tanks fail, potentially large volumes of electrolyte (approximately 21 m³ per battery container) could escape and hazardous substances may contaminate surrounding water resources as well as soil. If the cells are damaged or deteriorate over time, this may lead to potential hazardous chemical leaking out of the cells and entering the surrounding environment. Wetlands 5 & 6 could be affected by contaminated runoff from the construction activities as they occur down-gradient from the proposed site.

It is recognised that battery modules are separate modules and that a loss of containment in more than one module would be significantly less probable than a loss of containment from a single module.

Soil contamination is unlikely to occur off site, however, groundwater contamination, has the potential to migrate off site and a spatial rating of 'Regional' is therefore assigned. Due to the quantities of electrolytes, an intensity of rating of 'High' is assigned. The duration of an impact occurring is rated as 'Long-term' as the impact of vanadium in the groundwater would not readily be attenuated over a 15 year period.

The probability of an impact occurring is rated as 'Improbable'[6]. The impact has moderately reversible when the loss of containment is localised but becomes of 'Low' reversibility less reversible once it has migrated outside the site boundary.

With management measures, the significance can be reduced from 'HIGH' (-VE) to 'LOW' (-VE).

Table 8-21: Significance rating of surface and groundwater contamination during operation for a VRF BESS (C1)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	High	Long-term	Very high	Improbable	**High**	-	Medium	Low
Management Measures									
- A leak detection system to be installed; - Secondary containment systems to be in place for the BESS; - All spills to be cleaned immediately and workers on site to be trained on correct procedures; - A maintenance schedule to be developed and implemented prior to operation. - Adequate spill kits must be kept on site for small spills and must be accessible at all times; - In the event of a spillage or leaks, the spilled liquid must be collected in a suitable container and disposed of at a licensed hazardous waste site. The general area should be treated with an absorbing agent if necessary; - Regular visual inspections of all battery storage cells and the chemical storage area must be conducted to check for wear and/or damage; and - The correct chemical MSDS must be available on sit at all times.									
After Management	Local	High	Medium - term	Medium	Improbable	**Low**	-	Medium	Medium

8.2.2.4 General Operational Impacts

i) A4: Potential impacts on hydrology of wetlands and aquatic systems

This section describes the impacts on wetlands and aquatic systems associated with the proposed development, the significance thereof and the recommended mitigation measures, as assessed and rated by the Aquatic Specialist in the Aquatic Impact Assessment Report in Appendix D. This operational impact is independent of technology.

The construction of the Battery Energy Storage System (BESS) (specifically the foundation work) could alter the surrounding hydrology, most importantly the subsurface flow regime. Wetlands 5 is mostly at risk of impacts related to changes to the surrounding hydrology as it occurs directly down-gradient of the proposed site. Wetlands 1, 2, 3 & 4 are located on the opposite side of the R330 and should not be affected by hydrological changes resulting from the proposed development.

The impact is assigned a spatial rating of ‘Regional’ as the impact occurs off site, and an intensity of ‘Low’ as the footprint of the development takes up only a small portion of the Wetland 5’s catchment. Duration of the change in hydrology would be permanent and a duration rating of ‘Long-term’ is assigned. Probability is rated as ‘Possible’ as there will definitively be a change in hydrology, but runoff from the BESS might still enable percolation of water to the wetland.

The location of the existing substation is likely already forming a barrier and this will remain in the no-go scenario. The impact was rated as LOW (-VE).

Table 8-22: Significance rating of hydrology of wetlands and aquatic systems during operation (A4)

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Reversibility
Before Management	Regional	Low	Long - term	Medium	Possible	**Low**	-	High	Low
Management Measures									
None									

8.2.3 Decommissioning Impacts

Eskom plans to maintain the BESSs in the long-term. Replacement of battery components may be required however no decommissioning of the system as a whole is planned in the foreseeable future. Maintenance management measures (e.g. the return to supplier clause) that cover the disposal of certain components such as have been included in the EMPr under the operational phase.

8.2.4 Cumulative Impacts

i) GHG1: Impact on Greenhouse Gas Emissions

BESS enables Greenhouse Gas (GHG) emission reductions during operation through the following:

- Integration of renewable energy into the electricity grid;
- Supporting the existing generation facilities to operate at optimal levels;
- Reducing the dependence on inefficient energy generation technologies that would be utilised during peak times; and
- The potential to defer the need to develop additional fossil fuel based energy generation infrastructure.

The spatial extent of the impact is considered to be ‘National’ as the use of BESS will result in a reduced reliance on peaking power plants, the closest of which is located in Coega outside Port Elizabeth. As the Melkhout BESS forms part of a wider project to locate BESS across the country the impact will be experienced at several power plants. There are approximately 38 BESS’s proposed at various locations across South Africa, totalling 360 MW, or approximately 10% of Eskom’s total installed capacity. The intensity of the cumulative impact is rated at ‘Medium’ and positive, as the exact contribution of the BESS to the energy network in terms of GHG emissions has not yet been quantified. It is possible that a quantified GHG emission assessment would return a higher intensity. Duration is rated as ‘Medium’ term as the projected life of batteries proposed is less than 20 years. It is recognised that the BESS may continue indefinitely through the replacement of batteries, and that the rating presented here might be understating the positive impact. The probability is rated as ‘definite’ as all three technology alternatives will contribute to a reduced usage of fossil fuel plants and will support increased renewable energy generation through the smoothing of renewables.

Impacts are rated as HIGH (+VE) as a conservative estimate however once this has been quantified it is possible that the actual impact is greater.

Table 8-23: Significance rating of climate impacts and recommended mitigation measures

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence	Revers ibility
Before Manage ment	National	Medium	Medium-term	High	Definite	**High**	+	Medium	N/A
Management Measures									
• None									

9 Findings, Evaluations and Recommendations

This chapter evaluates the impact of the proposed BESS based on the findings of the Basic Assessment Report. The principal findings are presented in this chapter, followed by a discussion of the key factors DEA will have to consider in order to make a decision in the interests of sustainable development.

The BAR has examined all available project information and drawn on both available (secondary) and specifically collected (primary) baseline data to identify and evaluate the environmental impacts of the proposed project.

The BAR aims to inform decision-makers of the key considerations by providing an objective and comprehensive analysis of the potential impacts and benefits of the project, and has created a platform for the formulation of mitigation measures to manage these impacts. These measures are consolidated in the Draft Environmental Management Programme (EMPr) which is attached as Appendix F.

This chapter presents the general conclusions drawn from the Basic Assessment process which should be considered by decision makers in evaluating the project. The chapter should be viewed as a supplement to the detailed assessment of individual impacts presented in the previous chapter.

9.1 Assumptions and Limitations

The following assumptions or limitations have been considered in the preparation of this report as well as the associated specialist reports:

9.1.1 General

- As Battery Energy Storage at utility scale is a new and developing technology worldwide it must be noted that the information available is in some cases limited and there are still many uncertainties. This report is therefore based on what information was available at the time of compilation;
- As a general principal, the ability to store excess power generated from renewable sources and utilise this to offset the use of fossil fuel is a positive, and potentially significant, impact. This assessment has not attempted to quantify the extent to which GHG emissions would be reduced and it assumed that the technology would be effective, e.g. how often the stored energy would be released back into the grid; and
- A Basic Assessment process has been followed on the assurance from the Applicant that the storage threshold of 500 m^3 of dangerous goods will not be exceeded on the site.

9.1.2 Vegetation Assessment

- In order to obtain a comprehensive understanding of the dynamics of the floral component of the terrestrial environment, as well as the status of endemic, rare or threatened species in any given area, it is preferable that assessments consider both temporal and spatial scales within the study area. However, due to time and budget constraints, long-term studies are rarely feasible, resulting in most specialist assessments being once off surveys. Therefore, due to the scope of the work presented in this report, a detailed investigation over time and seasons were not possible;
- The assessment is based on information collected during the site visit conducted on 4 October 2018 It is probable that due to the timing of these site visits, certain species that could be flowering at other times of the year could have been overlooked (especially bulbs and forbs). This can influence the quality and accuracy of the data collected; and
- The scope of this study is limited to site-specific impacts, i.e. impacts that may occur as a result of the no-go option or on other projects are not addressed in this study.

9.1.3 Aquatic Impact Assessment

- The assessment is based on information collected during two site visits undertaken in October 2018. This can influence the quality and accuracy of the data collected. However, every attempt was made to collect the types of information necessary to assist in the assessment of the status and potential impacts of the wetlands and watercourses on site;
- Some inaccuracy (margin of error) in the hand-held Global Positioning System (GPS) is expected. The GPS used is accurate to within approximately 5 m; and
- The scope of this study is limited to site-specific impacts, i.e. impacts that may occur as a result of the no-go option, on other projects or areas outside of the project study area, are not addressed in this study.

9.2 Environmental Impact Statement

The evaluation is undertaken in the context of:

- The information provided during the BA;
- The assumptions made for this BA;
- The recommended mitigation measures, which it is assumed will be effectively implemented;
- The assessments provided by the specialists; and
- The practicality of the recommendations for mitigation.

The evaluation and the basis for the subsequent discussion are represented concisely in Table 9-1 Table 9-2 below, which summarises the potentially significant impacts and their significance ratings before and after application of mitigation and/or enhancement measures.

Table 9-1: Summary of potential impacts of technology options for the proposed Melkhout BESS

Impact code	Impact Description	Li-ion		NaS		VRF	
S1	Risk from catastrophic failure (e.g. Fire)	Very Low	Insignificant	High	Low	-	-
C1	Surface and groundwater contamination	-	-	Medium	Low	High	Low
A3	Wetland degradation due to fire	Very Low	Insignificant	Very Low	Insignificant	-	-
V2	Loss of Vegetation due to Fire	Medium	Very Low	Medium	Very low	-	-

Table 9-2: Summary of potential impacts of the proposed Melkhout BESS applicable to all technology alternatives

Impact Code	Impact Description	Significance without mitigation	Significance with mitigation
V1	Loss of Vegetation and Habitat	Medium	Low
V2	Loss of Species of Special Concern (SCC)	Low	Very Low
V3	Spread of Alien Invasive Species	Medium	Very Low
A1	Wetland degradation due to decreased water quality	Very Low	Insignificant
A2	Increased sedimentation of wetlands and watercourses	Insignificant	Insignificant
P1	Damage to, or destruction of paleontological resources	Low	Very Low
Ar1	Damage to archaeological resources	Very Low	Very Low
W1	Waste Management	Medium	Insignificant
A4	Impact to hydrology of the aquatic system	Low	-

Impact Code	Impact Description	Significance without mitigation	Significance with mitigation
GHG	Impact on Greenhouse Gas Emissions	Medium	-

Highest Positive Impact	
Highest Negative Impact	

Key observations with regard to the overall impact ratings, assuming mitigation measures are effectively implemented, are highlighted as follows:

- As a general principal, the ability to store excess power generated from renewable sources and utilise this to offset the use of fossil fuel is a positive, and potentially significant, impact. This assessment has not attempted to quantify the extent to which GHG emissions would be reduced and it assumed that the technology would be effective, e.g. how often the stored energy would be released back into the grid;
- The basic assessment is aimed primarily at on site impacts, and on attempting to determine the environmentally preferred technology alternative based on site specific factors;
- The VRF battery has been identified as having the least potential for environmental impact in comparison as it does not present a risk of fire as NaS and Li-ion do. With the implementation of mitigation measures however the difference in impact ratings between all three technologies is considered marginal;
- A Basic Assessment process has been followed on the assurance from the Applicant that the storage threshold of 500 m^3 of dangerous goods will not be exceeded on the site;
- The Applicant's technically preferred technology alternative is to install Li-ion battery modules, but it might be a combination of the alternatives. The application is therefore made for all three technology alternatives, i.e. technology agnostic;
- Safety risks from the operation of the BESS have been considered at a high level and it is anticipated that safety issues would be an inherent part of the technology design. The BA finds that the local Fire Department should be consulted in developing fire response plans dependent on the technology installed;
- Biophysical impacts resulting from the immediate footprint of the development are assessed and are not particularly significant;

9.3 Conclusion and Authorisation Opinion

In terms of Section 31 (n) of NEMA, the EAP is required to provide an opinion as to whether the activity should or should not be authorised. In this section a qualified opinion is ventured and in this regard SRK believes that sufficient information is available for DEA to make a decision.

It is noted that the proposed Battery Energy Storage System is not predicted to pose significant negative environmental or social impacts that cannot be mitigated to acceptable levels. No fatal flaws relating to the development have been identified in any of the specialist reports. The key to managing the negative impacts for all three technologies lies with design measures aimed at reducing safety risks, and in the commitments from technology suppliers to return to supplier battery modules at the end of their useful life and recover materials prior to disposal.

The importance of alternative technologies to reduce the country's reliance on fossil fuel should be considered as a significant motivator for this project. There has been a move worldwide towards BESS with large resources placed into researching the many technologies available. Approximately sixty BESS have been or are in the process of being developed in countries such as France, the U.S.A. and China.

With the above in mind, and in terms of meeting the objectives of sustainable development, the EAP is of the view that DEA should authorise all three technology alternatives, subject to effective implementation of the mitigation measures proposed in this Basic Assessment and the EMPr.

9.4 Recommendations

The specific recommended mitigation measures are presented in the impact assessment section and are recorded in the Draft Environmental Management Programme (see Appendix F of this report). A summary of the measures included in this DBAR are given below.

Recommendations to mitigate the impact of waste are as follows:

- Standard waste management practices should be implemented;
- All waste should be removed from the site on a regular basis and disposed of at a registered landfill site;
- No dumping within the surrounding area shall be permitted, and no waste may be buried or burned on site;
- The Contractor must identify and separate materials that can be reused or recycled to minimise waste, e.g. metals, packaging and plastics, and provide separate marked bins/ skips for these items. These wastes must then be sent for recycling and records kept of recycling;
- Battery suppliers to provide “end-of-life” Plan detailing disposal plan for the disposal of BESS components;
- During disposal batteries are to be stored and transported in a manner that reduces the chance of thermal runaway;
- Recyclable components of the batteries are to be sent to a recycling facility at the end of their life; and
- Batteries and components are to be disposed of in accordance with the National Waste Act (Act 59 of 2008), including the disposal of hazardous substances to be at a permitted hazardous waste disposal facility.

Recommendations to mitigate the impacts on vegetation are as follows:

- During the construction phase, the construction area (including site camp, laydown areas and access tracks) must be clearly demarcated and all other areas deemed as no-go areas for the duration of construction;
- The position of the construction site camp should be on an already disturbed area and should be identified in consultation with the Environmental Control Officer (ECO);
- Stripping of topsoil during the site clearing activities at the commencement of construction and appropriate storage for the duration of construction;
- Harvesting and collection of any flora, other than that performed under a permit from the Department of Economic Development, Environmental Affairs & Tourism, must be strictly prohibited A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire;

- No burning of vegetation, whether to clear the vegetation, or of cleared vegetation, shall be permitted;
- No open fires should be allowed on site;
- A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area;
- Sufficient fire-fighting equipment shall be maintained and be accessible on sites at all times. In particular, such firefighting equipment shall be readily on hand in areas where hot work may be required;
- The objective of rehabilitation of natural areas must be to re-establish indigenous vegetation (coverage of at least 80% should be attained);
- Rehabilitation of disturbed areas must commence immediately after construction has been completed in that area. General rehabilitation measures include:
    - Loosen compacted soils within construction footprint which do not form part of the BESS footprint (e.g. access roads, site camp area, stockpile and laydown areas, etc.);
    - Spread stored topsoil over disturbed areas and water regularly until vegetation has sufficiently established; and
    - All areas undergoing rehabilitation must be demarcated as no-go areas;
- During construction, erosion control measures must be implemented in areas sensitive to erosion such as exposed soil, areas with dispersive soils, etc. These measures include but are not limited to the use of sand bags, hessian sheets, silt fences and/ or replacement of vegetation;
- Apply for relocation and destruction permits from the relevant authority (DEDEAT);
- Conduct a Search and Rescue exercise before the start of construction, ahead of any clearing of vegetation;
- A suitably qualified and experienced individual should oversee the Search and Rescue operation;
- Sufficient time for Search and Rescue must be allowed before construction commences;
- Replant rescued SSCs in adjacent similar habitat on site preferably within a nearby reserves such as Lombardini Game Farm or African Whisper Private Game Reserve;
- A construction width of 15 m adjacent to the BESS area must be maintained in order to restrict the width of disturbance (site camp, laydown areas and access tracks outside of the proposed battery storage facility area) that may infringe upon the populations of SSC;
- Demarcate a no-go area around the rocky outcrop. No construction related activities should be allowed to take place within the demarcated no-go areas;
- All invasive alien species cleared for the construction of the battery storage facility must be collected and disposed of as waste. Care must be taken not to disperse seeds or seed pods in the surrounding environment during the removal thereof;
- Remove any new alien invasive plant species in the construction footprint as soon as they are detected, preferably by physical removal or by spraying herbicides should physical removal not be feasible (to be conducted in conjunction with the ECO);

- Monitoring and removing of alien invasive plants should be conducted from the start of the construction phase, during clearing, until rehabilitation has been complete at the end of the liability period;
- An item should be included in the Bill of Quantities for the contractor for control of alien species. In addition, allowance should be made for multiple site visits by the ECO for the duration of the construction contract, including the defects liability period, to assess and assist in all invasive alien plant eradication and control activities; and
- After construction, ongoing control of invasive alien plants must be addressed by the property owner;
- All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site;
- Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals;
- No smoking shall be allowed in the vicinity of flammable substances and relevant signage must be displayed; and
- It is recommended that an 8 m firebreak be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.

Recommendations to mitigate the impacts on aquatic resources are as follows:

- The construction site camp and laydown areas for stockpiles etc. should be located on higher ground and not within the sensitivity buffers (50 m) recommended for wetlands;
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be administered on site and at the construction camp site. If hazardous liquids are stored/ used on site, spill kits must be available;
- Hazardous materials must be stored on an impermeable, bunded surface within a weather-proof structure;
- Storage and maintenance of machinery and construction-related equipment should be done in the construction site camp and preferably on an impermeable surface;
- No wash water from washing of mechanical plant or equipment may be discharged into the surrounding environment. All wastewater must be collected in a container and allowed to evaporate. The resultant material must be disposed of as hazardous waste;
- Appropriate solid waste disposal facilities must be provided on-site during construction and adequate signage be provided;
- Spillages should be cleaned up immediately and contaminants properly contained and disposed of using appropriate waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and disposed of appropriately;
- Cement batching activities should occur in the construction camp, as far as possible, and conducted on an impermeable surface. Cement products/ wash may not be disposed of into the natural environment;
- Drip-trays must be provided beneath standing vehicles and machinery, and routine checks should be done to ensure that these are in a good condition;

- Portable toilets must be provided where construction is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Disposal slips should be kept for auditing purposes;
- All construction plant equipment, general waste, surplus rock, and other foreign materials must be completely removed from site once construction has been completed.
- Clearing of vegetation should be kept to a minimum as per the agreed design parameters;
- Excavated or spoil material (including any foreign materials) as well as topsoil stockpiles should not be placed within the recommended 50 m buffers (preferably further away) of the wetlands or drainage line in order to reduce the possibility of material being washed downstream;
- Disturbed areas should be rehabilitated immediately after construction in the relevant area (with indigenous vegetation or using topsoil);
- Rehabilitated areas should be monitored well and measures must be implemented to ensure that topsoil does not wash away, e.g. using swales;
- Any erosion gullies/ channels created during construction should be filled immediately to ensure silt does not drain into aquatic systems and the area revegetated;
- A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire;
- No burning of vegetation, whether to clear the vegetation and specifically invasive alien plant species, or of cleared vegetation, shall be permitted;
- No open fires should be allowed on site;
- A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area;
- All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site;
- An appropriate fire management system, as per the MSDS and the onsite Emergency Response Plan, should be implemented;
- Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; and
- It is recommended that an 8 m fire break be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The firebreak should be maintained on a regular basis.

Recommendations to mitigate the impacts on palaeontological resources are as follows:

- All workers on site should be informed of the types of paleontological resources that may be found and the correct procedure to follow should any paleontological resources be found;
- The Environmental Officer is to pay particular attention to mudstone removed from the excavation site and to examine it carefully for any impressions of marine invertebrates (such as brachiopods and other sea shells as well as, for example trilobite segments and heads). Any suspected fossils should be put to one side and photographed. Photos should be sent to an appropriate palaeontologist for evaluation; and

- Should fossil remains be discovered during construction, these should be safeguarded (preferably in situ) and the Designated Environmental Officer should alert the Eastern Cape Provincial Heritage Resources Authority (ECPHRA. Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional palaeontologist.

Recommendations to mitigate the impacts on archaeological resources are as follows:

- If concentrations of pre-colonial archaeological heritage material (such as shell middens and associated material) and/or human remains (including graves and burials) are uncovered during construction, all work must cease immediately and be reported to the Albany Museum (046 622 2312) and/or the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) (043 745 0888) so that systematic and professional investigation/excavation can be undertaken. Phase 2 mitigation in the form of test-pitting/sampling or systematic excavations and collections of the archaeological / heritage site will then be conducted to establish the contextual status of the sites and possibly remove the archaeological deposit before development activities continue; and
- A person must be trained as a site monitor to report any archaeological sites found during the development. Construction managers/foremen and/or the Environmental Control Officer (ECO) should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.

Recommendations to mitigate the safety impacts are as follows:

- It is assumed that Eskom would implement a Fire Protection Plan for the facility and that the following management measures would be addressed in this Fire Protection Plan:
    - A fire monitoring system with early warning smoke detection;
    - A fire suppression system that will not aggravate a fire (e.g. prevent the application of water to metallic sodium);
    - The plan to be developed with the Kouga fire department, and to include training of the Kouga fire department on site specific risks;
    - Battery modules to include dividers to protect a failing cell from spreading to the neighbouring one;
    - Li ion batteries to have overcharge protection devices to avoid thermal runaway reactions; and
    - A maintenance schedule to be developed and implemented prior to operation.

Recommendations to mitigate the impacts on surface and groundwater are as follows:

- A leak detection system to be installed;
- Secondary containment systems to be in place for the BESS;
- All spills to be cleaned immediately and workers on site to be trained on correct procedures;
- A maintenance schedule to be developed and implemented prior to operation;
- Adequate spill kits must be kept on site for small spills and must be accessible at all times;

- In the event of a spillage or leaks, the spilled liquid must be collected in a suitable container and disposed of at a licensed hazardous waste site. The general area should be treated with an absorbing agent if necessary;
- Regular visual inspections of all battery storage cells and the chemical storage area must be conducted to check for wear and/or damage; and
- The correct chemical MSDS must be available on sit at all times

10 The Way Forward

The public participation process so far has given IAPs the opportunity to assist with identification of issues and potential impacts.

The Executive Summary of this FBAR has been distributed to authorities, stakeholders and registered IAPs for informational purposes. A printed copy of the complete report will be available for inspection at the Humansdorp Public Library. An electronic copy of the complete report is also available from SRK Consulting upon request.

The FBAR has been submitted to the Department of Environmental Affairs for a decision on Environmental Authorisation. Authorities, stakeholders and registered Interested & Affected Parties will be notified of the decision and appeal process once it is received.

Prepared by

Tanya Speyers

Environmental Scientist

Reviewed by

SRK Consulting - Certified Electronic Signature

srk consulting

535611/43751/Report

5347-5129-5398-GARR-15/10/2019

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Rob Gardiner

Partner, Principal Environmental Scientist

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

11 References

Arbabzadeh, M. e. (2016). Twelve Principals for Green Energy Storage in Grid Application. *Environmental Science and Technology, 50*, 1046-1055.

Eskom. (2018, September 5). Distributed Battery Storage Project Presentation. south Africa.

Ideal Energy. (2019). *How Battery Energy Storage Systems Work*. Retrieved from Ideal Energy : https://www.idealenergysolar.com/how-battery-energy-storage-works/

International Electrotechnical Commission. (2011). *Electrical Energy Storage White Paper.*

National Rural Electric Cooperative. (2018, July 11). *Reports*. Retrieved from Distributed Energy Resources: https://www.cooperative.com/topics/distributed-energy-resources/Pages/Battery-Energy-Storage-Overview-Report.aspx

State Utility Forecasting Group. (2013, June). Utility Scale Energy Storage Systems Benefits.

Tohoku University. (2015, December 7). *Basic technology of high thermally-durable all-solid-state lithium ion battery developed*. Retrieved from Science Daily: https://www.sciencedaily.com/releases/2015/12/151207100007.htm

US Trade and Development Agency. (2017). *South Africa Energy Storage Technology and Market Assessment.* Arlington.

Vsun Energy Pty Ltd. (2019). *Vanadium Energy Storage*. Retrieved from Vsun Energy: https://vsunenergy.com.au/vanadium-battery-storage/how-a-vanadium-redox-battery-works-diagram/

Whitehead, A., & Rabbow, T. e. (2017). Critical safety features of the vanadium redox flow battery. *Journal of Power Sources, 351*, 1-7. Retrieved April 29 , 2019, from https://www.sciencedirect.com/science/article/abs/pii/S0378775317303725

Appendices

Appendix A: Site Plans

Appendix B: Photographs

Appendix C: Facility Illustrations

Appendix D: Specialist Report(s)

Appendix D1: Aquatic Impact Assessment

Appendix D2: Vegetation Impact Assessment

Appendix D3: Archaeological Impact Assessment

Appendix D4: Palaeontological Heritage Study

Appendix E: Public Participation Process

Appendix E1: Public Participation Summary

Appendix E2: Onsite poster, newspaper notice & BID

Appendix E3: IAP Register

Appendix E4: Proof of Distribution of Documents

Due to the protection of personal information, delivery receipts will only be made available to the Competent Authority

Appendix E4(i): Proof of distribution of BID

Appendix E4(ii): Proof of distribution of DBAR

Appendix E5: Original IAP correspondence

Appendix E5(i): IAP correspondence on BID

Appendix E5(ii): IAP correspondence on DBAR

Appendix E5(iii): DBAR comment period reminder

Appendix F: Environmental Management Programme (EMPr)

Appendix G: Other Information

Appendix H: EAPs CV

Appendix I: Impact Assessment

Appendix J: DEA Application Form

SRK Report Distribution Record

Report No. 535611/1

Copy No.

Name/Title	Company	Copy	Date	Authorised by
Case Officer	DEA	1	15 October 2019	R Gardiner
Stanley Titshiwalomoni	DEA: Biodiversity	electronic	15 October 2019	R Gardiner
Andries Struwig	DEDEAT	2	15 October 2019	R Gardiner
Marisa Bloem	DWS	3	15 October 2019	R Gardiner
Gcinile Dumse	DAFF	electronic	15 October 2019	R Gardiner
Municipal Manager	Kouga Local Municipality	electronic	15 October 2019	R Gardiner
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Approval Signature: