MUKONDELELI WIND ENERGY FACILITY (RF) (PTY) LTD

MUKONDELELI WIND ENERGY FACILITY

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT (REFERENCE: 1/3/1/16/1G-265)

13 MARCH 2023

FINAL

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MUKONDELELI WIND ENERGY FACILITY (RF) (PTY) LTD

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SIGNATURES

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DOCUMENT DESCRIPTION

APPLICANT

Mukondeleli Wind Energy Facility (RF) (Pty) Ltd

PROJECT NAME

Proposed Mukondeleli Wind Energy Facility, Mpumalanga, South Africa

MDARDLEA REFERENCE NUMBER

1/3/1/16/1G-265 (NEAS No. MPP/EIA/0001099/2022)

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Final Environmental Impact Assessment Report

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PRODUCTION TEAM

APPLICANT

Mukondeleli Wind Energy Facility (RF) (Pty) Ltd	Mercia Grimbeek

WSP

Project Manager	Ashlea Strong
Principal Associate	Anri Scheepers

SPECIALIST

Heritage and Palaeontology Specialist	Jayson Orton (ASHA Consulting (Pty) Ltd)
Agriculture Specialist	Johan Lanz
Ecology Specialist	Dr Noel van Rooyen and Prof. Gretel van Rooyen (Ekotrust CC)
Aquatic Specialist	Rudi Bezuidenhout & Lorainmari Den Boogert (Iggdrasil Scientific Services & Limosella Consulting)
Avifauna Specialist	Chris van Rooyen (Chris van Rooyen Consulting)
Bat Specialist	Werner Marais (Animalia Consultant (Pty) Ltd
Noise Specialist	M. de Jager (Enviro-Acoustic Research cc)
Social Specialist	Tony Barbour (Tony Barbour Environmental Consulting)
Traffic Specialist	A Ramawa (JG Afrika (Pty) Ltd)
Visual Specialist	Kerry Schwartz (SLR Consulting)
Risk Specialist	Debra Mitchell (Ishecon cc)

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1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

This final Environmental Impact Report (EIR) documents the process and findings of the impact assessment phase of the Scoping and Environmental Impact Reporting (S&EIR) process for the proposed Mukondeleli Wind Energy Facility (WEF), located approximately 8km south of Secunda in the Mpumalanga Province of South Africa.

The environmental impact assessment (EIA) process is an interdisciplinary procedure to ensure that environmental considerations are included in decisions regarding projects that may impact the environment. The process identifies potential environmental impacts associated with a proposed project and management actions required to either mitigate or avoid the negative impacts or to enhance the positive impacts associated with a proposed project. In the context of this report, the purpose of the S&EIR process is to inform decision-makers and the public of the environmental consequences of the proposed project. This final EIR (this document) is a technical tool that identifies, predicts, and analyses impacts on the physical environment, as well as social, cultural, and health impacts. The report identifies alternatives and mitigation measures to reduce the environmental impact of the proposed project; and it also serves an important procedural role in the overall decision-making process by promoting transparency and public involvement.

1.2 BACKGROUND INFORMATION

The proposed project will be operated under a Special Purpose Vehicle (SPV), and the Project Applicant is Mukondeleli Wind Energy Facility (RF) (Pty) Ltd. The proponent is proposing the development of an area of approximately 3 650ha, with a maximum export capacity of up to 300MW.

In order for the proposed project to proceed, it will require an Environmental Authorisation (EA) from the Competent Authority (CA) (i.e. the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA)).

1.3 KEY ROLE PLAYERS

1.3.1 PROJECT PROPONENT

Mukondeleli Wind Energy Facility (RF) (Pty) Ltd is the project proponent (Applicant) with regards to this application for the construction and operation of the WEF and associated infrastructure. **Table 1-1** provides the relevant details of the project proponent.

Table 1-1: Details of Project Proponent

PROPONENT:	**MUKONDELELI WIND ENERGY FACILITY (RF) (PTY) LTD**
Contact Person:	Mercia Grimbeek / Kyle Swartz
Postal Address	Suite 104, Albion Springs, 183 Main Road, Rondebosch, Cape Town, South Africa 7700
Telephone:	+27 21 207 2181
Email:	Mercia.Grimbeek@enertrag.com / Kyle.Swartz@enertrag.com

1.3.2 COMPETENT AUTHORITY

Section 24C(2)(a) of the National Environmental Management Act 107 of 1998 (NEMA) stipulates that the Minister of Forestry, Fisheries and the Environment ("the Minister") must be identified as the CA if the activity has implications for international environmental commitments or relations. GN 779 of 01 July 2016 identifies the Minister as the CA for the consideration and processing of environmental authorisations and amendments thereto for activities related to the Integrated Resource Plan (IRP) 2010 – 2030.

However, due to the fact that the power generated by the Mukondeleli WEF will be made available to a private off-taker, the project is not related to the IRP, and therefore, the CA was confirmed to be the MDARDLEA.

The CA (i.e. MDARDLEA) was confirmed during the Pre-Application Meeting held on **14 July 2022**.

Table 1-2 provides the relevant details of the competent authority on the Project.

Table 1-2: Competent Authority

ASPECT	COMPETENT / COMMENTING AUTHORITY	CONTACT DETAILS
Competent Authority: Environmental Authorisation	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA	Case Officer: Okwethu Fakude Email: oqfakude@mpg.gov.za

1.3.3 COMMENTING AUTHORITIES

The following commenting authorities have been identified for this application:

- Department of Mineral Resources and Energy (DMRE);
- Department of Forestry, Fisheries and Environment (DFFE): Biodiversity and Conservation;
- DFFE: Protected Areas;
- Department of Water and Sanitation (DWS);
- Vaal Water Management Area (WMA) Authority;
- South African Heritage Resource Agency (SAHRA);
- Mpumalanga Heritage Resources Authority (MHRA);
- Mpumalanga Tourism and Parks Agency (MTPA);
- Civil Aviation Authority (CAA);
- Air Traffic and Navigation Services (ATNS);
- Department of Defence (SA Army) (DD);
- Astronomy Management Authority (AMA);
- South African Weather Services (SAWS);
- South African National Roads Agency Limited (SANRAL);
- Gert Sibande District Municipality; and
- Govan Mbeki Municipality (GMM) Local Municipality.

1.3.4 ENVIRONMENTAL ASSESSMENT PRACTITIONER

WSP Group Africa (Pty) Ltd (WSP) has been appointed in the role of Independent Environmental Assessment Practitioner (EAP) to undertake the S&EIR processes for the development of the Project. The CV of the EAP is available in **Appendix A**. The EAP declaration of interest and undertaking is included in **Appendix B**. **Table 1-3** details the relevant contact details of the EAP. In order to adequately identify and assess potential environmental impacts, a number of specialists will support the EAP.

Table 1-3: Details of the Environmental Assessment Practitioner

ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP)	WSP GROUP AFRICA (PTY) LTD
Contact Person:	Ashlea Strong
Postal Address:	Building C, Knightsbridge, 33 Sloane Street, Bryanston, 2191, South Africa
Telephone:	011 361 1392
Fax:	011 361 1381
E-mail:	Ashlea.Strong@wsp.com
Professional Registration:	EAPASA (2019/1005)
Qualifications:	— Masters in Environmental Management, University of the Free State — B Tech, Nature Conservation, Technikon SA — National Diploma in Nature Conservation, Technikon SA

STATEMENT OF INDEPENDENCE

Neither WSP 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 business, financial, personal or other interest that could be reasonably regarded as being capable of affecting their independence. WSP has no beneficial interest in the outcome of the assessment.

1.3.5 SPECIALISTS

Specialist input was required in support of this application for EA. The details of the specialists are provided in **Table 1-4** below. The specialist declarations are included in **Appendix C**.

Table 1-4: Details of Specialists

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Agriculture	Johann Lanz	Independent consultant	Sectio7.1.5 Section 8.5 **Appendix H-1**
Avifauna	Chris van Rooyen	Chris van Rooyen Consulting	Section 7.2.6 Section 8.8 **Appendix H-2**
Bats	Werner Marais	Animalia Consultants	Section 7.2.7 Section 8.9 **Appendix H-3**
Terrestrial Ecology	Dr Noel van Rooyen and Prof. Gretel van Rooyen	Ekotrust CC	Section 7.2.1 Section 7.2.2 Section 7.2.3 Section 7.2.4 Section 7.2.5 Section 8.7 **Appendix H-4**

ASSESSMENT	NAME OF SPECIALIST	COMPANY	SECTIONS IN REPORT
Aquatic	Rudi Bezuidenhout & Lorainmari Den Boogert	Iggdrasil Scientific Services & Limosella Consulting	Section 7.1.6 Section 8.6 **Appendix H-5**
Heritage	Jaco van der Walt	Beyond Heritage	Section 7.3.4 Section 8.11 **Appendix H-6**
Palaeontology	Prof Marion Bamford		Section 7.3.4 Section 8.12 **Appendix H-7**
Socio-economic	Tony Barbour	Tony Barbour Environmental Consulting	Section 7.3.6 Section 8.14 **Appendix H-8**
Traffic	A Ramawa	JG Afrika (Pty) Ltd	Section 7.3.3 Section 8.13 **Appendix H-9**
Visual	Kerry Schwartz	SLR Consulting (Pty) Ltd	Section 7.3.5 Section 8.10 **Appendix H-10**
Noise	M. de Jager	Enviro-Acoustic Research cc	Section 7.3.2 Section 8.3 Section 7.5.6 **H-11**
Safety Health and Environmental (SHE) Risk Assessment	Debra Mitchell	ISHECON	Section 7.4 Section 8.18 **Appendix H-12**
Geotechnical Desk Study	Heather Davies	WSP Group Africa (Pty) Ltd	Section 7.1.4 Section 8.4 **Appendix H-13**

1.4 IMPACT ASSESSMENT TERMS OF REFERENCE

The 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982), as amended, identifies the proposed Mukondeleli WEF development as an activity being subject to an S&EIR process due to the applicability of the EIA Listing Notices 1 and 2 (GNR 983 and 984, as amended). In order for the project to proceed it will require an Environmental Authorisation (EA) from MDARDLEA.

This EIR follows the Scoping Phase of the S&EIR process. The Scoping Process carried out involved consultation with interested and affected parties and the drafting of the Plan of Study for EIA (POS for EIA) and culminated in the submission of a Final Scoping Report to the MDARDLEA on 7 October 2022. The MDARDLEA acceptance of the Final Scoping Report and authorisation to proceed with EIA was received on 21 November 2022 (letter dated, 14 November 2022) (**Appendix G**)

As defined in Appendix 3 of GNR 982, as amended, the objective of the EIA Phase is to, through a consultative process:

— Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;

- Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;
- Identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- Determine the—
  - nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
  - degree to which these impacts—
    - can be reversed;
    - may cause irreplaceable loss of resources, and
    - can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;
- Identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;
- Identify suitable measures to avoid, manage or mitigate identified impacts; and
- Identify residual risks that need to be managed and monitored.

Public participation is a requirement of the S&EIR process; it consists of a series of inclusive interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIR decision-making process. Effective public participation requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the Proposed Project. The objectives of the public participation process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the Proposed Project;
- Clearly outline the scope of the proposed Project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed Project alternatives that will assist the relevant authorities in making an informed decision;
- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the subsequent specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and
- To inform and provide the public with information and an understanding of the Proposed Project, issues and solutions.

1.5 IMPACT ASSESSMENT REPORT STRUCTURE

Table 1-5 cross-references the sections where the legislated requirements as per Appendix 3 of the 2014 EIA Regulations (GNR 982) can been located within the EIR.

Table 1-5: Legislated Report Requirements as detailed in GNR 982

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
(a)	Details of	
	the EAP who compiled the report; and	Section 1.3.4 **Appendix A**

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
	the expertise of the EAP, including a Curriculum Vitae	**Appendix A**
(b)	The location of the activity, including-	
	The 21 digit Surveyor code for each cadastral land parcel;	Section 6.1
	Where available, the physical address and farm name	Section 6.1
	Where the required information in terms of (i) and (ii) is not available, the coordinates of the boundary of the property.	N/A
(c)	A plan which locates the proposed activities applied for at an appropriate scale, or, if it is-	
	A linear activity, a description of the corridor in which the proposed activity or activities is to be undertaken; or	N/A
	On land where the property has not been defined, the coordinates within which the activity is to be undertaken.	N/A
(d)	A description of the proposed activity, including-	
	All listed and specified activities triggered;	Section 2.1
	A description of the activities to be undertaken, including associated structures and infrastructure;	Section 6
(e)	A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process;	Section 2
(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	Section 5
(h)	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including-	
	Details of all the alternatives considered;	Section 6.5
	Details of the public participation undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Section 4.3
	a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	**Appendix D**
	the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 7
	the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated;	Section 7.4

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
	the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;	Section 4.2
	positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 7.4
	the possible mitigation measures that could be applied and level of residual risk;	Section 7.4
	the outcome of the site selection matrix;	Section 6.5
	if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such and	Section 6.5
	a concluding statement indicating the preferred alternatives, including preferred location of the activity;	Section 6.5 Section 10.5
(i)	a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including—	-
	a description of all environmental issues and risks that were identified during the environmental impact assessment process; and;	Section 7.4
	an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	Section 7.4
(j)	an assessment of each identified potentially significant impact and risk, including—	
	cumulative impacts;	Section 9
	the nature, significance and consequences of the impact and risk;	Section 7.4
	the extent and duration of the impact and risk;	Section 7.4
	the probability of the impact and risk occurring;	Section 7.4
	the degree to which the impact and risk can be reversed;	Section 7.4
	the degree to which the impact and risk may cause irreplaceable loss of resources; and	Section 7.4
	the degree to which the impact and risk can be mitigated.	Section 7.4
(k)	where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report.	Section 10.3

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
(l)	an environmental impact statement which contains —	
	a summary of the key findings of the environmental impact assessment:	Section 10
	a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and	Section 10.2
	a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	Section 8 Section 10.3
(m)	based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for inclusion in the EMPr as well as for inclusion as conditions of authorisation.	Appendix I
(n)	the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment.	Section10.5
(o)	any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Section 7.4
(p)	a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed.	Section 1.7
(q)	a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	Section 0
(r)	where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised.	N/A
(s)	an undertaking under oath or affirmation by the EAP in relation to—	
	the inclusion of comments and inputs from stakeholders and I&APs;	Appendix B
	the inclusion of inputs and recommendations from the specialist reports where relevant; and	Appendix B
	any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.	Appendix B
(t)	where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts	N/A
(u)	an indication of any deviation from the approved scoping report, including the plan of study, including—	N/A
	any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and	N/A
	a motivation for the deviation	N/A
(v)	any specific information required by the competent authority; and	N/A
(w)	any other matter required in terms of section 24(4)(a) and (b) of the Act	N/A

APPENDIX 3	LEGISLATED REQUIREMENTS AS PER THE NEMA GNR 982	RELEVANT REPORT SECTION
(2)	Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to an environmental impact assessment report the requirements as indicated in such notice will apply.	Appendix H

1.6 ADDITIONAL PERMITS AND AUTHORISATIONS

Table 1-6 outlines permits and authorisations required for the proposed development as well as the relevant Competent Authorities responsible.

Table 1-6: Additional Permits and Authorisations required for the proposed development

PERMITS/AUTHORISATION	LEGISLATION	RELEVANT AUTHORITY	STATUS
Water Use Licence / General Authorisation	National Water Act (Act No. 36 of 1998)	Department of Water and Sanitation	Application process will run concurrently with the EIA Phase.
Section 38 Notification	National Heritage Resource Act (Act No. 25 of 1999)	Mpumalanga Heritage Resources Authority	Final Comment received from SAHRA on 8 February 2023.
Obstacle Permit	Civil Aviation Act (Act 13 of 2009)	Air Traffic and Navigation Services / Civil Aviation Authority	The Obstacle permits were submitted by the Proponent in July 2021 and amended application was submitted in February 2022. The permits have not yet been issued.
Defence consent	Electronic Communications Act (No. 36 of 2005)	South African National Defence Force	Permit submitted by the Proponent in November 2022.
Section 53 Approval	Minerals and Petroleum Resources Development Act (No. 28 of 2002)	Department of Mineral Resources and Energy	Application process will run following the EIA Phase.

1.7 ASSUMPTIONS AND LIMITATIONS

General assumptions and limitations:

- The EAP hereby confirms that they have undertaken to obtain project information from the client that is deemed to be accurate and representative of the project;
- Site visits have been undertaken to better understand the project and ensure that the information provided by the client is correct, based on site conditions observed;
- The EAP hereby confirms their independence and understands the responsibility they hold in ensuring all comments received are accurately replicated and responded to within the EIA documentation;
- The comments received in response to the public participation process, will be representative of comments from the broader community; and
- Based on the Pre-Application meeting and subsequent minutes, the CA would not require additional specialist input, in order to make a decision regarding the application.

Aquatic:

- The information provided by the client forms the basis of the planning and layouts discussed.
- All watercourses within 500 m of any developmental activities should be identified as per the DWS authorization regulations. In order to meet the timeframes and budget constraints for the project, watercourses within the study sites were delineated on a fine scale based on detailed soil and vegetation sampling. Watercourses that fall outside of the site, but that fall within 100 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.
- For the aquatic zoological site visit conducted on the 3rd to the 7th of January 2022, site access was an issue and not all sites could be visited. Access was arranged to sites situated within the Sasol boundary and the sites were revisited on the 3rd and 5th of February 2022, during this site visit water levels were too high and flood conditions were observed. The site visit was re-scheduled and conducted on the 22nd to the 24th of February 2022.
- This report as well as impact assessment methodology was provided to the specialist by WSP.
- The detailed field visit for the wetland specialist was conducted from a once off field trip and thus would not depict any seasonal variation in the wetland plant species composition and richness.
- In order to obtain a comprehensive understanding of the dynamics of the aquatic ecosystem in an area, ecological assessments should always consider investigations at different time scales (across seasons/years) and through replication, as river systems are in constant change.
- As aquatic systems are directly linked to the frequency and quantity of rain it will influence the systems drastically. If studies are done during dry months or dry seasons, the accuracy of the report's findings could be affected.
- Description of the depth of the regional water table and geohydrological and hydropedological processes falls outside the scope of the current assessment
- Floodline calculations fall outside the scope of the current assessment.
- A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study
- Species composition described for landscape units aimed at depicting characteristic species and did not include a survey for cryptic or rare species.
- The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.
- Watercourses delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.
- The calculation of buffer zones does not take into account climate change or future changes to watercourses resulting from increasing catchment transformation.
- No Mitigation Hierarchy or alternative layouts were discussed since this information was not available at the time of the assessment. This constitutes an important limitation to the study and should be included in an updated version of the assessment in order to provide a 'big picture 'view of the project.
- Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. The methods used for biomonitoring often require the author to make a predicted estimation based on prior knowledge and learning. These are however the methods as requested by the client and also accepted methods in the field of aquatic ecology.
- Sampling by its nature means that the entire study area cannot be assessed. In this case, the entirety of the study site could not be assessed due to time constraints and access restrictions. Therefore, the assessment findings are only applicable to the areas sampled and extrapolated to the rest of the study site.
- Due to the large extent of the study site several areas did not have access, and extrapolation was used here it is advised that additional studies be conducted during the installation phase and the footprint of each wind turbine is assessed and possibly moved if need be.
- Several changes were made to the initial layout and these areas were thus not assessed during the field work extrapolation was thus used here again.

Avifauna:

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna that could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring which was conducted over 12 months.
- The focus of the study was on the potential impacts of the proposed wind facility on wind priority species.
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Ralston-Paton et al., 2017; Retief et al., 2012).
- Powerline sensitive species were defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
- Despite the growing body of peer reviewed literature investigating the collision risks of birds with wind turbines and overhead powerlines in South Africa (see Section 8), relevant information for many individual species remains limited. The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: "to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."
- The assessment of impacts is based on the baseline environment as it currently exists at the PAOI as well as the broader area comprising the six SABAP2 pentads associated with the Mukondeleli WEF project site.
- According to the specifications received from the proponent, the 33kV medium-voltage lines will be buried where practically feasible. It was therefore assumed that there could be 33kV overhead lines which could pose an electrocution risk to priority species.
- Conclusions drawn in this study are based on experience of the specialists on the species found on site and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.

Bats:

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large-scale effect on migratory species. This limitation is partially overcome with the 12-months pre-construction sensitivity assessment, however some uncertainty in this regard will remain until the end of operational monitoring of at least 2 years. Based on the currently available information, there is nothing to date that indicates that the site is the location of a migratory path.
- The sensitivity map is based partially on satellite imagery and from several site visits. However, there is always the possibility that what has been mapped may differ slightly to what is on the ground.
- Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence with no harmful effects on bats being surveyed.
- Automated species identification by the Kaleidoscope software may produce a smaller portion of incorrect identifications or unknown identifications. In the last-mentioned case, the dominant frequency of the

unknown call was simply used to group the bat into a family or genus group, using dominant frequency only as the determining factor. However, the automated software is very effective at distinguishing bat calls from ultrasonic noise, therefore the number of bat passes are not significantly overestimated.

- It is not possible to determine actual individual bat numbers from acoustic bat activity data, whether gathered with transects or the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.
- Exact foraging distances from bat roosts or exact commuting pathways cannot be determined by the current methodology. Radio telemetry tracking of tagged bats is required to provide such information if needed.
- Periods of exceptional drought or rain during the pre-construction assessment study can influence bat numbers, causing measurements of lower or higher bat activity due to less open water sources, lower insect prey numbers, or higher insect numbers and more available water.

Terrestrial Biodiversity:

The following assumptions, limitations or uncertainties are listed regarding the evaluation of the impacts of the proposed Mukondeleli project on the terrestrial biodiversity and ecology:

- The area has been moderately collected in the past and the list of plant species that could potentially occur on site as obtained from the NewPosa database, is thus considered to provide a fair representation of the flora on site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species. Information on rare and threatened plant and animal species was supplemented by data provided by MTPA (M. Lötter) on localities of such species at farm level.
- Rare plant species usually occur in specialised and localised habitats, thus special attention was given to these habitats.
- The site visit was undertaken in December 2021 after the region had received good rains, thus the botanical assessment was conducted under favourable conditions.
- No aerial census, road census or trapping (either camera trapping or by way of Sherman traps) was conducted for fauna, since these methods generally provide an underrepresentation of the full faunal diversity within the limited timeframe available. Faunal lists were sourced from literature and the website of the Animal Demography Unit of the University of Cape Town.

Social Environment:

- Technical suitability: It is assumed that the development site represents a technically suitable site for the establishment of the proposed WEF and associated infrastructure.
- Strategic importance of the project: The strategic importance of promoting renewable and other forms of energy is supported by the national and provincial energy policies.
- Fit with planning and policy requirements: Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard, a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported.
- Demographic data: Some of the provincial documents do not contain data from the 2011 Census and or 2016 Household Community Survey. However, where required the relevant 2011 and 2016 data has been provided.

Visual Impacts:

Assumptions, knowledge gaps and limitations relevant to this study are outlined below:

- This visual study has been undertaken based on the project description provided by the Developer and the EAP at the inception of the project.
- Given the nature of the receiving environment and the height of the proposed wind turbines, the study area or visual assessment zone is assumed to encompass an area of 10km from the proposed WEF – i.e., an area of 10km from the boundary of the WEF application site. The application of the 10km limit on the visual assessment zone relates to the fact that visual impacts decrease exponentially over distance. Thus, although

the WEF may still be visible beyond 10km, the degree of visual impact would diminish considerably. As such, the need to assess the impact on potential receptors beyond this distance would not be warranted.

- The identification of visual receptors involved a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potential receptors within the study area. Where possible, these receptor locations were verified and assessed during a site visit which was undertaken between the 25th and 26th of January 2022. Due to the extent of the study area however and the number of receptors that could potentially be sensitive to the proposed development, it was not possible to visit or verify every potentially sensitive visual receptor location. As such, several broad assumptions have been made in terms of the likely sensitivity of the receptors to the proposed development. It should be noted that not all receptor locations would necessarily perceive the proposed development in a negative way. This is usually dependent on the use of the facility, the economic dependency of the occupants on the scenic quality of views from the facility and on people's perceptions of the value of "Green Energy". Sensitive receptor locations typically include sites such as tourism facilities and scenic locations within natural settings which are likely to be adversely affected by the visual intrusion of the proposed development. Thus, the presence of a receptor in an area potentially affected by the proposed development does not necessarily mean that any visual impact will be experienced.
- The potential visual impact at each visual receptor location was assessed using a matrix developed for this purpose. The matrix is based on three main parameters relating to visual impact and, although relatively simplistic, it provides a reasonably accurate indicative assessment of the degree of visual impact likely to be experienced at each receptor location as a result of the proposed development. It is however important to note the limitations of quantitatively assessing a largely subjective or qualitative type of impact and as such the matrix should be seen merely as a representation of the likely visual impact at a receptor location.
- The exact status of all the receptors could not be verified during the field investigation and as such the receptor impact rating was largely undertaken via desktop means.
- Receptors that were assumed to be farmsteads were still regarded as being potentially sensitive to the visual impacts associated with the proposed development and were thus assessed as part of the VIA.
- Based on the project description provided by Mukondeleli, all analysis for this VIA is based on a worst-case scenario where turbine heights are assumed to be 300 m **at the blade tip**. Substation, Battery Energy Storage (BESS) facilities and office building heights are assumed to be less than 25m in height.
- Due to the varying scales and sources of information; maps may have minor inaccuracies. Terrain data for this area, derived from the NGI's 5 m Contour Database, is fairly coarse and somewhat inconsistent and as such, localised topographic variations in the landscape may not be reflected on the DEM used to generate the viewshed(s) and visibility analysis conducted in respect of the proposed development.
- In addition, the viewshed analysis did not take into account any existing vegetation cover or built infrastructure which may screen views of the proposed development. This analysis should therefore be seen as a conceptual representation or a worst-case scenario.
- No feedback regarding the visual environment has been received from the public participation process to date. Any feedback from the public during the review period of the draft EIA Report (DEIR) will however be incorporated into further drafts of this report, if relevant.
- At the time of undertaking the visual study no information was available regarding the type and intensity of lighting that will be required for the proposed WEF and therefore the potential impact of lighting at night has not been assessed at a detailed level. However, lighting requirements are relatively similar for all WEFs and as such, general measures to mitigate the impact of additional light sources on the ambiance of the nightscape have been provided.
- This study includes a broad assessment of the potential cumulative impacts of other renewable energy developments on the existing landscape character and on the identified sensitive receptors.
- Photomontages included in this report have been provided merely as indicative illustrations and should not be seen as an accurate representation of the proposed Mukondeleli turbine layout.
- Photomontages have not been compiled for all sensitive and potentially sensitive receptor locations. Instead a range of locations was selected for modelling purposes to provide an indication of how views could potentially be transformed from different locations within the study area. It should be noted that the photomontages are specific to each location, and that even sites in close proximity to one another may be affected in different ways by the proposed WEF development.
- The photomontages represent a visual environment that assumes that all vegetation cleared during construction will be restored to its current state after the construction phase. This is however an improbable

scenario as some vegetation cover may be permanently removed which may reduce the accuracy of the models generated.

- At the time the VIA was undertaken the proposed project was still in the planning stage and as such the turbine layout, as provided by the client, may change. In addition, infrastructure associated with the WEF has not been included in the models.
- It should be noted that the site visit was undertaken in late January 2022, during mid-summer, which is characterised by higher levels of rainfall and increased vegetation cover. In these conditions, slightly reduced levels of visual impact will be experienced from receptor locations in the surrounding area.
- In clear weather conditions, wind turbines would present a greater contrast with the surrounding environment than they would on an overcast day. The field investigation was conducted during clear to partly cloudy weather conditions.

Heritage:

- The field study was carried out at the surface only and hence any completely buried archaeological sites would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. The survey was based on a preliminary layout and not all turbine locations were checked due to planted fields. However, being in ploughed lands, it is assumed that intact archaeological features will not be present in those locations. In some non-planted areas the vegetation was also very dense which greatly reduced ground visibility. It is assumed that stone features would, however, generally be protruding from the grass but due to the height of the grass it is easily possible to miss small features and/or graves located more than a few meters away. No road layout was available for consideration in the field and the final turbine positions are now different which means that very little of the final layout has actually been surveyed. Nonetheless, aerial photography was scrutinised to locate any further obvious sites.
- Cumulative impacts are difficult to assess due to the variable site conditions that would have been experienced in different areas and in different seasons. Survey quality is thus likely to be variable. As such, some assumptions need to be made in terms of what and how much heritage might be impacted by other developments in the broader area.

Palaeontology:

- Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some contain fossil plant, insect, invertebrate and vertebrate material. The dolerite and the overlying soils and sands of the Quaternary period would not preserve fossils. It is not known if the project excavations will reach the shales below ground, or if the shales have any fossil plants preserved in them. There are no coal mines in the project footprint so it is unlikely that any coal seams of economic value are present. It is known that dolerite destroys any fossils in its vicinity as the hot lava bakes the adjacent sediments through which it intrudes.

Agriculture:

- There are no specific assumptions, uncertainties or gaps in knowledge or data that affect the findings of this study.

Noise/Acoustic:

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced a measurement using the reading result at the end of the measurement. Therefore, trying to define ambient sound levels using the result of one 10-minute measurement can be inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement. Semi-continuous measurements for this report were collected at four locations over a period of at least three nights, with a high confidence level in the resulting information.

- Ambient sound levels are dependent not only on time of day and meteorological conditions but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals1.
- It is assumed that the measurement locations represent other residential dwellings in the area (similar environment), yet, in practice, this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
  - the distance to closest trees, number and type of trees as well as the height of trees;
  - available habitat and food for birds and other animals;
  - distance to residential dwelling, type of equipment used at dwelling (compressors, air-con);
  - general maintenance condition of house (especially during windy conditions);
  - number and type of animals kept in the vicinity of the measurement locations (typical land use taking place around the dwelling); and
  - Distance to busy roads or other industrial or mining activities.
- Measurements over wind speeds of 3 -5 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity, which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during the dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural baseline, and in various cases sought after and pleasing. Using this data to define the ambient sound level will result in a higher rating level, and data collected close to such measurement locations will not be considered;
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as LAMin, LAeq, LAMax, LA10, LA90 and spectral analysis forms part of the many variables that can be considered. However, South African legislation requires consideration of the impulse-weighted LAeq setting that will be considered when measuring ambient sound levels;
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptors' dwelling, or measuring environmental ambient baseline contributors of significance (fauna, roads traffic, railway traffic movement etc.); and
- As a residential area develops, the presence of people will result in increased dwelling-related sounds. These are generally a combination of traffic noises, voices, animals and equipment (including TVs and radios). The result is that ambient sound levels will increase as an area matures.

Limitations due to the calculations of the noise emissions into the environment include the following:

- Many sound propagation models do not consider sound characteristics as calculations are based on an equivalent level (with the appropriate correction implemented e.g. tone or impulse). These other characteristics include intrusive sounds or amplitude modulation;
- Most sound propagation models do not consider refraction through the various temperature layers (specifically relevant during the night-times);
- Most sound propagation models do not consider the low frequency range (third octave 16 Hz – 31.5 Hz). This would be relevant to facilities with a potentially low frequency issue;
- Many environmental models consider sound to propagate in hemi-spherical way. Certain noise sources (e.g., a speaker, exhausts, fans) emit sound power levels in a directional manner;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Many environmental models are not highly suited for close proximity calculations; and

[1]Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

— Acoustical characteristics of the ground are over-simplified, with ground conditions accepted as uniform.

Geotechnical (Desktop study):

The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimize the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by WSP, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Risk:

— This study proceeded based on the assumption that vanadium redox flow batteries would most likely be installed within a building and lithium solid state batteries would be installed in containers.

Traffic:

This study is based on the project information provided by the client.

— According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300mm and total maximum length 10 500mm. It is envisaged that for this project, the inverter, transformer, and switchgear will be the transformer transport are the only abnormal load envisaged for the site. The crane will be utilised for offloading equipment, such as the transformers.
— Maximum vertical height clearances along the haulage route are 5.2m for abnormal loads.
— If any elements are manufactured within South Africa, these will be transported from their respective manufacturing centres, which would be either in the greater Cape Town area, Johannesburg, or possibly Pinetown/Durban.
— All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
— Material for the construction of internal access roads will be sourced locally as far as possible.
— The maximum number of turbines to be used at the site is estimated to be 42.
— The final access points are to be determined during the detailed design stage. Only recommended access points are known at this stage.
— Projects in the vicinity of the site to be considered as part of the EIA cumulative impacts are currently unknown.
— An 18-to-24-month construction period is assumed with 48% of the construction period dedicated to site prep and civil works.

2 GOVERNANCE FRAMWORK

2.1 NATIONAL ENVIRONMENTAL LEGAL FRAMEWORK

The South African regulatory framework establishes well-defined requirements and standards for environmental and social management of industrial and civil infrastructure developments. Different authorities at both national and regional levels carry out environmental protection functions. The applicable legislation and policies are shown in **Table 2-1**.

Table 2-1: Applicable National Legislation[2]

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
The Constitution of South Africa (No. 108 of 1996)	The Constitution cannot manage environmental resources as a stand-alone piece of legislation hence additional legislation has been promulgated to manage the various spheres of both the social and natural environment. Each promulgated Act and associated Regulations are designed to focus on various industries or components of the environment to ensure that the objectives of the Constitution are effectively implemented and upheld in an on-going basis throughout the country. In terms of Section 7, a positive obligation is placed on the State to give effect to the environmental rights.
National Environmental Management Act (No. 107 of 1998)	In terms of Section 24(2) of the NEMA, the Minister may identify activities, which may not commence without prior authorisation. The Minister thus published GNR 983 (as amended) (Listing Notice 1), GNR 984 (as amended) (Listing Notice 2) and GNR 985 (as amended) (Listing Notice 3) listing activities that may not commence prior to authorisation. The regulations outlining the procedures required for authorisation are published in the EIA Regulations of 2014 (GNR 982) (as amended). Listing Notice 1 identifies activities that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 2 identifies activities that require an S&EIR process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. Listing Notice 3 identifies activities within specific areas that require a BA process to be undertaken, in terms of the EIA Regulations, prior to commencement of that activity. WSP undertook a legal review of the listed activities according to the proposed project description to conclude that the activities listed in in this section are considered applicable to the development: A S&EIR process must be followed. An EA is required and will be applied for with the MDARDLEA.
Listing Notice 1: GNR 983, as amended	***Activity 11(i):*** *The development of facilities or infrastructure for the transmission and distribution of electricity—* *(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or* **Description:** The Facility is located outside urban areas. Furthermore, internal distribution electrical infrastructure required to connect the respective electrical components related to the Facility, and the onsite substation, including cabling (buried or overhead) will be between 33kV and 132kV. The onsite substation will be rated 33/132kV whereas internal cabling will be up to 33kV.

[2] It should be noted that all dimensions outlined in relation to Listing Notice 1, 2 and 3 are provisional and are subject to final design.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Listing Notice 1: GNR 983, as amended	***Activity 12(ii)(a)(c)*** *The development of—* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;* **Description:** The Facility will require the development of internal roads and/or access roads around the site. The physical footprint of internal access roads and electrical cabling required to connect the various components of the Facility either traverse the delineated watercourses on site, or be located within 32m of the outer extent of the delineated watercourses on site
Listing Notice 1: GNR 983, as amended	***Activity 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 metres or more but not exceeding 500 cubic metres.* **Description:** The Facility will require storage and handling of dangerous goods, including fuel, cement and chemical storage onsite, that will be greater than $80m^3$ but not exceeding $500m^3$. This activity will also be applicable in the event that Redox Flow Battery technology is considered preferred.
Listing Notice 1: GNR 983, as amended	***Activity 19*** *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;* **Description:** Internal access roads and stormwater control infrastructure, as well as electrical cabling required to connect the various components of the Facility will collectively require the excavation, infilling or removal of soil exceeding $10m^3$ from delineated watercourses on site. The exact values will be confirmed once final designs have been provided.
Listing Notice 1: GNR 983, as amended	***Activity 24(ii)*** *The development of a road—* *(ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres* **Description:** Internal access roads required by the Facility will be up to 10m wide, and exceed 1km in length. Where required for turning circle/bypass areas, however, access or internal roads may be up to 20m to allow for larger component transport. The exact values will be confirmed once final designs have been provided.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Listing Notice 1: GNR 983, as amended	***Activity 27*** *The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation* **Description:** The non-linear infrastructure components of the development footprint (buildable area) is approximately 100ha; inclusive of infrastructure such as the onsite substation, the turbine hard standings, the BESS facility etc.
Listing Notice 1: GNR 983, as amended	***Activity 28(ii)*** *Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development:* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* **Description:** The Facility is considered a commercial and/or industrial development, and is located on several farm portions outside an urban area, used for agricultural purposes. The total area to be developed for the Facility (buildable area) is approximately 100ha (i.e. greater than 1 hectare).
Listing Notice 1: GNR 983, as amended	***Activity 30*** *Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).* **Description:** The Facility infrastructure is located within, and will require vegetation clearance or disturbance of ecosystems confirmed to be listed in the National List of Ecosystems that are Threatened and in Need of Protection (as indicated in GNR 1002 of 9 December 2011). Due to the fact that these ecosystems are listed as threatened, it is assumed that various threatened or protected species may be found within the development area. The restricted activity of "cutting, chopping off, uprooting, damaging or destroying, any specimen" has been identified in terms of NEM:BA and is therefore applicable to the vegetation clearance that will be required to construct the development. In light of this, Activity 30 is considered applicable.
Listing Notice 1: GNR 983, as amended	***Activity 48(i)(a)(c)*** *The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more;* *where such expansion occurs—* *(a) within a watercourse;* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;* **Description:** Transport of large infrastructure components related to the facility will require the expansion of existing access and/or internal roads, culverts or similar drainage crossing infrastructure collectively exceeding 100m^2 or more beyond existing road or road reserves located within

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	delineated watercourses on site, or within 32m of the outer extent of the delineated watercourses on site.
Listing Notice 1: GNR 983, as amended	***Activity 56(ii)*** *The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre—* *(ii) where no reserve exists, where the existing road is wider than 8 metres;* **Description:** Transport of large infrastructure components related to the facility will require the widening of existing access and/or internal roads where no reserve exists and where such road is wider than 8 metres. The Facility is located within a rural area.
Listing Notice 2: GNR 984, as amended	***Activity 1*** *The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more,* **Description:** The proposed project entails the construction and operation of a wind energy facility that will generate up to 300MW of electricity from a renewable resource (wind). The proposed project is located outside an urban area.
Listing Notice 2: GNR 984, as amended	***Activity 15*** *The clearance of an area of 20 hectares or more of indigenous vegetation,* **Description:** The clearance required for the Facility will be approximately 100ha (subject to finalisation based on technical, final design and environmental requirements) of indigenous vegetation. Although the approximate footprint will be confirmed at final design, more than 20ha of indigenous vegetation would be removed for the construction of the individual project infrastructure.
Listing Notice 3: GNR 985, as amended	***Activity 4(f)(i)(ee)*** *The development of a road wider than 4 metres with a reserve less than 13,5 metres.* *f. Mpumalanga* *i. Outside urban areas:* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* **Description:** Internal access roads required by the Facility will be 10m wide, and approximately 60km in length. Where required for turning circle/bypass areas, however, access or internal roads may be up to 20m to allow for larger component transport. The exact values will be confirmed once final designs have been provided. In addition, the site will be located within, and will require vegetation clearance or disturbance within Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA).

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Listing Notice 3: GNR 985, as amended	***Activity 10(f)(i)(ee)(hh)*** *The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.* *f. Mpumalanga* *i. Outside urban areas:* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(hh) Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland;* **Description:** The Facility will require storage and handling of dangerous goods, including fuel, cement and chemical storage onsite, that will be greater than 80m^3 but not exceeding 500m^3. This activity will also be applicable in the event that Redox Flow Battery technology is considered preferred. Furthermore, storage contemplated above will be located within, and will require vegetation clearance or disturbance within CBA and ESA.
Listing Notice 3: GNR 985, as amended	***Activity 12(f)(ii)*** *The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *f. Mpumalanga* *ii. Within critical biodiversity areas identified in bioregional plans; or* **Description:** The clearance required for the Facility will be approximately 100ha of indigenous vegetation. Such clearance will be in excess of 300m^2 and be located in a CBA and ESA.
Listing Notice 3: GNR 985, as amended	***Activity 14(ii)(a)(c)(f)****(i)(ff)* *The development of—* *(ii) infrastructure or structures with a Physical footprint of 10 Square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *f. Mpumalanga* *i. Outside urban areas:* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* **Description:** The Facility will require the development of internal roads and/or access roads around the site (total physical footprint of approximately 72 hectares). The physical footprint of internal access roads, stormwater control infrastructure and electrical cabling required to connect the various

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	components of the Facility will either traverse the delineated watercourses on site, or be located within 32m of the outer extent of the delineated watercourses on site. The physical footprint of internal access roads, stormwater control infrastructure and electrical cabling required to connect the various components of the Facility will either traverse the delineated watercourses on site, or be located 32m of the outer extent of the delineated watercourses on site, located within CBA and ESA.
Listing Notice 3: GNR 985, as amended	***Activity 18(f)(i)(ee)*** *The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.* *f. Mpumalanga* *i. Outside urban areas:* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* **Description:** Transport of large infrastructure components related to the facility will require the widening of existing access and/or internal roads where by more than 4 metres or in excess of 1km within the Mpumalanga Province and outside urban areas. Such widening will be located within CBA and ESA.
Listing Notice 3: GNR 985, as amended	***Activity 23(ii)(a)(c)(f)(i)(ee)*** *The expansion of—* *(ii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more;* *where such expansion occurs —* *(a) within a watercourse;* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *f. Mpumalanga* *i. Outside urban areas:* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* **Description:** The Facility will require the development of internal roads and/or access roads around the site (total physical footprint of approximately 72 hectares). The physical footprint of internal access roads, stormwater control infrastructure and electrical cabling required to connect the various components of the Facility will either traverse the delineated watercourses on site, or be located within 32m of the outer extent of the delineated watercourses on site. The physical footprint of internal access roads, stormwater control infrastructure and electrical cabling required to connect the various components of the Facility either traverse the delineated watercourses on site, or be located within 32m of the outer extent of the delineated watercourses on site, located within CBA and ESA.
Procedures for the Assessment and Minimum Criteria for	The protocols provide the criteria for specialist assessment and minimum report content requirements for impacts for various environmental themes for activities requiring environmental authorisation. The protocols replace the requirements of Appendix 6 of the EIA Regulations,

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
Reporting on Identified Environmental Themes (GNR 320, 20 March 2020 and GNR 1150, 30 October 2020)	2014, as amended. The assessment and reporting requirements of the protocols are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool). The following environmental themes were applicable to the Mukondeleli WEF project: — Agricultural Theme — Animal Species Theme — Aquatic Biodiversity Theme — Archaeological and Cultural Heritage Theme — Avian Theme — Bats Theme — Civil Aviation Theme — Defence Theme — Flicker Theme — Landscape — Palaeontology Theme — Noise Theme — Plant Species Theme — RFI Theme — Terrestrial Biodiversity Theme
National Environmental Management: Waste Act (59 of 2008) (NEM:WA)	This Act provides for regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation. The Act also provides for the licensing and control of waste management activities through GNR. 921 (2013), as amended: List of Waste Management Activities that Have, or are Likely to Have, a Detrimental Effect on the Environment. The proposed project does not constitute a Listed Activity requiring a Waste Management Licence (WML) as defined in GNR 921, as amended. However, the contents of this Scoping Report will include reasonable measures for the prevention of pollution and good international industry practice (GIIP).
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) was promulgated in June 2004 within the framework of NEMA to provide for the management and conservation of national biodiversity. The NEMBA's primary aims are for the protection of species and ecosystems that warrant national protection, the sustainable use of indigenous biological resources, the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources. In addition, the NEMBA provides for the establishment and functions of a South African National Biodiversity Institute (SANBI). SANBI was established by the NEMBA with the primary purpose of reporting on the status of the country's biodiversity and conservation status of all listed threatened or protected species and ecosystems. During screening CBAs were identified, which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. Based on the screening, a significant part of the Project Area falls within CBA (Irreplaceable and Optimal), especially the especially the western part of the site. There are also some Ecological Support Area (ESA) Local and Landscape corridors demarcated within the Mukondeleli site. According to the description for the Mpumalanga Biodiversity Sector Plan (MBSP) Terrestrial Assessment categories, CBAs are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features). The management approach is that they should remain in a natural state. CBAs are areas of high biodiversity value which are usually at risk of being lost and usually identified as important in meeting biodiversity targets, except for

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	Critically Endangered Ecosystems or Critical Linkages. CBAs in the Province can be divided into two sub-categories: — Irreplaceable (parts of the site are within this sub-category), and — Optimal (northern parts of the site are within this sub-category). The site is located in the Soweto Highveld Grassland vegetation type (Mucina & Rutherford 2006, SANBI 2006-2018) which is classified as "Vulnerable" (NEMA 2011, Skowno et al. 2018). Terrestrial ecology studies will be undertaken during the EIA phase to inform the assessment of impacts and will include flora surveys of the project footprint to determine the presence of flora species of concern (SoC), and bird surveys of the area to define the potential risks to bird SoC. The Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) Regulations with regards to alien and invasive species have been superseded by the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. Specific management measures for the control of alien and invasive plants will be included in the Environmental Management Programme (EMPr).
National Environmental Management Protected Areas Act (No. 57 of 2003)	The purpose of the National Environmental Management Protected Areas Act (No. 57 of 2003) (NEMPAA) is to, inter alia, provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. To this end, it provides for the declaration and management of various types of protected areas. According to the National Protected Area Expansion Strategy (NPAES), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore outside the NPAES focus area. In addition, the site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).
The National Water Act (No. 36 Of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) provides the framework to protect water resources against over exploitation and to ensure that there is water for social and economic development, human needs and to meet the needs of the aquatic environment. The Act defines water source to include watercourses, surface water, estuary or aquifer. A watercourse is defined in the Act as a river or spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which or from which water flows, and any collection of water that the Minister may declare a watercourse. Section 21 of the Act outlines a number of categories that require a water user to apply for a Water Use License (WUL) and Section 22 requires water users to apply for a General Authorisation (GA) with the Department of Water and Sanitation (DWS) if they are under certain thresholds or meet certain criteria. The list of water uses applicable to the proposed Project include: *a) Taking water from a water resource;* *c) Impeding or diverting the flow of water in a watercourse;* *g) Disposing of waste in a manner which may detrimentally impact on a water resource;* *i) Altering the bed, banks, course or characteristics of a watercourse;* The DWS will make the final decision on water uses that are applicable to the project through a pre-application meeting after which a Water Use Authorisation Application (WUA) as determined by the risk assessment will be undertaken in compliance with procedural regulations published by the DWS within General Notice 267 (GN267). These regulations specify required information per water use and the reporting structure of required supporting technical information.
The National Heritage Resources Act (No. 25 Of 1999)	The National Heritage Resource Act (Act No. 25 of 1999) (NHRA) serves to protect national and provincial heritage resources across South Africa. The NHRA provides for the protection of all archaeological and palaeontological sites, the conservation and care of cemeteries and graves by the South African Heritage Resources Agency (SAHRA), and lists activities that require any

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
	person who intends to undertake to notify the responsible heritage resources agency and furnish details regarding the location, nature, and extent of the proposed development. Part 2 of the NHRA details specific activities that require a Heritage Impact Assessment (HIA) that will need to be approved by SAHRA. Parts of Section 35, 36 and 38 apply to the proposed project, principally: — Section 35 (4) - No person may, without a permit issued by the responsible heritage resources authority- — destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite; — destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite. — Section 38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as- — any development or other activity which will change the character of a site— (i) exceeding 5 000 m^2 in extent, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. In terms of Section 38(8), approval from the heritage authority is not required if an evaluation of the impact of such development on heritage resources is required in terms of any other legislation (such as NEMA), provided that the consenting authority ensures that the evaluation of impacts fulfils the requirements of the relevant heritage resources authority in terms of Section 38(3) and any comments and recommendations of the relevant resources authority with regard to such development have been taken into account prior to the granting of the consent. However, should heritage resources of significance be affected by the proposed Mukondeleli WEF, a permit is required to be obtained prior to disturbing or destroying such resources as per the requirements of Section 48 of the NHRA, and the SAHRA Permit Regulations (GN R668). The proposed project will be loaded onto the SAHRIS portal for comment by SAHRA.
Mineral and Petroleum Resources Development Act (No. 28 of 2002)	The aim of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources. Section 53(1) of the MPRDA provides that any person who intends to use the surface of any land in any way that may be contrary to any object of the MPRDA, or which is likely to impede any such object, must apply to the Minister of Mineral Resources (the Minister) for approval. Section 53 of the MPRDA provides a mechanism for ensuring that, inter alia, the mining of mineral resources is not detrimentally affected through the use of the surface of land and which may, for example, result in the sterilisation of a mineral resource. A Section 53 approval will be required due to the fact that the project is located on various mining right areas. The Amendment Regulations (GNR 420 of 27 March 2020) introduced a template for section 53 applications (Form Z) and the specific information that applicants will need to provide as part of a section 53 application.
Noise Control Regulations in terms of the Environmental Conservation, 1989 (Act 73 of 1989)	In South Africa, environmental noise control has been in place for three decades, beginning in the 1980s with codes of practice issued by the South African National Standards (formerly the South African Bureau of Standards, SABS) to address noise pollution in various sectors of the country. Under the previous generation of environmental legislation, specifically the Environmental Conservation Act 73 of 1989 (ECA), provisions were made to control noise from a National level in the form of the Noise Control Regulations (GNR 154 of January 1992). In later years, the ECA was replaced by the NEMA as amended. The National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) was published in line with NEMA and contains noise control provisions under Section 34: *(1) The minister may prescribe essential national standards –*

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	(a) for the control of noise, either in general or by specific machinery or activities or in specified places or areas; or *(b) for determining –* *(i) a definition of noise; and* *(ii) the maximum levels of noise.* *(2) When controlling noise, the provincial and local spheres of government are bound by any prescribed national standards.* Under NEMAQA, the Noise Control Regulations were updated and are to be applied to all provinces in South Africa. The Noise Control Regulations give all the responsibilities of enforcement to the Local Provincial Authority, where location specific by-laws can be created and applied to the locations with approval of Provincial Government. Where province-specific regulations have not been promulgated, acoustic impact assessments must follow the Noise Control Regulations. Furthermore, NEMAQA prescribes that the Minister must publish maximum allowable noise levels for different districts and national noise standards. These have not yet been accomplished and as a result all monitoring and assessments are done in accordance with the South African National Standards (SANS) 10103:2008 and 10328:2008.
Conservation of Agricultural Resources Act (No. 43 of 1983)	The Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) provides for the implementation of control measures for soil conservation works as well as alien and invasive plant species in and outside of urban areas. In terms of the amendments to the regulations under the CARA, landowners are legally responsible for the control of alien species on their properties. Various Acts administered by the DFFE and the DWS, as well as other laws (including local by-laws), spell out the fines, terms of imprisonment and other penalties for contravening the law. Although no fines have yet been placed against landowners who do not remove invasive species, the authorities may clear their land of invasive alien plants and other alien species entirely at the landowners' cost and risk. The CARA Regulations with regards to alien and invasive species have been superseded by NEMBA Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014.
Civil Aviation Act (No. 13 of 2009)	Civil aviation in South Africa is governed by the Civil Aviation Act (Act 13 of 2009). This Act provides for the establishment of a stand-alone authority mandated with controlling, promoting, regulating, supporting, developing, enforcing and continuously improving levels of safety and security throughout the civil aviation industry. This mandate is fulfilled by South African Civil Aviation Authority (SACAA) as an agency of the Department of Transport (DoT). SACAA achieves the objectives set out in the Act by complying with the Standards and Recommended Practices (SARPs) of the International Civil Aviation Organisation (ICAO), while considering the local context when issuing the South African Civil Aviation Regulations (SA CARs). As of the 1st of May 2021, Air Traffic and Navigation Services (ATNS) has been appointed as the new Obstacle application Service Provider for Windfarms and later Solar Plants. Their responsibility would pertain to the assessments, maintenance, and all other related matters in respect to Windfarms and in due time Power Plant assessments. The DEA Screening Tool Report identified Civil Aviation as having medium sensitivity for the proposed Mukondeleli WEF, and as being located between 8 and 15km of other civil aviation arerodrome. An Application for the Approval of Obstacles will also be submitted to ATNS. SACAA will be included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from these authorities as applicable.
Occupational Health and Safety Act (No. 85 of 1993)	The National Occupational Health and Safety Act (No. 85 of 1993) (OHSA) and the relevant regulations under the Act are applicable to the proposed project. This includes the Construction Regulations promulgated in 2014 under Section 43 of the Act. Adherence to South Africa's OHSA and its relevant Regulations is essential.

LEGISLATION	DESCRIPTION OF LEGISLATION AND APPLICABILITY
National Energy Act (No. 34 of 2008)	The National Energy Act aims to ensure that diverse energy resources are available, in sustainable quantitates, and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors. The main objectives of the Act are to: — Ensure uninterrupted supply of energy to the Republic; — Promote diversity of supply of energy and its sources; — Facilitate effective management of energy demand and its conservation; — Promote energy research; — Promote appropriate standards and specifications for the equipment, systems and processes used for producing, supplying and consuming energy; — Ensure collection of data and information relating to energy supply, transportation and demand; — Provide for optimal supply, transformation, transportation, storage and demand of energy that are planned, organised and implemented in accordance with a balanced consideration of security of supply, economics, consumer protection and a sustainable development; — Provide for certain safety, health and environment matters that pertain to energy; — Facilitate energy access for improvement of the quality of life of the people of Republic; — Commercialise energy-related technologies; — Ensure effective planning for energy supply, transportation, and consumption; and — Contribute to sustainable development of South Africa's economy. In terms of the act, the Minister of Energy is mandated to develop and, on an annual basis, review and publish the Integrated Energy Plan (IEP) in the Government Gazette. The IEP analyses current energy consumption trends within different sectors of the economy (i.e. agriculture, commerce, industry, residential and transport) and uses this to project future energy requirements, based on different scenarios. The IEP and the Integrated Resource Plan are intended to be updated periodically to remain relevant. The framework is intended to create a balance between energy demand and resource availability so as to provide low-cost electricity for social and economic development, while taking into account health, safety and environmental parameters.
Electricity Regulation Act (No. 4 of 2006)	The Electricity Regulation Act (No. 4 of 2006) (ERA) aims to: — Achieve the efficient, effective, sustainable and orderly development and operation of electricity supply infrastructure in South Africa; — Ensure that the interests and needs of present and future electricity customers and end users are safeguarded and met, having regard to the governance, efficiency. effectiveness and long-term sustainability of the electricity supply industry within the broader context of economic energy regulation in the Republic: — Facilitate investment in the electricity supply industry; — Facilitate universal access to electricity; — Promote the use of diverse energy sources and energy efficiency; — Promote competitiveness and customer and end user choice; and — Facilitate a fair balance between the interests of customers and end users, licensees, investors in the electricity supply industry and the public. The Act establishes a National Energy Regulator as the custodian and enforcer of the National Electricity Regulatory Framework. The Act also provides for licenses and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated.

2.2 POLICES AND PLANS

Table 2-2 Summarised key policies and plans as an outline of the governance framework for the project.

Table 2-2: Applicable Regional Policies and Plans

APPLICABLE POLICY	DESCRIPTION OF POLICY
National Development Plan	The National Development Plan aims to eliminate poverty and reduce inequality by 2030. The NDP identifies a number of enabling milestones. Of relevance to the proposed development the NDP refers to the need to produce sufficient energy to support industry at competitive prices and ensure access for poor households, while reducing carbon emissions per unit of power by about one-third. In this regard the infrastructure is not just essential for faster economic growth and higher employment. It also promotes inclusive growth, providing citizens with the means to improve their own lives and boost their incomes. Infrastructure is essential to development. Chapter 3, Economy and Employment, identifies some of the structural challenges specific to South Africa, including an energy constraint that will act as a cap on growth and on options for industrialisation. The NDP notes that from an environmental perspective South Africa faces several related challenges. The reduction of greenhouse gas emissions and shift to a green low-carbon economy, is one of these challenges. In terms of implementation the NDP identifies three phases. The first two are of specific relevance to the proposed project. The first phase (2012–2017) notes that ensuring the supply of energy and water is reliable and sufficient for a growing economy. The second phase (2018–2023) involves building on the first phase to lay the foundations for more intensive improvements in productivity. The provision of affordable and reliable energy is a key requirement for this to take place. Chapter 4, Economic infrastructure, notes that economic infrastructure provides the foundation for social and economic development. In this regard South Africa must invest in a strong network of economic infrastructure designed to support the country's medium- and long-term economic and social objectives. The plan envisages that, by 2030, South Africa will have an energy sector that promotes: — Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation. — Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change. More specifically, South Africa should have adequate supply security in electricity and in liquid fuels, such that economic activity, transport, and welfare are not disrupted. The plan sets out steps that aim to ensure that, in 20 years, South Africa's energy system looks very different to the current situation. In this regard coal will contribute proportionately less to primary-energy needs, while gas and renewable energy resources, will play a much larger role.
Integrated Resource Plan 2010 – 2030	The IRP is an electricity capacity plan which aims to provide an indication of the country's electricity demand, how this demand will be supplied and what it will cost. On 6 May 2011, the then Department of Energy (DoE) released the Integrated Resource Plan 2010-2030 (IRP 2010) in respect of South Africa’s forecast energy demand for the 20-year period from 2010 to 2030. The promulgated IRP 2010–2030 identified the preferred generation technology required to meet expected demand growth up to 2030. It incorporated government objectives such as affordable electricity, reduced greenhouse gas (GHG) emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development. The IRP recognises that Solar photovoltaic (PV), wind and concentrated solar power (CSP) with storage present an opportunity to diversify the electricity mix, to produce distributed generation and to provide off-grid electricity. Renewable technologies also present huge potential for the creation of new industries, job creation and localisation across the value chain.
New Growth Path	Government released the New Economic Growth Path Framework on 23 November 2010. The aim of the framework is to enhance growth, employment creation and equity. The policy’s principal target is to create five million jobs over the next 10 years and reflects government’s commitment to prioritising employment creation in all economic policies. The framework identifies strategies that will enable South Africa to grow in a more

APPLICABLE POLICY	DESCRIPTION OF POLICY
	equitable and inclusive manner while attaining South Africa's developmental agenda. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard the framework identifies investments in five key areas namely: energy, transport, communication, water, and housing.
National Infrastructure Plan	The South African Government adopted a National Infrastructure Plan (NIP) in 2012. The NIP aims to transform the South African economic landscape while simultaneously creating significant numbers of new jobs and strengthening the delivery of basic services. It outlines the challenges and enablers which needs to be addressed in the building and developing of infrastructure. The Presidential Infrastructure Coordinating Commission (PICC) was established by the Cabinet to integrate and coordinate the long-term infrastructure build. The plan also supports the integration of African economies. In terms of the plan Government will invest R827 billion over the next three years to build new and upgrade existing infrastructure. The aim of the investments is to improve access by South Africans to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools and dams will contribute to improved economic growth.
Strategic Integrated Projects	As part of the NIP and in terms of Section 8(1)(a) read with Section 7(1) of the Infrastructure Development Act, as amended (Act 23 of 2014), large-scale infrastructure projects, known as Strategic Integrated Projects (SIPs), have been identified across all nine provinces. Thirty-six (36) SIPs have been prioritised as part of the NIP. SIPs cover catalytic projects that can fast-track development and growth. Work is being aligned with key cross-cutting areas: human settlement planning and skills development. The SIPs comprise: — Six Geographically-focussed SIPs (SIP 1 to 5 and 36); — Three Spatial SIPs (SIP 6, 7 and 11); — Four Energy SIPs (SIP 8 to 10 and 20); — Thirteen Socially focussed Infrastructure SIPs (SIP 12 to 14 and 24 to 27 and 31); — Two Knowledge SIPs (SIP 15 and 16); — One Regional Integration SIP (SIP 17); and — Three Water and Sanitation SIPs (SIP 18, 19 and 33); — One Transport SIP (SIP 21); — Two Digital Infrastructure SIP (SIP 22 and 30); — One Agriculture and Agro-Processing Sip (SIP 23) As of 6 December 2022 a total of 9 projects have been successfully registered with Infrastructure South Africa (ISA). Projects registered with ISA received their SIP letters immediately after GN2835 was published in December 2022. One of the projects registered included the Sasol HyShift Project in Secunda, Mpumalanga. The Mukondeleli WEF feeds into the broader HyShift Project through the generation of renewable energy. Therefore, the MDARDLEA have been requested to consider reducing their decision making timeframe to 57 days as per the timeframes outlined in the Infrastructure Development Act, as amended (Act 23 of 2014).
Integrated Energy Plan	The development of a National IEP was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette. The purpose of the IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development. The IEP notes that South Africa needs to grow its energy supply to support economic expansion and in so doing, alleviate supply bottlenecks and supply-demand deficits. In addition, it is essential that all citizens are provided with clean and modern forms of

APPLICABLE POLICY	DESCRIPTION OF POLICY
	energy at an affordable price. As part of the Integrated Energy Planning process, eight key objectives are identified, namely: — Objective 1: Ensure security of supply. — Objective 2: Minimise the cost of energy. — Objective 3: Promote the creation of jobs and localisation. — Objective 4: Minimise negative environmental impacts from the energy sector. — Objective 5: Promote the conservation of water. — Objective 6: Diversify supply sources and primary sources of energy. — Objective 7: Promote energy efficiency in the economy. — Objective 8: Increase access to modern energy. The IEP provides an assessment of current energy consumption trends within different sectors of the economy (i.e., agriculture, commerce, industry, residential and transport) and uses this information to identify future energy requirements, based on different scenarios. The scenarios are informed by different assumptions on economic development and the structure of the economy and also take into account the impact of key policies such as environmental policies, energy efficiency policies, transport policies and industrial policies, amongst others. Based on this information the IEP then determines the optimal mix of energy sources and technologies to meet those energy needs in the most cost-effective manner for each of the scenarios. The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed. The IEP is therefore focused on determining the long-term energy pathway for South Africa, taking into account a multitude of factors which are embedded in the eight objectives. As part of the analysis four key scenarios were developed, namely the Base Case, Environmental Awareness, Resource Constrained and Green Shoots scenarios: — The Base Case Scenario assumes that existing policies are implemented and will continue to shape the energy sector landscape going forward. It assumes moderate economic growth in the medium to long term. — The Environmental Awareness Scenario is characterised by more stringent emission limits and a more environmentally aware society, where a higher cost is placed on externalities caused by the supply of energy. — The Resource Constrained Scenario in which global energy commodity prices (i.e. coal, crude oil and natural gas) are high due to limited supply. — The Green Shoots Scenario describes an economy in which the targets for high economic growth and structural changes to the economy, as set out in the National Development Plan (NDP), are met. The IEP notes that South Africa should continue to pursue a diversified energy mix which reduces reliance on a single or a few primary energy sources. In terms of existing electricity generation capacity, the IEP indicates that existing capacity starts to decline notably from 2025, with significant plant retirement occurring in 2031, 2041 and 2048. By 2050 only 20% of the current electricity generation capacity remains. As a result, large investments are required in the electricity sector in order to maintain an adequate supply in support of economic growth. By 2020, various import options become available, and some new coal capacity is added along with new wind, solar and gas capacity. The mix of generation capacity technologies by 2050 is considerably more diverse than the current energy mix, across all scenarios. The main differentiating factors between the scenarios are the level of demand, constraints on emission limits and the carbon dioxide externality costs. In all scenarios the energy mix for electricity generation becomes more diverse over the period to 2050, with coal reducing its share from about 85% in 2015 to 15–20% in 2050 (depending on the scenario). Solar, wind, nuclear, gas and electricity imports increase their share. The Environmental Awareness and Green Shoots scenarios take on higher levels of renewable energy. An assessment of each scenario against the eight objectives with reference to renewable energy notes while all scenarios seek to ensure that costs are minimised within the

APPLICABLE POLICY	DESCRIPTION OF POLICY
	constraints and parameters of each scenario, the Base Case Scenario presents the least cost followed by the Environmental Awareness, Resource Constrained and Green Shoots scenarios respectively when total energy system costs are considered. In terms of promoting job creation and localisation potential the Base Case Scenario presents the greatest job creation potential, followed by the Resource Constrained, Environmental Awareness and Green Shoots scenarios respectively. In all scenarios, approximately 85% of total jobs are localisable. For electricity generation, most jobs result from solar technologies followed by nuclear and wind, with natural gas and coal making a smaller contribution. The Environmental Awareness Scenario, due to its stringent emission constraints, shows the lowest level of total emissions over the planning horizon. This is followed by the Green Shoots, Resource Constrained and Base Case scenarios. These trends are similar when emissions are considered cumulatively and individually by type.
National Protected Area Expansion Strategy, 2010	The NPAES areas were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2010). According to the NPAES, there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**.

2.3 PROVINCIAL AND MUNICIPAL LEGAL FRAMEWORK

Table 2-3: Provincial Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Mpumalanga Growth and Development Path	The primary objective of the Mpumalanga Economic Growth and Development Path (MEGDP) (2011) is to foster economic growth that creates jobs, reduce poverty and inequality in the Province. The MEGDP identifies supporting the development of clean forms of energy such as wind and hydro power generation opportunities, as well as opportunities including gas production from landfill and organic waste, as one of the key interventions to facilitate growth and job creation in the manufacturing sector. A focal point of the MEGDP is massive investments in infrastructure as a key driver of job creation across the economy, with alternative energy production identified as one of the key opportunities in the Mpumalanga Economic sectors.
Mpumalanga Spatial Development Framework (MSDF), 2019	The Mpumalanga Spatial Development Framework (SDF) (2019) identifies that tourism is an important economic sector and has emerged as a robust driver of growth for emerging economies. The SDF also notes that a significant portion of Mpumalanga’s land area is classified as Moderate to High-Very High agricultural potential which can be utilised for agricultural production. However, there are other factors affecting the agricultural sector including loss of agricultural land to other activities, availability of water, contamination of the water used for irrigation by other economic activities, and access to the market. The SDF further notes that mining is the largest economic sector in the province and has assisted other sectors such as manufacturing and power generation, to grow in the province. However, the mining sector has posed some key challenges, including soil and water contamination and environmental pollution, development of mines on good agricultural soil thus threatening food security, restriction of animal movement due to open cast mining thus affecting the ecosystem etc. It also notes that Mpumalanga’s manufacturing plants and coal fired power plants are the key polluters of air, with climate change also identified as a key challenge in the province. Therefore, the province must carefully design interventions that provide a gradual shift from mining

APPLICABLE PLAN	DESCRIPTION OF PLAN
	oriented sectors to the sustainable economic sectors to maintain sustained growth of the provincial economy. The SDF notes that a significant amount of the country's electricity comes from coal-fired stations in Mpumalanga. It also observes that there is a steady increase in the demand for electricity in the province, mostly attributed to residential, commercial and industrial development, including mining and heavy industry. The Provincial SDF also notes that the abundance of coal has led to the development of many coal-fired power stations in the province, however these coalfields are depleting, therefore making it necessary to consider renewable power sources in Mpumalanga. The SDF also recognises that Mpumalanga's Coal Mining and Coal Fired Power Plant region (mainly the Highveld area) will be under immense pressure for environmental considerations and as a result, the region will witness a possible decline in demand of coal and large-scale employment. The SDF proposes to diversify the regional economy and facilitate the gradual transition of economic activities in the region.
Mpumalanga Industrial Development Plan	In terms of industry, the purpose of the Mpumalanga Industrial Development Plan (MIDP) (2015) is to promote the establishment of new industries and promote growth of existing industries in the province.
Mpumalanga Conservation Act (No. 10 of 1998)	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: — Various species are protected; — The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. The Act provides lists of protected species for the Province. According to the Mpumalanga Nature Conservation Act, a permit is required for the removal of any species on this list.

Table 2-4: District and Local Municipality Plans

APPLICABLE PLAN	DESCRIPTION OF PLAN
Gert Sibande Municipality Integrated Development Plan	According to the Municipal Systems Act (Act 32 of 2000) (MSA), all municipalities have to undertake an Integrated Development Plan (IDP) process. The IDP is a legislative requirement thus it has legal status and supersedes all other plans that guide development at local government level. The Gert Sibande Municipality (GSM) IDP Review (2019/ 2020) and Final IDP (2020/2021) has identified the following development priorities: — Municipal Transformation and Organisational Development — Basic Service Delivery and Infrastructure Development — Local Economic Development — Municipal Financial Viability and Management — Good Governance and Public Participation — Spatial Development Analysis and Rationale The main goal and strategic objective of the Basic Service Delivery and Infrastructure Development priority is a reliable and sustainable service. One of the main strategic objectives for reaching the goal is the provision of basic services such as water and electricity to an approved minimum level of standards in a sustainable manner; as per the national guidelines.

APPLICABLE PLAN	DESCRIPTION OF PLAN
Govan Mbeki Local Municipality IDP	The GMM Revised IDP (2020/2021) has identified the following key Municipal priorities: — Providing sustainable, quality services; — Enabling diversified local economic development and job creation; — Ensuring the financial sustainability of the Municipality; — Working together with our stakeholders; — Empowering our workforce; and — Ensuring sound corporate governance. The Vision, Mission and Values are informed by six Key Strategic objectives of which Strategic Objective 3, To facilitate and create an enabling environment for diversified local economic development, social cohesion, and job creation and Strategic Objective 5, To develop spatially integrated, safe communities and a protected environment, are relevant to the proposed development. The IDP also refers to the establishment of a Special Economic Zone (SEZ) in the GMM, including the establishment of an industrial park. The proposed Industrial Park is to be located on an identified portion of land north west of Secunda. The success of the park and other industrial developments in the GMM will be dependent on the provision of reliable energy.
Govan Mbeki Spatial Development Framework	The GMM SDF is informed by six strategic objectives, including: — Strategic Objective 1: Economic development and job creation supporting and guiding development; — Strategic Objective 2: Promoting education, training, and innovation; — Strategic Objective 3: Accommodating urbanisation and transforming human settlements; — Strategic Objective 4: Promote the development of the rural areas within GMM that can support sustainable economic, social, and engineering infrastructure; — Strategic Objective 5: Protect biodiversity, water, and agricultural resources; and — Strategic Objective 6: Infrastructure Investment. Strategic Objective 1, 5 and 6 are relevant to the proposed development: — Strategic Objective (S0)1: Of specific relevance SO 1 refers to the need to diversify the local mining dependent economy by phasing in renewable energy options, which include concentrated solar power, wind, and natural gas, reducing dependence on coal resources. — Strategic Objective (SO) 5: Of specific relevance SO5 highlights the need to minimise the consumption of scarce environmental resources, particularly water, electricity and land and protect biodiversity, water, and agricultural resources. — Strategic Objective (SO) 6: Of specific relevance SO6 highlights the need to ensure efficient supply of electricity and water install green infrastructure, including renewable energy.

2.4 INTERNATIONAL ENVIRONMENTAL AND SOCIAL STANDARDS

2.4.1 IFC PERFORMANCE STANDARDS

The International Finance Corporation (IFC) is an international financial institution that offers investment, advisory, and asset management services to encourage private sector development in developing countries. The IFC is a member of the World Bank Group (WBG) and is headquartered in Washington, D.C., United States. It was established in 1956 as the private sector arm of the WBG to advance economic development by investing in strictly for-profit and commercial projects that purport to reduce poverty and promote development.

The IFC's stated aim is to create opportunities for people to escape poverty and achieve better living standards by mobilizing financial resources for private enterprise, promoting accessible and competitive markets, supporting businesses and other private sector entities, and creating jobs and delivering necessary services to those who are poverty-stricken or otherwise vulnerable. Since 2009, the IFC has focused on a set of development goals that its projects are expected to target. Its goals are to increase sustainable agriculture opportunities, improve health and education, increase access to financing for microfinance and business clients, advance infrastructure, help small businesses grow revenues, and invest in climate health.

The IFC is owned and governed by its member countries but has its own executive leadership and staff that conduct its normal business operations. It is a corporation whose shareholders are member governments that provide paid-in capital and which have the right to vote on its matters. Originally more financially integrated with the WBG, the IFC was established separately and eventually became authorized to operate as a financially autonomous entity and make independent investment decisions. It offers an array of debt and equity financing services and helps companies face their risk exposures, while refraining from participating in a management capacity. The corporation also offers advice to companies on making decisions, evaluating their impact on the environment and society, and being responsible. It advises governments on building infrastructure and partnerships to further support private sector development.

The IFC's Sustainability Framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. IFC's Access to Information Policy reflects IFC's commitment to transparency and good governance on its operations and outlines the Corporation's institutional disclosure obligations regarding its investment and advisory services. The Performance Standards (PSs) are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the PSs to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives. The PSs may also be applied by other financial institutions (FIs).

The Project is considered a Category B project in terms of the IFC Policy on E&S Sustainability (2012), having the potential to cause limited adverse environmental or social risks and/or impacts that are few in number, generally site specific, largely reversible, and readily addressed through mitigation measures.

The objectives and applicability of the eight PSs are outlined in **Table 2-5.**

Table 2-5: IFC Performance Standards Applicability to the Project

REFERENCE	REQUIREMENTS	PROJECT SPECIFIC APPLICABILITY
Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts		
Overview	Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.	
Objectives	— To identify and evaluate environmental and social risks and impacts of the project. — To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. — To promote improved environmental and social performance of clients through the effective use of management systems.	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	— To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. — To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.		
Aspects	1.1	Policy	The IFC Standards state under PS 1 (Guidance Note 23) that "*the breadth, depth and type of analysis included in an ESIA must be proportionate to the nature and scale of the proposed project's potential impacts as identified during the course of the assessment process*." This document is the second deliverable from the S&EIR process undertaken for the proposed Project. The impact assessment comprehensively assesses the key environmental and social impacts and complies with the requirements of the South African EIA Regulations. In addition, an EMPr has been compiled during this EIA phase of the project (**Appendix I**). A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlines in the EMPr will serve as the basis for an ESMS for the proposed Project.
	1.2	Identification of Risks and Impacts	
	1.3	Management Programmes	
	1.4	Organisational Capacity and Competency	
	1.5	Emergency Preparedness and Response	
	1.6	Monitoring and Review	
	1.7	Stakeholder Engagement	
	1.8	External Communication and Grievance Mechanism	
	1.9	Ongoing Reporting to Affected Communities	
Performance Standard 2: Labour and Working Conditions;			
Overview	Performance Standard 2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.		
Objectives	— To promote the fair treatment, non-discrimination, and equal opportunity of workers. — To establish, maintain, and improve the worker-management relationship. — To promote compliance with national employment and labour laws. — To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. — To promote safe and healthy working conditions, and the health of workers. — To avoid the use of forced labour.		
Aspects	2.1	— Working Conditions and Management of Worker Relationship — Human Resources Policy and Management — Working Conditions and terms of Engagement — Workers organisation — Non- Discrimination and Equal Opportunity — Retrenchment — Grievance Mechanism	The construction activities will require contractors for completion. A safe working environment and fair contractual agreements must be in place. The operational phase will have permanent employees for day-to-day activities as well as contractors who will all need a safe working environment and fair contractual agreements. Whilst PS2 will be applicable to the Project, it is not intended to be addressed in detail at the ESIA stage. Recommendations are provided concerning development of a detailed Human Resources (HR) and Occupational Health and Safety (OHS) system by the developer and its partners as the Project moves towards implementation. In addition, measures to address the Interim Advice for IFC Clients on Supporting Workers in the Context of COVID-19 are referenced. The EMPr incorporates the requirements for compliance with local and international Labour and Working legislation and good practice on the part of the contractors (**Appendix I**).
	2.2	— Protecting the Workforce — Child Labour	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
		— Forced Labour	
	2.3	Occupational health and Safety	
	2.4	Workers Engaged by Third Parties	
	2.5	Supply Chain	
Performance Standard 3: Resource Efficiency and Pollution Prevention			
Overview	Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world.		
Objectives	— To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities. — To promote more sustainable use of resources, including energy and water. — To reduce project related GHG emissions.		
Aspects	3.1	— Policy Resource Efficiency — Greenhouse Gases — Water Consumption	PS3-related impacts, such as the management of construction waste, hazardous substances, and stormwater are assessed in **Section 7.4** of this report. There are no material resource efficiency issues associated with the Project. The EMPr includes general resource efficiency measures (**Section 6 of Appendix I**). The project is not GHG emissions intensive and a climate resilience study or a GHG emissions-related assessment is not deemed necessary for a project of this nature. However, the Mukondeleli WEF seeks to facilitate resource efficiency and pollution prevention by contributing to the South African green economy. Dust air pollution in the construction phase has been adequately addressed in the EMPr (**Section 6** (**Air Quality Management**) **of Appendix I**). The Project will not result in the release of industrial effluents. Potential pollution associated with sanitary wastewater is low and mitigation measures have been included in the EMPr. Land contamination of the site from historical land use (i.e. low intensity agricultural / grazing) is not considered to be a cause for concern. The waste generation profile of the project is not complex. Waste mitigation and management measures have been included in EMPr. Hazardous materials are not a key issue; small quantities of construction materials (oil, grease, diesel fuel etc.) are the only wastes expected to be associated with the project. The EMPr identifies these anticipated hazardous materials and recommends relevant mitigation and management measures. Hazardous materials are not a key issue; small quantities of construction materials (oil, grease, diesel fuel etc.) are the only wastes expected to be associated with the project. The EMPr identifies these anticipated hazardous materials and recommends relevant mitigation and management measures (**Section 6 of Appendix I**).
	3.2	— Pollution Prevention — Air Emissions — Stormwater — Waste Management — Hazardous Materials Management — Pesticide use and Management	
Performance Standard 4: Community Health, Safety, and Security			

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
Overview	Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.		
Objectives	— To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. — To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.		
Aspects	4.1	— Community Health and Safety — Infrastructure and Equipment Design and Safety — Hazardous Materials Management and Safety — Ecosystem Services — Community Exposure to Disease — Emergency Preparedness and Response	The requirements included in PS 4 have been addressed in the S&EIR process and the development of the EMPr (**Appendix I**). During the construction phase there will be an increase in vehicular traffic along public roads, largely due to the need for importation of construction material. Pedestrian and road safety risks will be qualitatively evaluated in the S&EIR process and the clients' standard safety and security measures, as well as potential additional measures recommended by WSP, are detailed in the EMPr (**Section 6** and **Section 7.9 of Appendix I**).
	4.2	Security Personnel	
Performance Standard 5: Land Acquisition and Involuntary Resettlement			
Overview	Performance Standard 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use.		
Objectives	— To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. — To avoid forced eviction. — To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. — To improve, or restore, the livelihoods and standards of living of displaced persons. — To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.		
Aspects	5.1	— Displacement — Physical Displacement — Economic Displacement — Private Sector Responsibilities under Government Managed Resettlement	PS5 is not applicable to the proposed Mukondeleli WEF as no physical or economic displacement or livelihood restoration will be required. The proposed Mukondeleli WEF is located on privately owned land that is utilised for agriculture by the landowners. The significance of all potential agricultural impacts is kept low by the very small proportion of the land that is impacted.
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources			
Overview	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.		
Objectives	— To protect and conserve biodiversity. — To maintain the benefits from ecosystem services.		

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
	— To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.		
Aspects	6.1	Protection and Conservation of Biodiversity	A significant part of the Project Area falls within CBAs (Irreplaceable and Optimal) and some ESA Local and Landscape corridors are demarcated within the Mukondeleli site. A Biodiversity Impact Assessment as well as an Avifaunal Impact Assessment and Freshwater Ecology Impact Assessment have been included in the EIA scope, **Appendix H-4** and **H-2** of this EIR respectively. These specialist assessments comprise of a combination of literature review, in-field surveys and sensitivity mapping, as well as the assessment of impacts on biodiversity associated with the proposed project. This substantively complies with the PS 6 general requirements for scoping and baseline assessment for determination of biodiversity and ecosystem services issues, as well as the risks and impacts identification process requirements. The determination of habitat sensitivity was undertaken within the legal and best practice reference framework for South Africa. Specific mitigation and management measures for alien invasive species control are included in the EMPr (**Section 6** (**Biodiversity Management**) and **Section 7.2 of Appendix I)**.
Performance Standard 7: Indigenous People			
Overview	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded.		
Objectives	— To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. — To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. — To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. — To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. — To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. — To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.		
Aspects	7.1	General — Avoidance of Adverse Impacts — Participation and Consent	As per the international instruments under the United Nations (UN) Human Rights Conventions, no indigenous peoples are present within the study area. The Project does not involve displacement. PS7 will not be triggered.
	7.2	Circumstances Requiring Free, Prior, and Informed Consent — Impacts on Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use — Critical Cultural Heritage — Relocation of Indigenous Peoples from Lands and Natural Resources Subject	

REFERENCE	REQUIREMENTS		PROJECT SPECIFIC APPLICABILITY
		to Traditional Ownership or Under Customary Use	
	7.3	Mitigation and Development Benefits	
	7.4	Private Sector Responsibilities Where Government is Responsible for Managing Indigenous Peoples Issues	
Performance Standard 8: Cultural Heritage			
Overview	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations.		
Objectives	— To protect cultural heritage from the adverse impacts of project activities and support its preservation. — To promote the equitable sharing of benefits from the use of cultural heritage.		
Aspects	8.1	Protection of Cultural Heritage in Project Design and Execution	A Heritage Impact Assessment Report (**Appendix H-6**) has been carried out by a suitably qualified specialist, revealing that no archaeological sites of significance were noted, and finds were limited to several ruins and graves recorded in the Project area. Based on the current layout, none of the recorded sites will be directly impacted on. A Chance Find Procedure has been included in the EMPr (**Section 7.13.1 of Appendix I**).

2.4.2 WORLD BANK GROUP ENVIRONMENTAL HEALTH AND SAFETY GUIDELINES

In support of the Performance Standards, the World Bank Group (WBG) has published a number of Environmental Health and Safety (EHS) Guidelines. The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to PS3: Pollution Prevention and Abatement, as well as certain aspects of occupational and community health and safety.

Where host country regulations differ from the levels and measures presented in the EHS Guidelines, projects seeking international funding may be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

The following IFC / WBG EHS Guidelines have been generally consulted during the preparation of the EIA in order to aid the identification of EHS aspects applicable to the project:

— *Wind Energy (August 2015)* - The EHS Guidelines for wind energy include information relevant to environmental, health, and safety aspects of onshore and offshore wind energy facilities. It should be applied to wind energy facilities from the earliest feasibility assessments, as well as the environmental impact assessment, and continue to be applied throughout the construction and operation phases

  The guidelines list issues associated with wind energy facilities which need to be considered. These include:

- Environmental impacts associated with the construction, operation, and decommissioning of wind energy facilities activities may include, among others, impacts on the physical environment (such as noise or visual impact) and biodiversity (affecting birds and bats, for instance).
  - Due to the typically remote location of wind energy facilities, the transport of equipment and materials during construction and decommissioning may present logistical challenges (e.g., transportation of long, rigid structures such as blades, and heavy tower sections).
  - Environmental issues specific to the construction, operation, and decommissioning of wind energy projects and facilities include the following:
    - Landscape, Seascape, and Visual impacts;
    - Noise;
    - Shadow Flicker; and
    - Water Quality.
- *Electric Power Transmission and Distribution (2007)* - information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas
- *General EHS Guidelines* – this includes a section on a range of environmental, occupational health and safety, community health and safety, and construction activities that would apply to the project. The guideline also contains recommended guidelines adopted form the World Health Organisation (WHO) for ambient air and water quality, which are referred to in the relevant impact assessment sections in the ESIA report.

2.4.3 EQUATOR PRINCIPLES

The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing, and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making.

The EPs apply globally to all industry sectors and to five financial products 1) Project Finance Advisory Services, 2) Project Finance, 3) Project-Related Corporate Loans, 4) Bridge Loans and 5) Project-Related Refinance and Project-Related Acquisition Finance. The relevant thresholds and criteria for application is described in detail in the Scope section of the EP. Currently 125 Equator Principles Financial Institutions (EPFIs) in 37 countries have officially adopted the EPs, covering the majority of international project finance debt within developed and emerging markets. EPFIs commit to implementing the EPs in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the EPs.

While the EPs are not intended to be applied retroactively, EPFIs apply them to the expansion or upgrade of an existing project where changes in scale or scope may create significant environmental and social risks and impacts, or significantly change the nature or degree of an existing impact. The EPs have greatly increased the attention and focus on social/community standards and responsibility, including robust standards for indigenous peoples, labour standards, and consultation with locally affected communities within the Project Finance market.

The EPs have also helped spur the development of other responsible environmental and social management practices in the financial sector and banking industry and have supported member banks in developing their own Environmental and Social Risk Management Systems.

The requirements and applicability of the EPs are outlined in **Table 2-6**.

It should be noted that Principles 8 and 10 relate to a borrower's code of conduct and are therefore not considered relevant to the S&EIR process and have not been included in this discussion.

Table 2-6: Requirements and Applicability of the Equator Principles

REQUIREMENT	PROJECT SPECIFIC APPLICABILITY
Principle 1: Review and Categorisation	

<table>
<tr><th colspan="2">REQUIREMENT</th><th>PROJECT SPECIFIC APPLICABILITY</th></tr>
<tr><td>Overview</td><td>When a project is proposed for financing, the EPFI will, as part of its internal social and environmental review and due diligence, categorise such project based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC.
Using categorisation, the EPFI's environmental and social due diligence is commensurate with the nature, scale, and stage of the Project, and with the level of environmental and social risks and impacts.
The categories are:
— Category A: Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;
— Category B: Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and
— Category C: Projects with minimal or no adverse environmental and social risks and/or impacts.</td><td>Based upon the significance and scale of the Project's environmental and social impacts, the proposed project is regarded as a Category B project i.e. a project with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.</td></tr>
<tr><td colspan="3">Principle 2: Environmental and Social Assessment</td></tr>
<tr><td>Overview</td><td>For all Category A and Category B Projects, the EPFI will require the client to conduct an appropriate Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and where residual impacts remain, to compensate/ offset/ remedy for risks and impacts to Workers, Affected Communities, and the environment, in a manner relevant and appropriate to the nature and scale of the proposed Project.
The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. For other Category B and potentially C Projects, a limited or focused environmental or social assessment may be appropriate, applying applicable risk management standards relevant to the risks or impacts identified during the categorisation process.
The client is expected to include assessments of potential adverse Human Rights impacts and climate change risks as part of the ESIA or other Assessment, with these included in the Assessment Documentation.</td><td>This document is the second deliverable (i.e. <u>final</u> EIR) from the S&EIR process undertaken for the proposed Project. The assessment appropriately and comprehensively assessed the key environmental and social impacts and complies with the requirements of the South African EIA Regulations and this Principle. In addition, an EMPr has been compiled and is included in Appendix I. A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr will serve as the basis for an ESMS for the proposed Project.</td></tr>
<tr><td colspan="3">Principle 3: Applicable Environmental and Social Standards</td></tr>
<tr><td>Overview</td><td>The Assessment process should, in the first instance, address compliance with relevant host country laws,</td><td>As South Africa has been identified as a non-designated country, the reference framework for</td></tr>
</table>

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
	regulations and permits that pertain to environmental and social issues. The EPFI's due diligence will include, for all Category A and Category B Projects globally, review and confirmation by the EPFI of how the Project and transaction meet each of the Principles. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC PS and WBG EHS Guidelines. For Projects located in Designated Countries, compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.	environmental and social assessment is based on the IFC PS. In addition, this S&EIR process has been undertaken in accordance with NEMA (the host country's relevant legislation).
Principle 4: Environmental and Social Management System and Equator Principles Action Plan		
Overview	For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree on an Equator Principles Action Plan (EPAP). The EPAP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.	A formal project specific ESMS will be compiled in the event that the project is developed in the future. Management and monitoring plans outlined in the EMPr will serve as the basis for an ESMS for the proposed Project.
Principle 5: Stakeholder Engagement		
Overview	EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities Workers and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. To accomplish this, the appropriate assessment documentation, or non-technical summaries thereof, will be made available to the public by the borrower for a reasonable minimum period in the relevant local language and in a culturally appropriate manner. The borrower will take account of and document the process and results of the consultation, including any actions agreed resulting from the consultation. Disclosure of environmental or social risks and adverse impacts should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis. All Projects affecting Indigenous Peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for Indigenous Peoples contained in relevant national law, including those laws implementing host country obligations under international law.	The S&EIR process includes an extensive stakeholder engagement process which complies with the South African EIA Regulations. The process includes consultations with local communities, nearby businesses, and a range of government sector stakeholders (state owned enterprises, national, provincial and local departments). The stakeholder engagement process solicits interest from potentially interested parties through the placement of site notices and newspaper advertisements as well as written and telephonic communication. The stakeholder engagement process is detailed in **Appendix D.**

REQUIREMENT		PROJECT SPECIFIC APPLICABILITY
Principle 6: Grievance Mechanism		
Overview	For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish effective grievance mechanisms which are designed for use by Affected Communities and Workers, as appropriate, to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The borrower will inform the Affected Communities and Workers about the grievance mechanism in the course of the stakeholder engagement process and ensure that the mechanism addresses concerns promptly and transparently, in a culturally appropriate manner, and is readily accessible, at no cost, and without retribution to the party that originates the issue or concern.	The EMPr includes a *Grievance Mechanism Process for Public Complaints and Issues* (**Section 7.15.1 of Appendix I**). *Mechanism Process for Public Complaints and Issues*. This procedure effectively allows for external communications with members of the public to be undertaken in a transparent and structured manner.
Principle 7: Independent Review		
Overview	For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	This principle will only become applicable in the event that that the project is developed in the future.
Principle 9: Independent Monitoring and Reporting		
Overview	To assess Project compliance with the Equator Principles after Financial Close and over the life of the loan, the EPFI will require independent monitoring and reporting for all Category A, and as appropriate, Category B projects. Monitoring and reporting should be provided by an Independent Environmental and Social Consultant; alternatively, the EPFI will require that the client retain qualified and experienced external experts to verify its monitoring information, which will be shared with the EPFI in accordance with the frequency required.	This principle will only become applicable in the event that the project is developed in the future.

2.4.4 INTERNATIONAL LABOUR STANDARDS

The International Labour Organisation (ILO) brings together governments, employers, and workers of 187 member states, to set labour standards, develop policies and devise programmes promoting decent work for all women and men. The ILO advocates and governs a set of International Labour Standards (ILS). The ILS is a system of standards that are fundamental, universal, and invisible human rights for all working people across the world. The aim of the international labour standards is to ensure that the growth the of the global economic provides benefits to all. These standards are legal instruments drawn up by ILO's constituents setting out basic principles and rights at work. These instruments are either Conventions (or Protocols), which are legally binding international treaties that may be ratified by member states, or recommendations, which serve as non-binding guidelines. The fundamental instruments of the ILO and ILS outlined in **Table 2-7**.

Table 2-7: Fundamental Instruments of the ILO and ILS.

INTERNATIONAL LABOUR STANDARDS: FUNDAMENTAL INSTRUMENTS	PROJECT SPECIFIC APPLICABILITY
1. Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87) 2. Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	The Constitution of the Republic of South Africa (1996) allows for all workers to: — Section 18: Freedom of Association — Section 23: Labour Relations — Everyone has the right to fair labour practices; — Every worker has the right to form and join a trade union and to participate in the union's activities; — Every worker has the right to strike — Every employer has the right to form and join an employers' organization and to participate in the activities of the organization; and — Every trade union, employers' organization and employer has the right to engage in collective bargaining. The Mukondeleli WEF project shall abide by all laws and rights enshrined by The Constitution of The Republic of South Africa (1996).
3. Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol) 4. Abolition of Forced Labour Convention, 1957 (No. 105)	The South African Constitution (1996) and Basic Conditions of Employment Act (as amended) prohibits any forced labour in the country. Therefore, the Mukondeleli WEF project commits to not undertake any forced labour over the lifespan of the project. During the operational phase labour audits will be conducted on the project's main contractors and subcontractors.
5. Minimum Age Convention, 1973 (No. 138) 6. Worst Forms of Child Labour Convention, 1999 (No. 182)	According to the South African Basic Conditions of Employment Act and entrenched in the Constitution of the Republic of South Africa (1996), it is a criminal offence to employ a child younger than 15, except in the performing arts with a permit from the Department of Labour. Children aged 15 to 18 may not be employed to do work inappropriate for their age or work that place them at risk. The project will not employ individuals 18 years old or younger.
7. Equal Remuneration Convention, 1951 (No. 100) 8. Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	This WEF project will follow The Promotion of Equality and Prevention of Unfair Discrimination Act, 2000 (PEPUDA or the Equality Act, Act No. 4 of 2000). This is a comprehensive South African anti-discrimination law. It prohibits unfair discrimination by the government and by private organisations and individuals and forbids hate speech and harassment. The project will ensure employment equity across all individuals employed by the project, and all employment opportunities will be free of discrimination.
9. Occupational Safety and Health Convention, 1981 (No. 155) 10. Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)	The Mukondeleli WEF development will abide by the South African Occupational Health and Safety Act 85 of 1993. This act intends to:

INTERNATIONAL LABOUR STANDARDS: FUNDAMENTAL INSTRUMENTS	PROJECT SPECIFIC APPLICABILITY
	— to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; — the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; — to establish an advisory council for occupational health and safety; and — to provide for matters connected therewith.

3 SCOPING PHASE SUMMARY

3.1 PROCEDURAL PROCESS

The application form was compiled and submitted to the MDARDLEA on **25 August 2022**.

The MDARDLEA reference number allocated to this application is **1/3/1/16/1G-265**. This reference number will appear on all official correspondence with the authorities and the public regarding the Proposed Project. A copy of the acknowledgement of receipt of the application is included in **Appendix F**.

The Draft Scoping Report (DSR) was released for public review between **25 August 2022** and **27 September 2022**. Subsequently the scoping report was finalised and submitted to the MDARDLEA on **7 October 2022** for their review and approval. The submission of the final scoping report was within 44 days of receipt of the application by the DEA as required by GNR 982.

The approval of the Final Scoping Report (FSR) and the plan of study for the environmental impact assessment was received on **21 November 2022** (letter dated, **14 November 2022**) and is included in **Appendix G**.

The final EIR was released for public review between **12 January 2023** and **13 February 2023**.

3.2 AUTHORITY CONSULTATION

A pre-application meeting was held on 14 July 2022 with the MDARDLEA in order to discuss the proposed project. The minutes of this meeting are included in **Appendix K**. In addition, WSP notified a number of commenting authorities of the Proposed Project via a notification letter, these included:

- DMRE;
- DFFE: Biodiversity and Conservation;
- DFFE: Protected Areas;
- DWS;
- Vaal WMA Authority;
- SAHRA;
- MHRA;
- MTPA;
- CAA;
- ATNS;
- DD (SA Army);
- AMA;
- SAWS;
- SANRAL;
- Gert Sibande District Municipality; and
- Govan Mbeki Municipality (GMM) Local Municipality.

WSP received comments on the DSR from the MDARDLEA on **27 September 2022**. The comments and responses have been outlined in **Table 3-1** and included in the SER (**Appendix D**). The MDARDLEA stated that they had no comments on the Draft EIA Report.

Table 3-1: Comments received from the MDARDLEA regarding the Draft Scoping Report

COMMENT	RESPONSE
Please ensure that relevant activities applied for are specific and linked to the proposed development.	**EAP:** The applicable activities have been identified and linked to the proposed development.

COMMENT	RESPONSE
	Refer to Table 3-1 of the Final Scoping Report where each listed activity is linked to the applicable project description.
Ensure that the development is prioritized in areas of low ecological importance, and activities must be avoided or minimized as far as possible in more sensitive units since the site falls within Critical Biodiversity Areas according to Mpumalanga Biodiversity Sector Plan, EIM GIS Viewer. Ensure that reasonable measures are implemented to prevent ecological degradation since some properties to be affected by the activity are of high ecological sensitivity according to Mpumalanga Biodiversity Sector Plan, EIM GIS Viewer.	**EAP:** Noted A detailed impact assessment, along with specialist studies, will be undertaken in the EIA Phase. The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.
Ensure that all other applications necessary in respect of any other applicable legislations are lodged to all relevant departments for the proposed Wind Energy Facility in respect of all the properties to be affected by this activity.	**EAP:** The environmental permits and applications required in respect of the proposed Mukondeleli WEF have been identified and will be applied for as required. The permits are outlined in Section 7.9 of the FSR.
An issues and response report must be included in the final basic assessment report, as well as copies of and responses received from all I&APs, including comments from this Department.	**EAP:** A comment and response report has been compiled and attached to the FSR. Copies of the comments received from all I&APs, including comments from this Department has been included.
Comments from the Mpumalanga Tourism and Parks Agency must be obtained and incorporated in the final report.	**EAP:** An electronic copy of the DSR was submitted to the MTPA on 25 August 2022 and a hard copy was delivered on 31 August 2022. Comments provided by MTPA have been included in the Final EIR.
Ensure that you submit to this Department a final scoping report which contains all information set out in appendix 2 of the EIA Regulations 2014 as amended.	**EAP:** The FSR will be submitted to the Department and contains all information as set out in appendix 2 of the EIA Regulations 2014 as amended.
You are reminded of the requirements of Regulation 21(1), and that if such requirement is not met, the application will lapse in terms of the provisions of Regulation 45.	**EAP:** The DSR was received by the Department on 26 August 2022 and the FSR will be submitted by 10 October 2022.
The Department confirms having received the application form for environmental authorisation and the draft Scoping Report for the abovementioned project on 26 August 2022.	**EAP:** Noted
The application has been assigned the reference number 1/3/1/16/1G-265. Kindly quote this reference number in any future correspondence in respect of the application. The responsible officer is Okwethu-kuhle Fakude and all correspondence must be directed to the Deputy Director, Environmental Impact Management, Gen Sibande District Office, marked for the attention of the responsible officer.	**EAP:** The reference number is noted and will be quoted in all future correspondence. The DSR was received by the Department on 26 August 2022 and the FSR will be submitted by 10 October 2022, which is within 44 days from 26 August 2022.

COMMENT	RESPONSE
Please note that you must, within 44 days from 26 August 2022 submit to this office a final Scoping Report- inclusive of specialist reports and an EMPr- which has already been subjected to a public participation process of at least 30 days, and which reflects the incorporation of comments received.- including any comments from this office. In this regard you are referred to the requirements of Regulation 40(3).	Kindly note that this the EMPr and Specialist Studies have been included in the Final EIR. The DSR was placed on public review for a period of 30 days from 25 August 2022 to 27 September 2022.
Please note that in terms at the provisions of Regulation 45, this application will lapse, and this office will deem the application to have lapsed. if the applicant fails to submit the final scoping report within the timeframe specified above.	**EAP:** Noted. The DSR was received by the Department on 26 August 2022 and the FSR will be submitted by 10 October 2022, which is within 44 days from 26 August 2022.
Please draw the applicants attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.	**EAP:** Noted. The applicant has been informed that activities may not commence prior to environmental authorisation being granted by the Department.

3.3 STAKEHOLDER CONSULTATION

Stakeholders were identified and will continue to be identified through several mechanisms. These include:

- Utilising existing databases from other projects in the area;
- Networking with local business owners, non-governmental agencies, community based organisations, and local council representatives;
- Field work in and around the project area;
- Advertising in the press;
- Placement of community notices;
- Completed comment sheets; and
- Attendance registers at meetings.

All Stakeholders identified to date have been registered on the project stakeholder database. The EAP endeavoured to ensure that individuals/organisations from referrals and networking were notified of the Proposed Project. Stakeholders were identified at the horizontal (geographical) and vertical extent (organisations level).

A list of stakeholders captured in the project database is included in Appendix A of the SER (**Appendix D**).

Table 3-2 provides a breakdown of stakeholders currently registered on the database while **Figure 3-1** illustrates the number of stakeholders per representative sector.

Table 3-2: Breakdown of Stakeholders currently registered on the database

REPRESENTATIVE SECTOR	FURTHER EXPLANATION	NO. STAKEHOLDERS
Government Departments	All tiers of government, namely, national, provincial, local government and parastatal organisations including: — Department of Mineral Resources and Energy (DMRE); — DFFE: Biodiversity and Conservation; — DFFE: Protected Areas;	94

REPRESENTATIVE SECTOR	FURTHER EXPLANATION	NO. STAKEHOLDERS
	— Mpumalanga Department Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA); — Department of Water and Sanitation (DWS); — Vaal Water Management Area (WMA) Authority; — South African Heritage Resource Agency (SAHRA); — Mpumalanga Heritage Resources Authority (MHRA); — Mpumalanga Tourism and Parks Agency (MTPA); — Civil Aviation Authority (CAA); — Air Traffic and Navigation Services (ATNS); — Department of Defence (SA Army) (DD); — Astronomy Management Authority (AMA); — South African Weather Services (SAWS); — South African National Roads Agency Limited (SANRAL); — Gert Sibande District Municipality; and — Govan Mbeki Municipality (GMM) Local Municipality	
Business and consultants	Local and neighbouring businesses in the area. Representatives of consulting organisations that provide services in the area	25
Non-governmental organisations (NGOs) and community based organisations	Agricultural unions, churches, and environmental NGOs	18
General public	Local communities, farmers, and other such individuals who may have an interest in the project	1

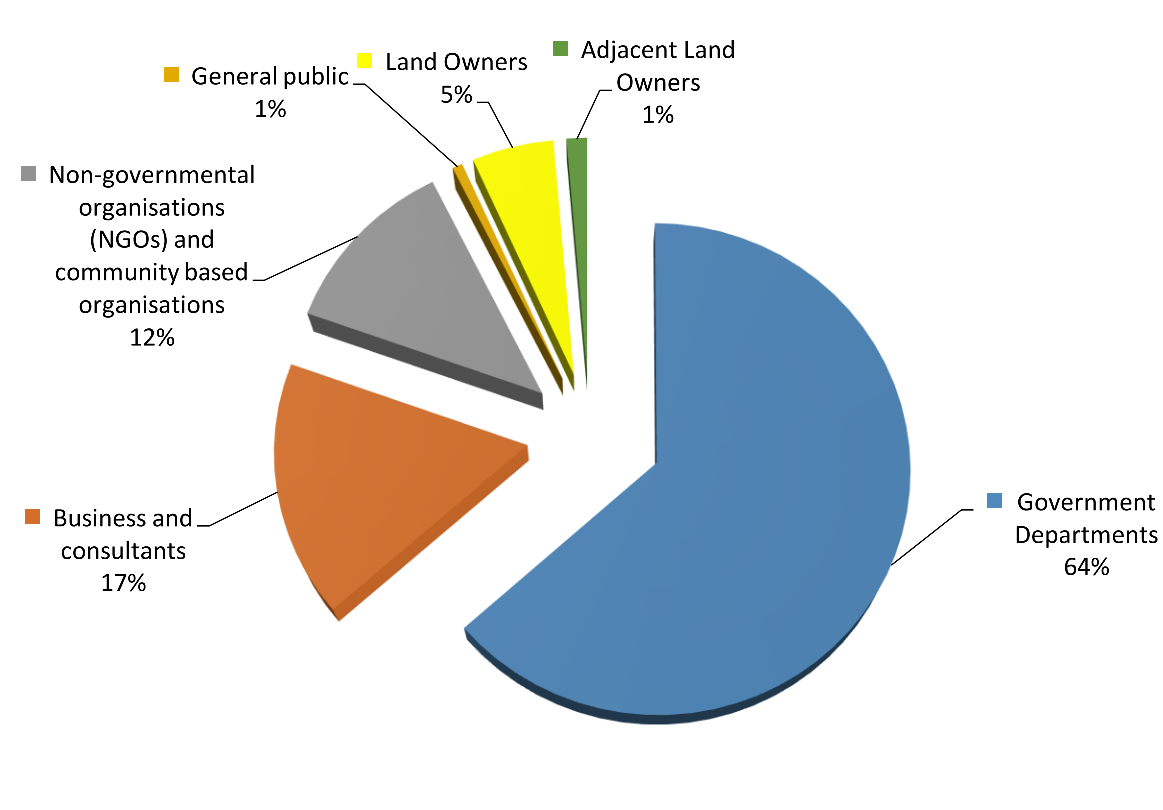


Figure 3-1: Pie chart showing the breakdown of the stakeholder currently registered on the database

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') received to date have been documented and responded to the SER included in **Appendix D.**

3.3.1 STAKEHOLDER NOTIFICATION

DIRECT NOTIFICATION

Notification of the proposed Project was issued to potential Stakeholders, via direct correspondence (i.e. site notices and e-mail) on **25 August 2022**. The notification letter was circulated is included in Appendix B-3 of the SER **(Appendix D)**. Proof of notification is included in the SER (i.e., **Appendix D**).

NEWSPAPER ADVERTISEMENTS

In accordance with the requirements of GNR 982, as amended, the proposed project was advertised in two local newspapers. The purpose of the advertisement was to notify the public about the proposed project and to invite them to register as stakeholders. A copy of the advertisements are included in Appendix B-1 of the SER **(Appendix D)**. The relevant scoping phase advertisement dates are listed in **Table 3-3**.

Table 3-3: Dates on which the Adverts were published

NEWSPAPER	PUBLICATION DATE	LANGUAGE
Ridge Times	26 August 2022	English, Afrikaans and Zulu

SITE NOTICES

The official site notices were erected as per GNR 982, as amended, on the boundary fence of the proposed site. In addition, general project notices, announcing the Proposed Project and inviting stakeholders to register, were placed at various locations in and around the project area. A copy of the site notice is included in_Appendix B-2 of the SER (**Appendix D**).

3.4 SCOPING STUDY FINDINGS

The scoping phase identified a number of impacts associated with the proposed Mukondeleli WEF. The findings of the preliminary significance ratings undertaken during the scoping phase for the construction phase and operational phase are included in **Table 3-4** and **Table 3-5**, respectively.

Table 3-4: Construction Phase Impacts

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Air Quality	Dust Emissions	Negative	3	1	**Low**	**No**
Noise and Vibrations	Noise and Vibration Emissions	Negative	3	1	**Low**	**No**
Topography, & Geology	Constructability	Negative	3	1	**Low**	**No**
Soils, Land Capability and Agricultural Potential	Loss of agricultural potential by soil degradation	Negative	4	3	**High**	**Yes**
	Loss of agricultural potential by occupation of land	Negative	4	3	**High**	
Surface water	Changes in water flow regime	Negative	3	3	**Medium**	**Yes**
	Changes in sediment volume	Negative	3	3	**Medium**	
	Introduction and spread of alien vegetation	Negative	3	3	**Medium**	
	Loss and disturbance of watercourse habitat and fringe vegetation	Negative	3	3	**Medium**	
	Changes in water quality due to pollution	Negative	3	3	**Medium**	
	Loss of aquatic biota	Negative	3	3	**Medium**	
Groundwater	Ground Contamination	Negative	3	1	**Low**	**No**

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Hazardous Substances and Pollutants	Soil, groundwater and surface water contamination	Negative	3	3	**Medium**	**No**
Waste Generation	Generation of General Waste	Negative	3	2	**Medium**	**No**
	Generation of Hazardous Waste	Negative	3	2	**Medium**	
	Sanitation Waste	Negative	3	2	**Medium**	
Biodiversity	Clearing of vegetation	Negative	4	3	**High**	**Yes**
	The loss of threatened, protected & endemic plant species	Negative	4	3	**High**	
	Loss and Displacement of Fauna	Negative	4	3	**High**	
	Loss of faunal habitat	Negative	4	3	**High**	
	Direct faunal mortalities due to construction and increased traffic	Negative	4	3	**High**	
	Increased dust deposition	Negative	4	3	**High**	
	Establishment of alien vegetation	Negative	4	3	**High**	
Avifauna	Displacement due to disturbance during the Construction Phase	Negative	4	3	**High**	**Yes**
Bats	Loss of foraging habitat by clearing of vegetation	Negative	4	3	**High**	**Yes**
	Roost destruction during earthworks	Negative	4	3	**High**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Visual and Landscape	Potential visual intrusion resulting from large construction vehicles and equipment	Negative	3	2	**Medium**	**Yes**
	Potential visual effect of construction laydown areas and material stockpiles.	Negative	3	2	**Medium**	
	Potential impacts of increased dust emissions from construction activities and related traffic	Negative	3	2	**Medium**	
	Potential visual scarring of the landscape as a result of site clearance and earthworks	Negative	3	2	**Medium**	
	Potential visual pollution resulting from littering on the construction site	Negative	3	1	**Low**	
Heritage and Cultural Resources	Disturbance to known Cultural Resources	Negative	3	2	**Medium**	**Yes**
	Chance Find of Cultural Resources	Negative	3	2	**Medium**	
Palaeontology	Chance Find of Palaeontological resources	Negative	3	2	**Medium**	**Yes**
Traffic	Increased traffic generation around the study area by construction vehicles	Negative	3	1	**Low**	**Yes**
	Deterioration of the surrounding road network due to an increase of traffic around the site	Negative	3	2	**Medium**	
	Transportation of abnormal loads during the construction phase	Negative	4	1	**Medium**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Socio-Economic	Creation of local employment, training, and business opportunities	Positive	2	3	**Medium**	**Yes**
	Impact of construction workers on local communities	Negative	3	3	**Medium**	
	Influx of job seekers	Negative	3	3	**Medium**	
	Risk to safety, livestock, and farm infrastructure	Negative	3	3	**Medium**	
	Increased risk of grass fires	Negative	3	3	**Medium**	
	Nuisance impacts associated with construction related activities	Negative	3	3	**Medium**	
	Impacts associated with loss of farmland	Negative	3	3	**Medium**	
Climate Change	Greenhouse Gas Emissions	Negative	2	1	**Very Low**	**No**
	Climate Risks & Vulnerabilities	Negative	2	1	**Very Low**	

Table 3-5: Operational Phase Impacts

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Noise and Vibrations	Noise Emissions	Negative	4	3	**High**	**Yes**
Soils, Land Capability and Agricultural Potential	Enhanced agricultural potential through increased financial security for farming operations	Positive	3	3	**Medium**	**Yes**

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Prevention of crop spraying by aircraft over land occupied by turbines.	Negative	4	3	**High**	
Surface Water	Alteration in flow regime	Negative	3	3	**Medium**	**Yes**
	Changes in sediment regimes	Negative	3	3	**Medium**	
	Introduction and spread of alien vegetation	Negative	3	3	**Medium**	
	Loss and disturbance of riparian/watercourse habitat and vegetation	Negative	3	3	**Medium**	
	Alteration in water quality due to pollution	Negative	3	3	**Medium**	
	Loss of aquatic biota	Negative	3	3	**Medium**	
Waste Generation	Generation of General Waste	Negative	3	2	**Medium**	**Yes**
	Generation of Hazardous Waste	Negative	3	2	**Medium**	
	Sanitation Waste	Negative	3	2	**Medium**	
Biodiversity	Direct faunal mortalities	Negative	3	3	**Medium**	**Yes**
	Increased light and noise levels and changes in animal behaviour	Negative	3	3	**Medium**	
	Establishment of alien vegetation	Negative	3	3	**Medium**	
Avifauna	Displacement due to habitat loss	Negative	4	3	**High**	**Yes**

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Collisions Mortality on wind turbines	Negative	4	3	**High**	
	Electrocution on the medium voltage network	Negative	4	3	**High**	
	Collisions with the medium voltage network	Negative	4	3	**High**	
Bats	Bat mortalities during foraging	Negative	4	3	**High**	**Yes**
	Bat mortalities during migration	Negative	4	3	**High**	
	Increased bat mortalities due to light attraction and habitat creation	Negative	4	3	**High**	
Visual	Potential alteration of the visual character of the area;	Negative	4	3	**High**	**Yes**
	Potential visual intrusion resulting from wind turbines dominating the skyline in a largely natural / rural area	Negative	4	3	**High**	
	Potential visual clutter caused by substation and other associated infrastructure on-site	Negative	3	3	**Medium**	
	Potential visual effect on surrounding farmsteads	Negative	4	3	**High**	
	Visual impact of shadow flicker impact, and motion-based visual intrusion	Negative	4	3	**High**	

ASPECT	IMPACT	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
	Potential alteration of the night time visual environment as a result of operational and security lighting as well as navigational lighting on top of the wind turbines	Negative	3	3	**Medium**	
Social	Generate renewable energy to produce green hydrogen and ammonia	Positive	3	3	**Medium**	**Yes**
	Creation of employment and business opportunities	Positive	3	3	**Medium**	
	Generate income for affected landowners	Positive	3	3	**Medium**	
	Visual impact and impact on sense of place	Positive	3	3	**Medium**	
	Potential impact on property values	Negative	4	3	**High**	
	Potential impact on tourism	Negative	3	3	**Medium**	
	Improved security	Negative	3	3	**Medium**	
Climate Change	Reduced GHG Emissions	Positive	4	3	**High**	**No**
	Contribution of cleaner energy to the National Grid	Positive	4	3	**High**	

Table 3-6: Initial Cumulative Impacts

RECEPTOR	DESCRIPTION	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Noise and Vibrations	Cumulative Noise Emissions	Negative	4	3	**High**	**Yes**

RECEPTOR	DESCRIPTION	NATURE	PROBABILITY	CONSEQUENCE	SIGNIFICANCE (BEFORE MITIGATION)	FURTHER ASSESSMENT REQUIRED
Soils, Land Capability and Agricultural Potential	Cumulative Agricultural Impacts	Negative	4	3	**High**	**Yes**
Biodiversity	Cumulative impacts on biodiversity	Negative	4	3	**High**	**Yes**
Avifauna	Cumulative Collision impacts	Negative	4	3	**High**	**Yes**
	Cumulative Electrocution Impacts	Negative	4	3	**High**	
Bats	Cumulative Mortalities	Negative	4	3	**High**	**Yes**
Visual	Combined visual impacts from mining, industrial, infrastructural and renewable energy development in the broader area could potentially alter the sense of place and visual character of the area	Negative	4	3	**High**	**Yes**
	Combined visual impacts from mining, industrial, infrastructural and renewable energy development in the broader area could potentially exacerbate visual impacts on visual receptors	Negative	4	3	**High**	
Social	Cumulative impact on sense of place	Negative	4	3	**High**	**Yes**
	Cumulative impact on local service and accommodation	Positive	3	3	**Medium**	
	Cumulative impact on local economy	Positive	3	3	**Medium**	

3.5 SCOPING RECOMMENDATIONS

The scoping report identified and evaluated the feasibility of a range of site and technology options. **Table 3-7** provides a summary of the scoping phase alternatives assessment.

Table 3-7: Alternatives Summary

ALTERNATIVE CATEGORY	ALTERNATIVE IDENTIFIED IN SCOPING	ASSESSMENT IN EIA PHASE (YES / NO)
Infrastructure Location/Layout Alternatives	— Initial Turbine Layout (54)	No
	— Revised Turbine Layout (42)	Yes
	— Site Substation & BESS Alternatives: Alternative 1(Preferred) and Alternative 2	Yes
	— Three Construction Camp & Batching Plants Alternatives	Yes
	— Temporary Laydown Areas (4 locations)	Yes
Technology Alternatives	Wind Technology	Yes
	Two types of BESS Battery Technologies: Vanadium Redox flow technologies and Lithium battery technologies.	Yes

4 EIA METHODOLOGY

4.1 DETAILED ENVIRONMENTAL ASSESSMENT

4.1.1 SPECIALIST STUDIES

Specialist studies were undertaken during the EIA phase to consider and assess environmental impacts associated with the proposed project. The outcomes of these studies are included in the relevant reports contained in **Appendix H**. **Table 4-1** provides a list of the Specialist Studies that have been undertaken.

Table 4-1: Details of Specialists

SPECIALIST FIELD	SPECIALIST NAME	COMPANY
Agriculture	Johann Lanz	Independent consultant
Avifauna	Chris van Rooyen	Chris van Rooyen Consulting
Bats	Werner Marais	Animalia Consultant (Pty) Ltd
Terrestrial Ecology	Dr Noel van Rooyen and Prof. Gretel van Rooyen	Ekotrust CC
Aquatic	Rudi Bezuidenhout & Lorainmari Den Boogert	Iggdrasil Scientific Services & Limosella Consulting
Heritage	Jaco van der Walt	Beyond Heritage
Palaeontology	Prof Marion Bamford	
Socio-economic	Tony Barbour	Tony Barbour Environmental Consulting
Traffic	A Ramawa	JG Afrika (Pty) Ltd
Visual	Kerry Schwartz	SLR Consulting (Pty) Ltd
Noise	M. de Jager (Enviro-Acoustic Research cc)	Enviro-Acoustic Research cc
SHE Risk	Debra Mitchell	Ishecon cc
Geotechnical Desk Study	Heather Davies	WSP Group Africa (Pty) Ltd

4.1.2 CUMULATIVE ASSESSMENT

Specialist assessments include a detailed cumulative environmental impact assessment. The cumulative impact assessment is provided in **Section 8**. The assessment of cumulative impacts considered existing and proposed projects within a 55km radius of the Mukondeleli WEF. Two developments (Forzando SEF and the Tutuka SEF) have been approved while the other two developments, Impumelelo WEF and Vhuvhili SEF are proposed, and therefore they are required to be considered in the cumulative impact assessment. This information was sourced from the DFFE web based environmental screening tool, as well as the Environmental Geographical Information Systems (E-GIS) webpage. The cumulative assessment considers a worst-case scenario with regards to the proposed Mukondeleli WEF.

4.2 IMPACT ASSESSMENT METHODOLOGY

The EIR uses a methodological framework developed by WSP to meet the combined requirements of international best practice and NEMA 2014 EIA Regulations (GNR 982), as amended.

As required by the 2014 EIA Regulations as amended, the determination and assessment of impacts will be based on the following criteria:

- Nature of the Impact
- Significance of the Impact
- Consequence of the Impact
- Extent of the impact
- Duration of the Impact
- Probability if the impact
- Degree to which the impact:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.

Following international best practice, additional criteria have been included to determine the significant effects. These include the consideration of the following:

- Magnitude: to what extent environmental resources are going to be affected;
- Sensitivity of the resource or receptor (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor); and
- Severity of the impact, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all of the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

4.2.1 METHODOLOGY

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct[3], indirect[4], secondary[5] as well as cumulative[6] impacts.

[3] Impacts that arise directly from activities that form an integral part of the Project.
[4] Impacts that arise indirectly from activities not explicitly forming part of the Project.
[5] Secondary or induced impacts caused by a change in the Project environment.
[6] Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e., residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[7] presented in **Table 4-2**.

Table 4-2: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

4.2.2 IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

[7] The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in **Figure 4-1** below.

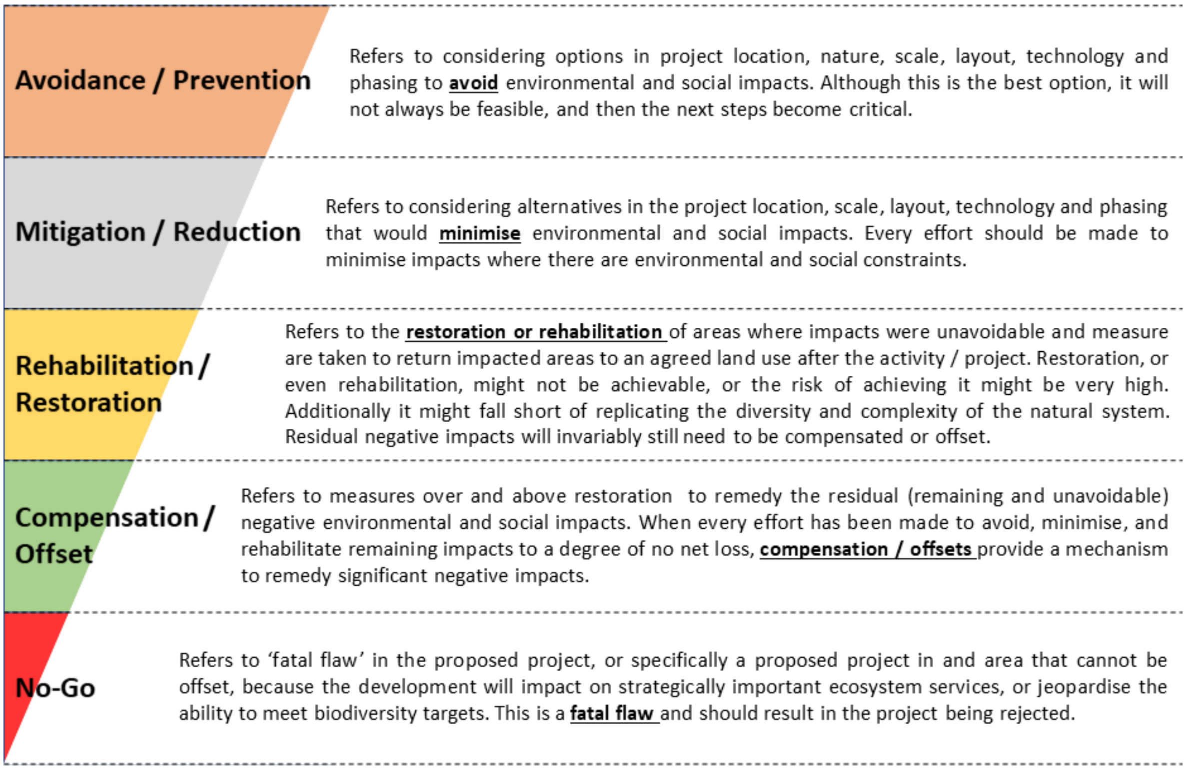


Figure 4-1: Mitigation Sequence/Hierarchy

4.3 STAKEHOLDER ENGAGEMENT

Stakeholder engagement (public participation) is a requirement of the S&EIR process. It consists of a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the S&EIR decision-making process. Effective engagement requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the proposed project. The objectives of the stakeholder engagement process can be summarised as follows:

- Identify relevant individuals, organisations and communities who may be interested in or affected by the proposed project;
- Clearly outline the scope of the proposed project, including the scale and nature of the existing and proposed activities;
- Identify viable proposed project alternatives that will assist the relevant authorities in making an informed decision;

- Identify shortcomings and gaps in existing information;
- Identify key concerns, raised by Stakeholders that should be addressed in the specialist studies;
- Highlight the potential for environmental impacts, whether positive or negative; and
- To inform and provide the public with information and an understanding of the proposed project, issues, and solutions.

A SER (**Appendix D**) has been compiled and included in the final EIR detailing the projects' compliance with Chapter 6 of the NEMA EIA Regulations 2014, as amended.

4.3.1 STAKEHOLDER AND AUTHORITY CONSULTATION

There will continue to be ongoing communication between WSP and stakeholders throughout the S&EIR process. These interactions include the following:

- A letter will be sent out to all registered stakeholders providing them with an update of the proposed project once the final scoping report has been approved;
- Interactions with stakeholders will be recorded in the comment and response report;
- Feedback to stakeholders will take place both individually and collectively; and
- Written responses (email, faxes or letters) will be provided to stakeholders acknowledging issues and
- information requested (dependent on availability).
- As per the GNR 982, particular attention will be paid to landowners, and neighbouring communities, specifically where literacy levels and language barriers may be an issue.

4.3.2 PUBLIC REVIEW

The Draft EIR was placed on public review for a period of 30 days from **12 January 2023** and **13 February 2023**, at the following public places:

- Gert Sibande District Municipality;
- Secunda Public Library
- WSP website (https://www.wsp.com/en-ZA/services/public-documents); and
- Datafree Website (https://wsp-engage.com/).

All registered stakeholders and authorising/commenting state departments were notified of the public review period as well as the locations of the draft EIR via email and SMS.

4.3.3 COMMENT AND RESPONSE REPORT

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') will continue to be documented and responded to adequately in the Comment and Response Report. The Comment and Response Report records the following:

- List of all issues raised;
- Record of who raised the issues;
- Record of where the issues were raised;
- Record of the date on which the issue was raised; and
- Response to the issues.

The updated Comment and Response Report has been included in the SER in **Appendix D.**

4.3.4 SUBMISSION AND DECISION MAKING

The EAP must submit the final EIR to the competent authority within 106 days of the acceptance of the scoping report. Once submitted, the delegated competent authority (i.e. the DEA) will be allocated 107 days to review the final EIR in order to either grant or refuse and environmental authorisation. *It is important to note that an* *extension of timeframe, in terms of the provision within EIA Regulation 3(7), was requested from the Department regarding extending the submission deadline of the FEIR by 60 days due to extenuating factors. The Department granted permission for the extension on 24 June 2022, and the final EIR must be submitted to the competent authority by 02 November 2022.*

The final EIR will be placed on stakeholder review for a reasonable time period during the MDARDLEA's final review and decision-making process. The delegated competent authority must issue their decision within this specified timeframe.

4.3.5 NOTIFICATION OF ENVIRONMENTAL AUTHORISATION

All stakeholders will receive a letter at the end of the process notifying them of the authority's decision, thanking them for their contributions, and explaining the appeals procedure as outlined in the national Appeal Regulations, 2014 (GNR 993 of 2014).

4.4 DFFE WEB-BASED ENVIRONMENTAL SCREENING TOOL

DFFE has developed the National Web-based Environmental Screening Tool in order to flag areas of potential environmental sensitivity related to a site as well as a development footprint and produces the screening report required in terms of regulation 16 (1)(v) of the EIA Regulations (2014, as amended). The Notice of the requirement to submit a report generated by the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended (GN 960 of July 2019) states that the submission of a report generated from the national web-based environmental screening tool, as contemplated in Regulation 16(1)(b)(v) of the EIA Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, is compulsory when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the EIA Regulations, 2014 as of 04 October 2019.

The Screening Report generated by the National Web-based Environmental Screening Tool contains a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmentally sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

A screening report for the proposed Mukondeleli WEF was generated on **11 July 2022** and is attached as **Appendix J**. The Screening Report for the project identified various sensitivities for the site. The report also generated a list of specialist assessments that should form part of the S&EIR based on the development type and the environmental sensitivity of the site. Assessment Protocols in the report provide minimum information to be included in a specialist report to facilitate decision-making.

Table 4-3 below provides a summary of the sensitivities identified for the development footprint.

Table 4-3: Sensitivities identified in the screening report

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
Agricultural Theme		✓		
Animal Species Theme		✓		
Aquatic Biodiversity Theme	✓			
Archaeological and Cultural Heritage Theme		✓		✓
Avian Theme				✓
Bats Theme		✓		
Civil Aviation Theme			✓	

THEME	VERY HIGH SENSITIVITY	HIGH SENSITIVITY	MEDIUM SENSITIVITY	LOW SENSITIVIY
Defence Theme				✓
Flicker Theme	✓			
Landscape	✓			
Palaeontology Theme	✓			
Noise Theme	✓			
Plant Species Theme			✓	
RFI Theme		✓		
Terrestrial Biodiversity Theme	✓			

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report as determined by the screening tool (please refer to Section 4.4.1 below for the EAP motivation applicable to this list):

— Agricultural Impact Assessment
— Archaeological and Cultural Heritage Impact Assessment
— Palaeontology Impact Assessment
— Landscape/Visual Impact Assessment
— Terrestrial Biodiversity Impact Assessment
— Aquatic Biodiversity Impact Assessment
— Avian Impact Assessment
— Socio-Economic Assessment
— Noise Impact Assessment
— A Geotechnical Assessment
— Civil Aviation Impact Assessment
— Défense Assessment
— Radio Frequency Interference (RFI) Assessment
— Flicker Assessment
— Traffic Impact Assessment
— Plant Species Assessment
— Animal Species Assessment

4.4.1 MOTIVATION FOR SPECIALIST STUDIES

The report recognises that "it is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation."

As summarised in **Table 4-3** above, the following specialist assessments have been commissioned for the project based on the environmental sensitivities identified by the Screening Report:

— Soils and Agricultural Potential Assessment;
— Archaeological and Cultural Heritage Assessment;
— Palaeontology Impact Assessment;

- Visual Impact Assessment[8] ;
- Biodiversity Impact Assessment (inclusive of terrestrial biodiversity, plant species and animal species);
- Freshwater Assessment;
- Avifauna Impact Assessment;
- Bat Impact Assessment;
- Environmental Acoustic (Noise) Impact Assessment;
- Social Impact Assessment;
- Qualitative Risk Assessment (specific to the BESS);
- Desktop Geotechnical Assessment; and
- Desktop Traffic Assessment.

Four of the identified specialist studies will not be undertaken as part of the S&EIR process for the proposed Mukondeleli WEF. Motivation for the exclusion of these specialist studies is provided below:

- **Detailed Geotechnical**

  A desktop Geotechnical Assessment has been commissioned and has been incorporated into the EIA. However, a detailed Geotechnical Assessment will not be undertaken as part of the S&EIR Process as this will be undertaken during the detailed design phase.

- **RFI Assessment**

  A Radio Frequency Interference (RFI) Study will not be undertaken. The proposed development area is not located within any Astronomy Advantage Area. The South African Weather Service (SAWS) and relevant telecommunications stakeholders will be engaged with as part of the Public Participation Process.

- **Civil Aviation**

  According to the DFFE Screening Tool Report, civil aviation is regarded as having low sensitivity. The proposed development site is located between 8 and 15 km of civil aviation aerodromes. A formal Civil Aviation Assessment will not be undertaken as part of the S&EIR Process. Nevertheless, the relevant Authorities have been included on the project stakeholder database. As of the 1st of May 2021, Air Traffic and Navigation Services (ATNS) has been appointed as the new Obstacle application Service Provider for Windfarms and later Solar Plants. Their responsibility would pertain to the assessments, maintenance, and all other related matters in respect to Windfarms and in due time Power Plant assessments. An Application for the Approval of Obstacles was submitted to ATNS in July 2021 and the required permits will be obtained prior to the construction of the project. The South African Civil Aviation Authority (SACAA) was also included on the project stakeholder database. Comments received from this stakeholder to date have been captured and responded to within the Comments and Responses Report (CRR) included in the SER (**Appendix D**) of this EIR.

- **Defence**

  The Department of Defence was included on the project stakeholder database. They will be informed of the proposed Project, and comment will be sought from this authority as applicable.

[8] The Visual Impact Assessment will consider the impact of flicker associated with the Mukondeleli WEF development.

5 NEEDS AND DESIRABILITY

The DEA&DP Guideline (2013) states that the essential aim of need and desirability is to determine the suitability (i.e. is the activity proposed in the right location for the suggested land-use/activity) and timing (i.e. is it the right time to develop a given activity) of the development. Therefore, need and desirability addresses whether the development is being proposed at the right time and in the right place. Similarly, the 'Best Practicable Environmental Option' (BPEO) as defined in NEMA is "*the option that provides the most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term.*"

South Africa is faced with significant increases in electricity demand and a shortage in electricity supply. South Africa is the seventh coal producer in the world, with approximately 77% of the country's electricity generated from coal. This large dependence on coal and its use has also resulted in a variety of negative impacts on the environment, including the contribution to climate change. South Africa is also the highest emitter of greenhouse gases in Africa; attributed to the country's energy-intensive economy that largely relies on coal-based electricity generation.

The development of renewable energy and the associated energy infrastructure is strongly supported at a national, provincial, and local level. The development of, and investment in, renewable energy and associated energy distribution infrastructure is supported by the National Development Plan, New Growth Path Framework and National Infrastructure Plan, which all highlight the importance of energy security and investment in energy infrastructure. The development of the proposed Mukondeleli WEF is therefore supported by key policy and planning documents and is in line with South Africa's strategic energy planning context.

5.1.1 INTERNATIONAL PERSPECTIVE

The proposed project will align with internationally recognised and adopted agreements, protocols, and conventions. This includes the Kyoto Protocol (1997) which calls for countries internationally to reduce their greenhouse gas emissions through cutting down on their reliance on fossil fuels and investing in renewable energy technologies for electricity generation. The proposed WEF will therefore add capacity to the energy sector and generate electricity without greenhouse gas emissions and meet international requirements in this regard.

South Africa is also signatory to the United Nations' Development Programmes' (UNDP) Sustainable Development Goals (SDGs), particularly SGD 7 relating to affordable and clean energy. The proposed WEF qualifies as a clean technology that will generate 300MW of affordable energy to contribute to South Africa's energy mix.

The project will also greatly contribute to the countries' efforts to reduce their carbon emissions and play their role as part of the Paris Climate Accord. The Paris Agreement is a legally binding international treaty signed by 196 countries at the COP 21 in Paris, on the 12$^{th\ of}$ December 2015 to combat climate change. The goal of the Paris Accord is to limit global warming to well below 2 degrees Celsius, compared to industrial levels to avoid catastrophic natural disasters which are driven by the global temperature increase. Therefore, to achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by 2050. This project will aid in the efforts towards a just energy transition in accordance to recently signed Political Declaration between SA, USA, UK, EU, Ireland etc.

The authorisation of the Project will further align with South Africa's National Climate Response White Paper which outlines the countries efforts to manage the impacts of climate change and to contribute to the global efforts to stabilize the Greenhouse gases concentrations in the atmosphere.

This project further supports the growing global demand for green hydrogen and its derivatives. One example of such emerging opportunities is that of the German Federal Government's H2Global platform. The H2Global platform is an international auction framework system that enables green hydrogen projects to be established in designated countries, such as South Africa.

5.1.2 NATIONAL PERSPECTIVE

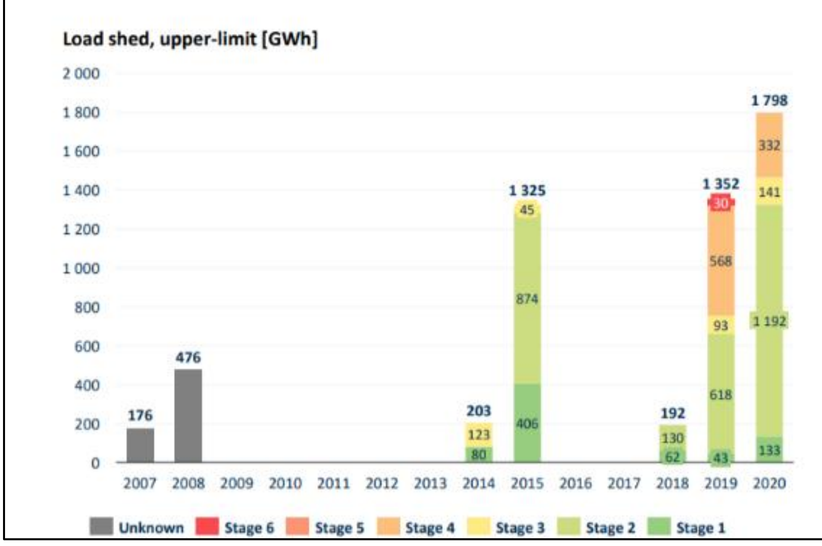
The South African Government, through the IRP, has set a target to secure 17 800 MW of renewable energy by 2030. This is an effort to diversify the country's energy mix in response to the growing electricity demand and promote access to clean sources of energy.

The National Development Plan (NDP) is aimed at reducing and eliminating poverty in South Africa by 2030. The NDP also outlines the need to increase electricity production by 2030, with 20 000 MW of electricity capacity generated from renewable sources to move to less carbon-intensive electricity production. The Plan also envisages that South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates, while supporting economic growth through job creation.

The authorisation of the Mukondeleli WEF will further align with South Africa's National Climate Response White Paper which outlines the countries efforts to manage the impacts of climate change and to contribute to the global efforts to stabilize the greenhouse gases concentrations in the atmosphere.

The proposed Mukondeleli WEF, will pave the way for the Just Energy Transition (JET)[9] in South Africa and promote the transition from a fossil fuel-based economy to a low carbon economy. The proposed Mukondeleli WEF aims towards the aforementioned national energy targets of diversification of energy supply and the promotion of clean energy. Wind and solar energy developments contribute to reduced emissions and subsequently climate change whilst promoting industrial development and job creation.

The proposed Mukondeleli WEF will also aid in overcoming the power shortages that are currently faced in the country. In 2020, South Africa witnessed its longest recorded hours of load shedding, with the power being off for 859 hours of the year as shown in **Figure 5-1**. The South African Government has taken strides to try reducing these power cuts through the implementation of bid Windows in REIPPP and lifting the independent power generation threshold to 100MW, but it is still expected that the country will undergo more load shedding. Over the years the construction of Wind facilities has become cheaper, and less time-consuming. Thus, acting as a faster and more efficient method of meeting the ever-growing demand for electricity in the country.



Year	Duration of outages (hours)	Energy shed (GWh)
2007	-	176
2008	-	476
....	....	....
2014	121	203
2015	852	1325
2016	-	-
2017	-	-
2018	127	192
2019	530	1352
2020	859	1798

Figure 5-1: Load shedding hours over the years in South Africa

In addition, the Council for Scientific and Industrial Research (CSIR) reported that renewable energy assisted in relieving pressure on the constrained South African power system during load shedding in the first quarter of 2019. This indicates that renewable energy is a key factor in ensuring that the country does not face further load shedding in the future.

[9] The Just Transition is described as the transition towards a low-carbon and climate-resilient economy that maximizes the benefits of climate action while simultaneously improving the welfare of the workers and their communities.

5.1.3 REGIONAL AND LOCAL PERSPECTIVE

JUST ENERGY TRANSITION

Coal power stations and the coal mining industry play a vital component in the economic and social components of the local Mpumalanga economy. Shifting to a low carbon economy will thus need to offset or exceed the benefits being realised by fossil fuels in the province. Thus, a key factor to ensuring the success of the Just Energy Transition is not only to focus on the transition from fossil fuels to renewable energy resources but to simultaneously ensure the Just Transition of jobs and skills.

The transition towards renewable energy will improve the socio-economic conditions of the Gert Sibande District Municipality. The Gert Sibande District Municipality recorded an unemployment rate of 26.7% in 2017, with the majority of its employed in the trade and community services sectors. The Project will aid in solving two of the leading challenges faced by the Gert Sibande District Municipality, namely the cost of electricity and lack of adequate employment opportunities. The Project will be the first large-scale wind energy facilities being developed in Mpumalanga. The proponent foresees this project as being the catalyst to realising a true Just Energy Transition for Mpumalanga. As various career opportunities are presented by the wind industry, and these are divided into four pillars that are aligned with the value chain. These four pillars are project development, component manufacturing, construction, and operation & maintenance as shown in **Figure 5-2**.

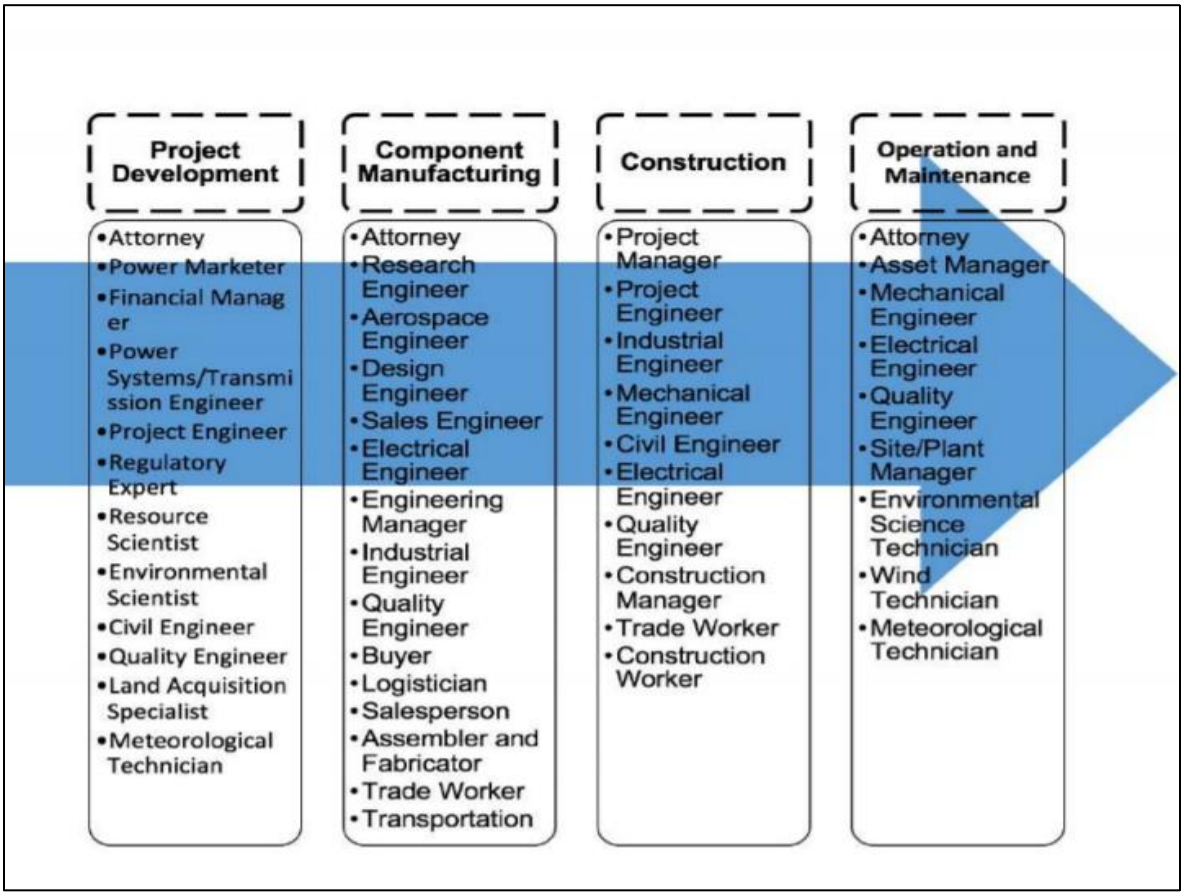


Figure 5-2: Career Opportunities presented by the Wind Industry (Source: https://www.res4africa.org/wp-content/uploads/2020/09/RES4Africa-Foundation-A-Just-Energy-Transition-in-South-Africa.pdf)

Figure 5-2 shows that the wind industry will create job opportunities throughout the supply chain. The wind industry will contribute to the Just transition in South Africa to ensure that there are no job losses but rather job transfers and skill exchange. For these opportunities to arise, renewable energy projects need to be approved in Mpumalanga to ensure that the transition from fossil fuels to renewable energy happens gradually and takes off effectively.

MULTIPLE LAND USE

Unlike opencast coal mining within the broader study area, the Project facilitates multiple land use functions within the development area. As wind turbines are spread out across the development area this allows multiple land use functions such as operating the wind farm in tandem with agricultural activities or even underground coal mining. This will boost the economic activities in the area which will in turn increase job opportunities in that area and help improve the local community's welfare without jeopardizing the environment.

DESIRABILITY OF THE PROJECT SITE

Due to the fact that the Project will be providing energy to Sasol, the Project will also aid in the increase of exports from South Africa through the production of green hydrogen that has become popular globally. Hydrogen has become one of the latest buzzes for meeting the world’s growing energy needs and a vital component for meeting the global decarbonization goals. Hydrogen is a clean fuel; however, the manufacturing of hydrogen fuel is energy-intensive and traditionally uses fossil fuels to power the production plant.

Sasol’s intent is to lead the energy transition in South Africa. Sasol’s goal is to reduce its greenhouse gas footprint for Scope 1 and 2 emissions by 30% by 2030 and achieve Net Zero by 2050. This will be achieved through a combination of energy and process efficiencies, strategic partnerships, investments in renewables and a shift to incremental natural gas as a transition feedstock and ultimately green hydrogen and sustainable carbon for the Southern African value chain.

At the core of Sasol’s renewable energy strategy is the development of green hydrogen innovations. Green hydrogen is recognised as a key enabler to decarbonisation because of its ability to decarbonise hard-to-abate industries such as aviation, steel and heavy-duty mobility.

6 PROJECT DESCRIPTION

6.1 SITE LOCATION

The proposed Mukondeleli WEF is located approximately 8km south of Secunda in the Gert Sibande District Municipality and the GMM Local Municipality, near the town of Secunda, in the Mpumalanga Province of South Africa (**Figure 6-1** and **Figure 6-2**).

The proposed Mukondeleli WEF is not located within one of the promulgated Renewable Energy Development Zones (REDZ). Furthermore, only four renewable energy projects are located within a 55km radius of the site, namely:

— The authorised Tutuka 65.9 MW Solar Photovoltaic (PV) Energy Facility and its associated infrastructure (Ref: 14/12/16/3/3/2/754) located 23km southwest of the site;

— The authorised Forzando North Coal Mine Solar PV Facility, 9.5MW, (Ref: 14/12/16/3/3/1/452) is located 55km northwest of the site; and

— The proposed Impumelelo WEF (Ref: 1/3/1/16/1G-265) to be located southeast of the site.

— The proposed Vhuvhili Solar Energy Facility (NEAS No. MPP/EIA/0001063/2022) located approximately 10km east of the site.

The details of the properties associated with the proposed Mukondeleli WEF, including the 21-digit Surveyor General (SG) codes for the cadastral land parcels are outlined in **Table 6-1.**

Table 6-1: Mukondeleli WEF Affected Farm Portions

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Portion 0 of the Farm Knoppies No. 314	T0IS00000000031400000
Portion 1 of the Farm van Tondershoek No. 317	T0IS00000000031700001
Portion 2 of the Farm van Tondershoek No. 317	T0IS00000000031700002
Portion 2 of the Farm Brandwacht No. 316	T0IS00000000031600002
Portion 2 of the Farm Bosjesspruit No. 291	T0IS00000000029100002
Portion 3 of the Farm Brandwacht No. 316	T0IS00000000031600003
Portion 4 of the Farm Brandwacht No. 316	T0IS00000000031600004
Portion 5 of the Farm Brandwacht No. 316	T0IS00000000031600005
Portion 5 of the Farm Tweefontein No. 321	T0IS00000000032100005
Portion 6 of the Farm Bosjesspruit No. 291	T0IS00000000029100006
Portion 7 of the Farm van Tondershoek No. 317	T0IS00000000031700007
Portion 8 of the Farm van Tondershoek No. 317	T0IS00000000031700008

FARM NAME	21 DIGIT SURVEYOR GENERAL CODE OF EACH CADASTRAL LAND PARCEL
Portion 11 of the Farm van Tondershoek No. 317	T0IS00000000031700011
Portion 8 of the Farm Bosjesspruit No. 291	T0IS00000000029100008
Portion 9 of the Farm Knoppiesfontein No. 313	T0IS00000000031300009
Portion 9 of the Farm Bosjesspruit No. 291	T0IS00000000029100009
Portion 10 of the Farm Bosjesspruit No. 291	T0IS00000000029100010
Portion 11 of the Farm Bosjesspruit No. 291	T0IS00000000029100011
Portion 12 of the Farm Bosjesspruit No. 291	T0IS00000000029100012
Portion 12 of the Farm van Tondershoek No. 317	T0IS00000000031700012
Portion 13 of the Farm Brandwacht No. 316	T0IS00000000031600013
Portion 13 of the Farm Bosjesspruit No. 291	T0IS00000000029100013
Portion 14 of the Farm Bosjesspruit No. 291	T0IS00000000029100014

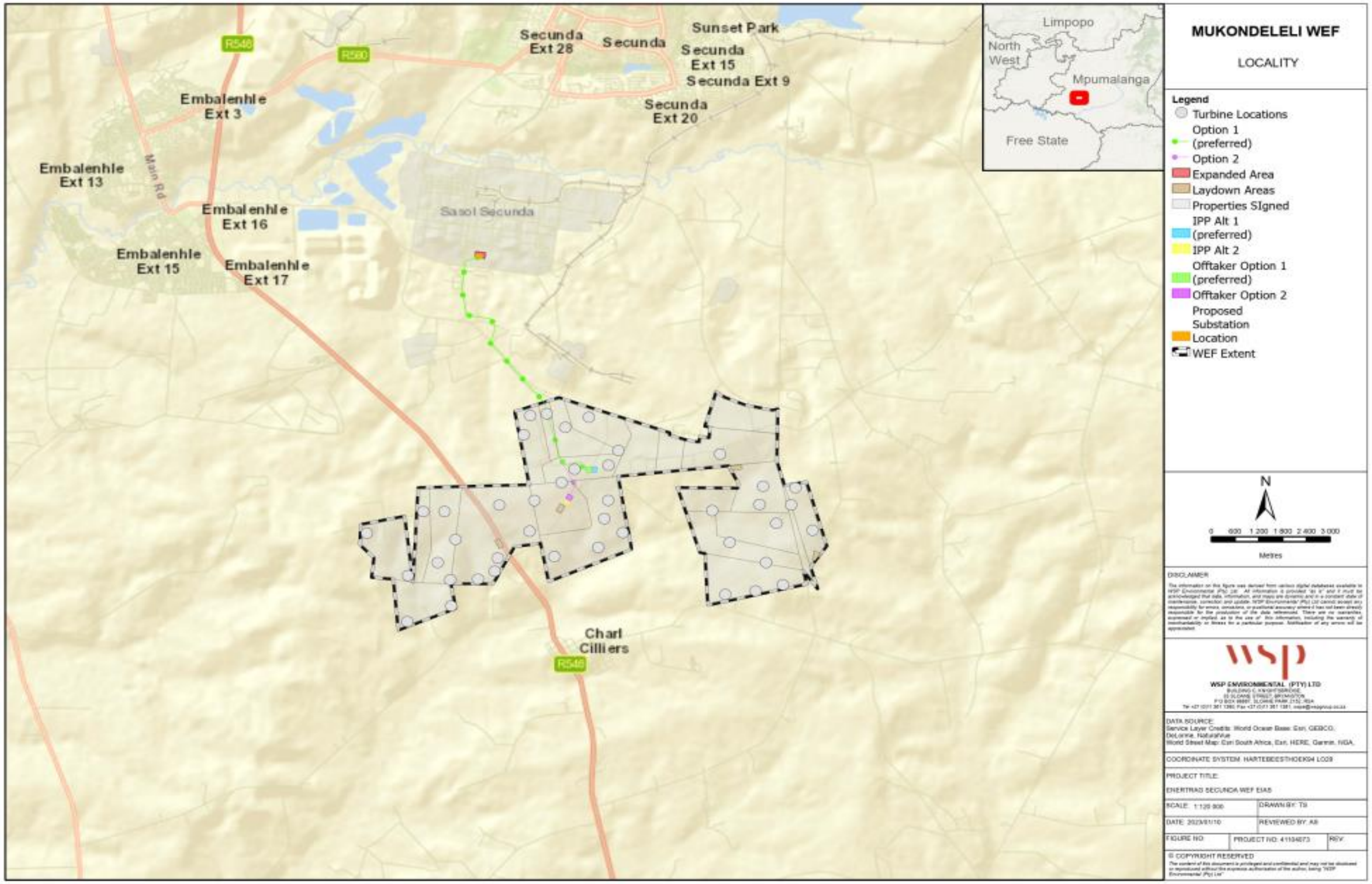


Figure 6-1: Locality map for the proposed Mukondeleli WEF, near Secunda in the Mpumalanga Province, showing the location and proximity of the respective projects to each other.

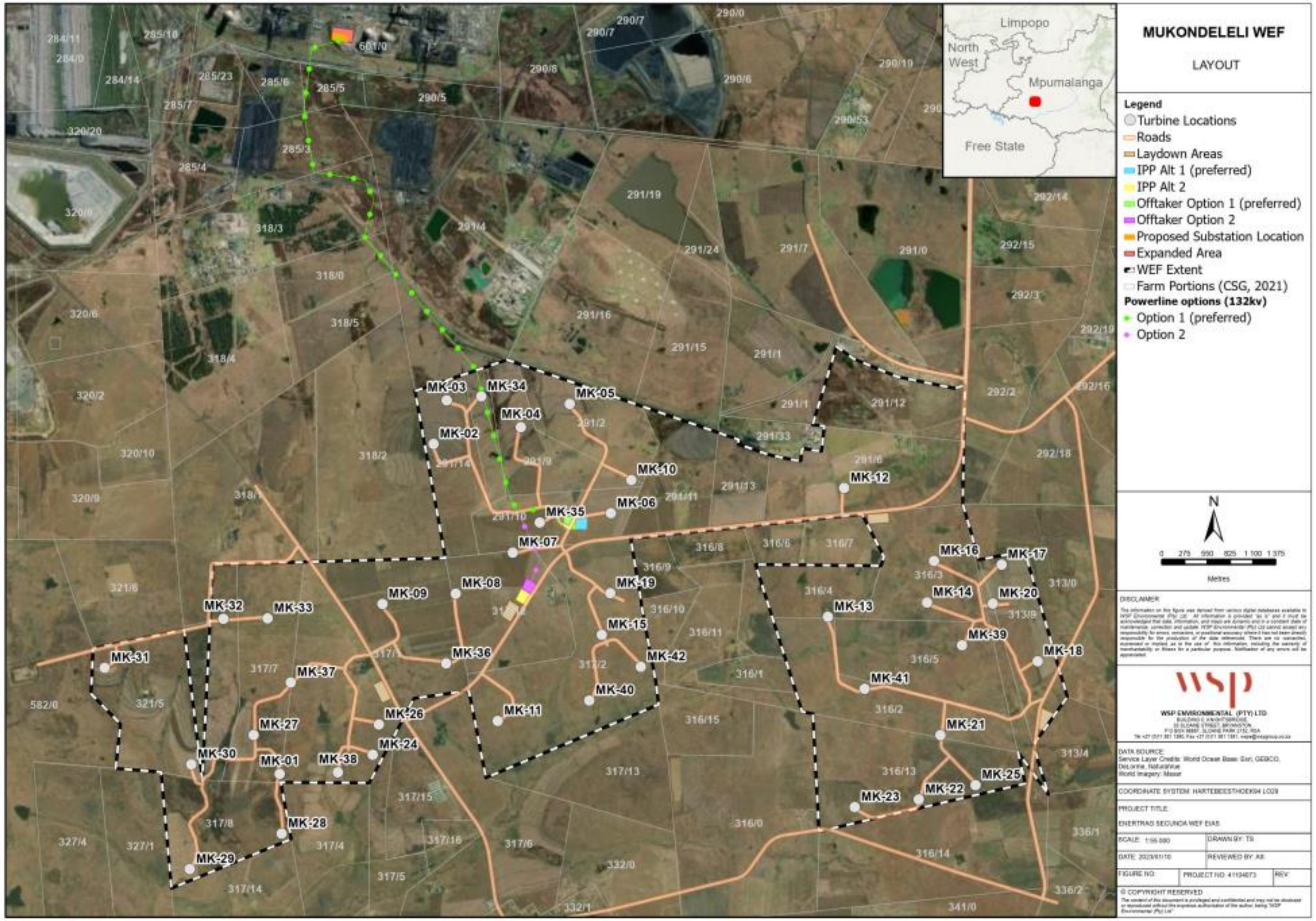


Figure 6-2: Proposed Mukondeleli WEF and associated main components

6.2 WIND ENERGY POWER GENERATION PROCESS

Wind power is the conversion of wind energy into a useful form of energy, such as electricity, using modern and highly reliable wind turbines. Wind Power is non-dispatchable, meaning that for economic operation, all the available output must be taken when it is available.

Wind turbines, like windmills, are mounted on a tower to harness wind energy at an increased level above the ground where wind is faster and less turbulent. The kinetic energy of the wind is used to turn the blades of the turbine to generate electricity. Wind turbines can operate at varying wind speeds, with the amount of energy the wind transfers to the rotor depending on the density of the air, the rotor area and the wind speed.

The electricity generated by the wind turbines is passed through the step-up transformer and then transmitted via either underground or overhead cables to a central substation, which connects the wind energy facility to a high voltage network. Wind turbines are designed to operate automatically with minimal maintenance for approximately 20-25 years.

Figure 6-3 illustrates the following main components of a wind turbine:

— The **rotor** consists of three **blades** which are attached to a **hub**. The blades collect energy from the wind and converts the wind energy into rotational shaft motion/energy to turn the generator;

— The **nacelle** houses the equipment at the top of the tower as well as a gearbox, a generator that converts the turning motion/mechanical energy of the blades into electricity and coupling and brake;

— The **tower** supports the nacelle and rotor and allows the blades to be distanced safely off the ground so as to reach the stronger winds found at higher elevations;

— Turbine **step-up transformer** which can be indoor or outdoor, depending on the turbine model whose function is to increase the voltage capacity of the electricity generated by the turbine to a higher, grid-equivalent.

— The **foundation** unit ensures the stability of the turbine structure.

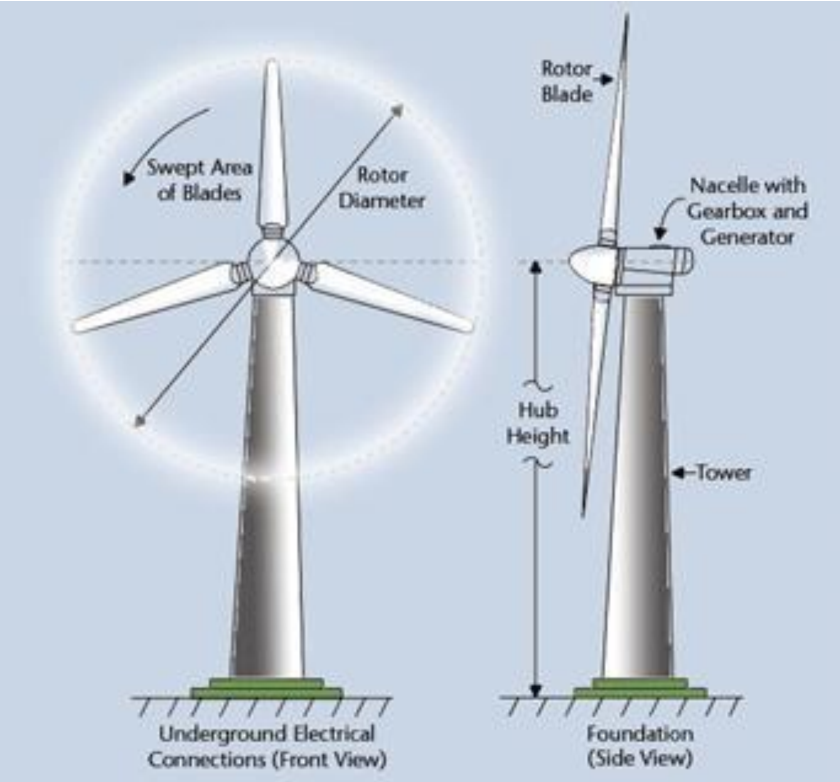


Figure 6-3: Illustration of the main components of a wind turbine

6.3 PROJECT INFRASTRUCTURE

The proposed Mukondeleli WEF will be developed with an installed with a maximum export capacity of 300 megawatt (MW). The proposed development will also include a 132 kV overhead power line and a step-down substation to feed the electricity generated by the project into the proposed Green Hydrogen Electrolyser facility located at Sasol Secunda which is between 5 and 10 km from the on-site substation. The 132 kV overhead power line and step-down substation at Sasol will be subject to a separate Basic Application to be undertaken by the applicant.

The proposed Mukondeleli WEF will comprise the following key components:

WIND TURBINES

— Up to 42 turbines;
— Temporary construction laydown and storage area of approximately 4 500m^2 per turbine.
— Turbine hub height of up to 200m;
— Turbine construction approximately 3m deep;
— Rotor diameter up to 200m; and
— Permanent hard standing area for each wind turbine (approximately 1 500m^2). **Figure 6-4** illustrates the typical hardstanding requirements for the construction of each turbine (it should be noted that the figure below is for illustration purposes only – the exact layout and specification of the hardstanding will be determined once the design phase has been completed).

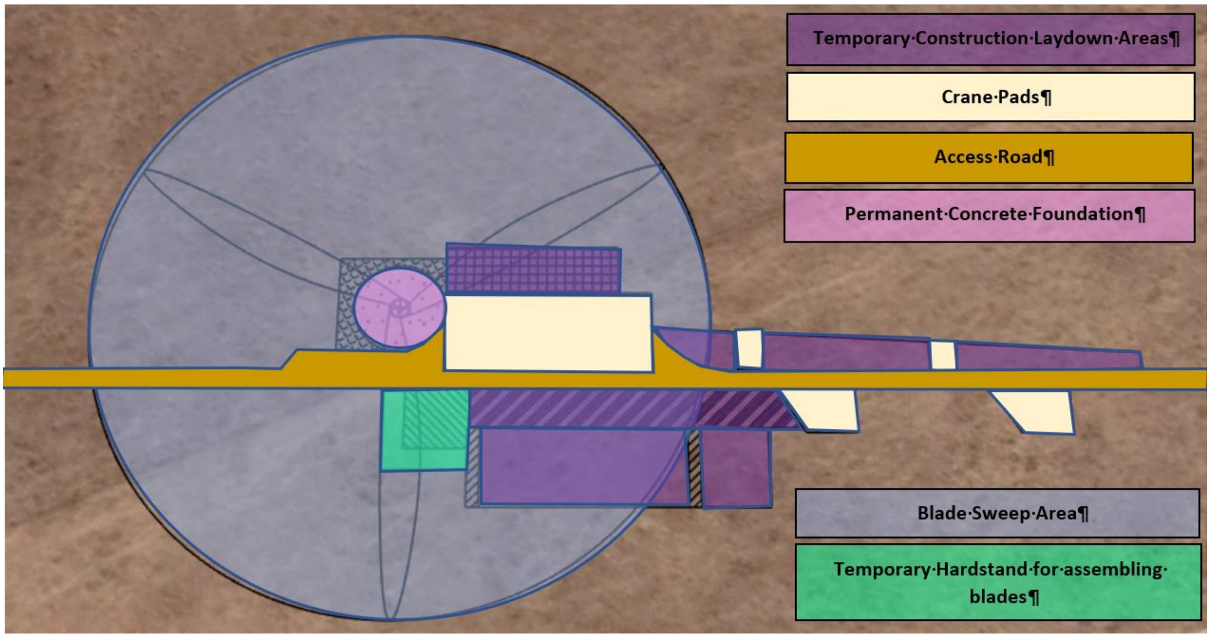


Figure 6-4: Typical Turbine Hard Standing Requirements (illustration purposes only)

SITE SUBSTATION AND BATTER ENERGY STORAGE SYSTEM (BESS)

— A Battery Energy Storage System (BESS) comprising of several utility scale battery modules within shipping containers or an applicable housing structure on a concrete foundation. Lithium-Ion Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology, however, the specific technology will only be determined following EPC procurement.
— A temporary construction laydown/staging area of approximately 4.5 hectares (ha) which will also accommodate the operation and maintenance (O&M) buildings.

- A 33/132kV on-site substation to feed electricity generated by the proposed Mukondeleli WEF into the step-down substation at the Sasol facility. The on-site substation will accommodate 1 x 132 kV incoming feeder bay, 1x 132 kV outgoing feeder bay and a motorised isolator with protection and metering.
- The substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building telecommunication, and other substation components as required; and
- The Battery Energy Storage System (BESS) and substation will have a combined footprint of up to 4 ha. The BESS storage capacity will be up to 300MW/1 200 megawatt-hour (MWh) with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology however the specific technology will only be determined following Engineering, Procurement, and Construction (EPC) procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers. The BESS components will arrive on site pre-assembled.

OPERATION AND MAINTENANCE BUILDING INFRASTRUCTURE

- Operation and maintenance (O&M) building infrastructure will be required to support the functioning of the WEF and for services required by operations and maintenance staff. The O&M building infrastructure will be part of the substation and BESS complex and will include:
  - Operations building of approximately 200m^2;
  - Workshop and stores area of approximately 300m^2; and
  - Refuse area for temporary waste storage and conservancy tanks to service ablution facilities.

CONSTRUCTION CAMP LAYDOWN

- Temporary infrastructure includes:
  - a construction camp laydown and concrete batching plant (up to 3ha footprint);
  - temporary laydown area (up to 2ha); and
  - sewage: conservancy tanks and portable toilets.

ACCESS ROAD

- Access to the proposed Mukondeleli WEF is gained from the R 546;
- Internal roads with a width of up to 10m, and approximately 60km in length, providing access to each turbine, the BESS, on-site substation, step-down substation and laydown area. The roads will accommodate cable trenches and stormwater channels (as required) and will include turning circle/bypass areas of up to 20 m at some sections during the construction phase; and
- The roads and cables will be positioned within a 20 m wide corridor. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.

ASSOCIATED INFRASTRUCTURE

- A 33/132kV on-site SS to feed electricity generated by the proposed Mukondeleli WEF into the step-down substation at the Sasol facility. The on-site SS will accommodate 1 x 132 kV incoming feeder bay, 1x 132kV outgoing feeder bay and a motorised isolator with protection and metering; and
- Fencing of up to 3m high around the construction camp, O&M building and Site substation and BESS areas, including any other associated infrastructure.

The proposed development footprint (buildable area) is approximately 100ha (subject to finalisation based on technical and environmental requirements), and the extent of the project area is approximately 4 250ha. The development footprint includes the turbine positions and all associated infrastructures as outlined above.

6.4 GENERAL CONSTRUCTION ACTIVITIES

The construction process will follow industry standard methods and techniques. Key activities associated with the construction phase are described in **Table 6-2.**

Table 6-2: Construction Activities

ACTIVITY	DESCRIPTION
Site preparation and establishment	Site establishment will include clearing of vegetation and topsoil at the footprint of each turbine, for laydown area and access routes. The temporary laydown area will be constructed, including establishment of the construction camp (temporary offices, storage containers, concrete batching plant etc). Site establishment will also entail the installation and/or connection of services (sanitation, electricity etc).
Transport of components and equipment to site	Bulk materials (aggregate, steel etc.), infrastructure components (masts, blades, tower sections etc), lifting and construction equipment (excavators, trucks, compaction equipment etc.) will be sourced and transported to site via suitable National and provincial routes and designated access roads. The infrastructure components may be defined as abnormal loads in terms of the Road Traffic Act (No. 29 of 1989) due to their large size and abnormal lengths and loads for transportation. A permit may be required for the transportation of these loads on public roads.
Excavation and earthworks	Subject to the determination of founding specifications, earthworks will be required. This is likely to entail: — Excavation of foundation holes to a depth of approximately 3m, and pouring of concrete foundations of approximately 500 – 650m^3 from the batching plant. Concrete foundations will be constructed at each turbine location — Levelling of the construction camp area, substation area, and O&M building area, and excavation of foundations prior to construction. — Excavation of trenches for the installation of underground cables.
Construction of wind turbines, site substation and BESS	A large lifting crane(s) will be required to lift the turbine sections (nacelle, blades) into place. The lifting crane/s will be brought on site and will be required to move between the turbine site. Cranes of varying sizes may be required depending on the size of the components. An IPP substation will be constructed on the site. The wind turbines will be connected to the IPP substation via underground or overhead (if required) up to 33kV electrical cables. The BESS will typically require the placement of multiple containers to house the BESS components.
Establishment of ancillary infrastructure	Ancillary infrastructure will include construction site office, temporary laydown area and workshop area for contractor's equipment.
Rehabilitation	Once all construction is completed on site and all equipment and machinery has been removed from the site, the site will be rehabilitated.

6.5 ALTERNATIVES

The EIA Regulations of 2014 (as amended) require that the S&EIR process must identify and describe alternatives to the proposed activity that were considered, or motivation for not considering alternatives. Different types or categories of alternatives could be considered including different locations, technology types, and project layouts. At the scoping level the evaluation of alternatives is provided at a high level in the absence of detailed environmental comparators for each alternatives; due to the two-staged nature of the S& EIA process it is more suitable to identify and describe the potential alternatives on a high level basis within scoping, and to perform a more detailed analysis of alternatives (with environmental comparators) in the EIA phase of the project. As such, the S&EIR will holistically assess the impacts and risks of each alternative in a comparative way, as suggested by Appendix 2 of the EIA Regulations of 2014 (as amended).

All alternatives outlined below are considered both feasible and reasonable with no apparent advantages or disadvantages at this stage of the project. All alternatives will be described and assessed in more detail during the EIA Phase.

6.5.1 SITE ALTERNATIVES

The selection of the Mukondeleli WEF site is the outcome of a feasibility assessment by the proponent, which *inter alia* served to identify site options that would be optimal for energy production and grid interconnection. The Mukondeleli WEF site was selected because it is strategically located due to the following factors:

1) **Proximity to Sasol** – The proposed WEF requires connection to Sasol Secunda. The electricity generated by the Mukondeleli WEF will be fed into the Sasol Secunda Facility where the power will be distributed within the Facility which is between 5 and 10 km from the on-site substation. The proposed project location is approximately 8km to the south of Sasol Secunda, consequently reducing the length of the powerline that will be constructed for connection.
2) **Land Availability** – The availability of land is a key feasibility criterion in the site selection process. The project site is of a suitable land size for the proposed development. The land available for the development of the Mukondeleli WEF extends approximately 3 600ha, providing a substantial amount of land for a 100ha development. Furthermore, this region is home to some of the biggest coal power stations in the country (Matla, Kriel, Tutuka, Komati and Camden among many others), and most land parcels have been given mining rights for coal beneficiation to provide fuel stock supply these power stations. Thus, there is very limited land available for the development of renewable energy facilities. The proponent has however secured sufficient land area for the development of the proposed WEF with landowners within the respective cadastral portions comprising the development footprint, indicating their support and willingness for the project to proceed to development via entering into agreement with the Developer.
3) **Strategic Approach** – Five of Eskom's coal-fired power stations are targeted for decommissioning in the short term. These include the Komati, Camden, Grootvlei, Arnot, and Hendrina power stations. These power stations range between 50 - 60 years of age. According to the 2019 IRP, over a 11-year period Eskom are expected to decommission over 11GW of its coal fired capacity. The development site is therefore strategically located such to introduce utility scale clean power technologies, such as wind, in a region that is historically known for coal fired power stations. The introduction of a WEF in this region would allow for new cleaner energy generation technologies to emerge in replacing aging coal fired power stations. A project of this kind supports the National Governments aim of a low carbon economy as described in the National Development Plan 2030.
4) **Road and labour pool accessibility** – The site is near the N17 highway and the town of Secunda, which will benefit construction logistics and provide a labour resource respectively. There is also an existing road that goes through the land parcels to allow for direct access to the project development area.

The site is considered suitable for the reasons provided. The investigation of an alternative site is not currently proposed within this Scoping Report.

There is no Site alternative for the Mukondeleli WEF.

The corner co-ordinates of the WEF development area are included in **Table 6-3** and **Figure 6-5**.

Table 6-3: Corner Co-Ordinates of the Mukondeleli WEF Development Area

CORNER POINT	LATITUDE	LONGITUDE
1	26° 36' 07.85187360" S	29° 10' 14.26709280" E
2	26° 35' 55.55039640" S	29° 10' 54.52525200" E
3	26° 36' 26.70660000" S	29° 12' 35.61480000" E
4	26° 36' 28.46232000" S	29° 12' 35.42760000" E
5	26° 36' 32.74092000" S	29° 12' 49.31280000" E
6	26° 36' 34.66512000" S	29° 12' 59.77440000" E
7	26° 36' 34.90560000" S	29° 13' 02.76960000" E
8	26° 36' 30.22272000" S	29° 13' 03.28440000" E

CORNER POINT	LATITUDE	LONGITUDE
9	26° 36' 30.56868000" S	29° 13' 07.91760000" E
10	26° 36' 30.81888000" S	29° 13' 07.88880000" E
11	26° 36' 31.18860000" S	29° 13' 11.84520000" E
12	26° 36' 21.30264000" S	29° 13' 12.99000000" E
13	26° 36' 20.82564000" S	29° 13' 07.89600000" E
14	26° 35' 50.08740000" S	29° 13' 18.28920000" E
15	26° 35' 54.99060000" S	29° 13' 25.85640000" E
16	26° 36' 01.92852000" S	29° 13' 44.86080000" E
17	26° 36' 06.43680000" S	29° 14' 09.81240000" E
18	26° 36' 05.27816520" S	29° 14' 14.38078920" E
19	26° 36' 51.69168000" S	29° 14' 13.49160000" E
20	26° 37' 13.65160080" S	29° 14' 20.62989240" E
21	26° 37' 10.25999400" S	29° 14' 40.59824280" E
22	26° 38' 07.32355080" S	29° 14' 59.33007600" E
23	26° 38' 26.20568040" S	29° 14' 44.56618080" E
24	26° 38' 45.58860960" S	29° 14' 51.13732200" E
25	26° 38' 29.00711040" S	29° 14' 37.83696360" E
26	26° 38' 41.36592480" S	29° 14' 41.06399640" E
27	26° 39' 00.22599720" S	29° 13' 11.16521760" E
28	26° 38' 59.20310040" S	29° 13' 10.91115120" E
29	26° 38' 14.14795200" S	29° 13' 08.23375200" E
30	26° 38' 13.29653040" S	29° 13' 03.52321320" E
31	26° 37' 15.62115720" S	29° 12' 43.08178320" E
32	26° 37' 16.07488680" S	29° 13' 37.89162480" E
33	26° 37' 12.51140160" S	29° 13' 39.12082320" E
34	26° 36' 55.88532000" S	29° 13' 29.58240000" E
35	26° 37' 05.55456000" S	29° 11' 48.51960000" E
36	26° 37' 29.73039600" S	29° 11' 53.09903760" E
37	26° 37' 32.28457080" S	29° 11' 53.38737960" E
38	26° 38' 01.72637160" S	29° 11' 59.60135400" E
39	26° 38' 10.58360640" S	29° 12' 00.89216280" E
40	26° 38' 39.43403520" S	29° 10' 45.46814160" E
41	26° 38' 05.25464160" S	29° 10' 37.99079760" E
42	26° 38' 08.37158280" S	29° 10' 13.99174320" E

CORNER POINT	LATITUDE	LONGITUDE
43	26° 38' 41.50703760" S	29° 09' 54.55170360" E
44	26° 38' 41.32123080" S	29° 09' 15.84424800" E
45	26° 39' 03.53991600" S	29° 09' 20.48574600" E
46	26° 39' 22.92914160" S	29° 08' 28.15456200" E
47	26° 38' 37.37268960" S	29° 08' 23.61628320" E
48	26° 38' 35.95119000" S	29° 08' 03.70290480" E
49	26° 38' 18.58691760" S	29° 08' 05.87986800" E
50	26° 38' 06.67416120" S	29° 07' 52.95694800" E
51	26° 37' 48.84982680" S	29° 07' 53.84986320" E
52	26° 37' 41.48982840" S	29° 08' 33.55996200" E
53	26° 38' 40.40768040" S	29° 08' 41.55200160" E
54	26° 37' 15.98936160" S	29° 08' 46.12633080" E
55	26° 37' 13.27839960" S	29° 10' 27.64339320" E

Figure 6-5: Corner points of the Mukondeleli WEF Development Area

6.5.2 ACTIVITY ALTERNATIVES

The Mukondeleli WEF will utilise wind technology to generate power. Therefore, no technology alternatives are being considered for this project. The motivation for the use of wind technology for this project is provided below:

WIND RESOURCE

The Project site was selected on the availability of wind resource in the Mpumalanga region. The availability of the wind resource is the main drivers of project viability. The Project site was identified by the proponent through a desktop pre-feasibility analysis based on the estimation of the wind energy resource. The average annual wind speed for the site was considered sufficient to ensure the economic viability of a wind energy facility. This viable wind resource ensures the best value for money is gained from the project, allowing for competitive pricing and maximum generation potential, with the resulting indirect benefits for the South African economy.

TOPOGRAPHY

The site is characterised by grassland on the gentle undulating plains which is suitable for the development of a wind project. The altitude ranges from about 1600 m in the west along the Boesmanspruit up to approximately 1660 m in the southeast of the eastern site.

COMPETITION

With regards to renewable energy facilities, there is minimal competition in the area. Should the project proceed, it will be the first WEF in the province and will act as one of the pioneering developments and open opportunities for other renewable developments. It will also serve as a case study for wind resource in the province, showing that commercially viable wind energy facilities are suitable for certain parts of Mpumalanga Province.

6.5.3 LAYOUT ALTERNATIVES

A conceptual layout of the turbines on the landscape has been developed during the Scoping Phase of the S&EIR process for the Mukondeleli WEF and is included in **Figure 6-6** Figure 6-2**.** The initial layout included 54 turbine positions and associated main WEF components. The project site consisted of the following farm portions:

— Portion 0 of the Farm Knoppies No. 314
— Portion 1 of the Farm van Tondershoek No. 317
— Portion 2 of the Farm van Tondershoek No. 317
— Portion 2 of the Farm Brandwacht No. 316
— Portion 2 of the Farm Bosjesspruit No. 291
— Portion 3 of the Farm Brandwacht No. 316
— Portion 4 of the Farm Brandwacht No. 316
— Portion 5 of the Farm Brandwacht No. 316
— Portion 5 of the Farm Tweefontein No. 321
— Portion 6 of the Farm Bosjesspruit No. 291
— Portion 7 of the Farm van Tondershoek No. 317
— Portion 8 of the Farm van Tondershoek No. 317
— Portion 11 of the Farm van Tondershoek No. 317
— Portion 8 of the Farm Bosjesspruit No. 291
— Portion 9 of the Farm Knoppiesfontein No. 313
— Portion 9 of the Farm Bosjesspruit No. 291
— Portion 10 of the Farm Bosjesspruit No. 291

- Portion 11 of the Farm Bosjesspruit No. 291
- Portion 12 of the Farm Bosjesspruit No. 291
- Portion 12 of the Farm van Tondershoek No. 317
- Portion 13 of the Farm Brandwacht No. 316
- Portion 13 of the Farm Bosjesspruit No. 291
- Portion 14 of the Farm Bosjesspruit No. 291

The location of the project infrastructure (i.e., layout) was determined based on initial environmental and technical screening which considered the infrastructure locations feasible from a constructability perspective. This included several key aspects including environmental constraints and opportunities, distance to grid connection, topography, site accessibility. The proposed development footprint (buildable area) is approximately 100ha (subject to finalisation based on technical and environmental requirements), and the extent of the project area was approximately 4 100 ha, with the main project components consisting of wind turbines and associated infrastructure including the substation and BESS, access and internal roads, construction camp laydown areas (including batching plants).

The preliminary Mukondeleli layout (**Figure 6-6**), inclusive of the various project infrastructure alternatives, has been updated and refined following input from the various Specialist studies during the Scoping Phase as well as input from Sasol regarding undermining present in the study area.

The relevant Specialist studies mapped out sensitive areas (and no-go areas) to be avoided or mitigated through the planning process. Based on the Specialist findings, the refined/revised layout was developed (**Figure 6-7**) to avoid sensitive features and buffer areas and mitigate against overall impact. The revised layout includes a reduced number of turbines from 54 to 42 turbine positions. The revised layout, including the amended turbine positions was taken forward for assessment by the various Specialists during this EIA Phase.

Two site locations for the on-site substation, which include the BESS, were identified during preliminary technical investigations:

- Substation and BESS Alternative 1 located on Bosjesspruit 291/10
- Substation and BESS Alternative 2 located on Vantondershoek 317/12

Alternative 1 is preferred as it provides the shorter connection to the substation at Sasol. However, both Alternatives are considered feasible and reasonable.

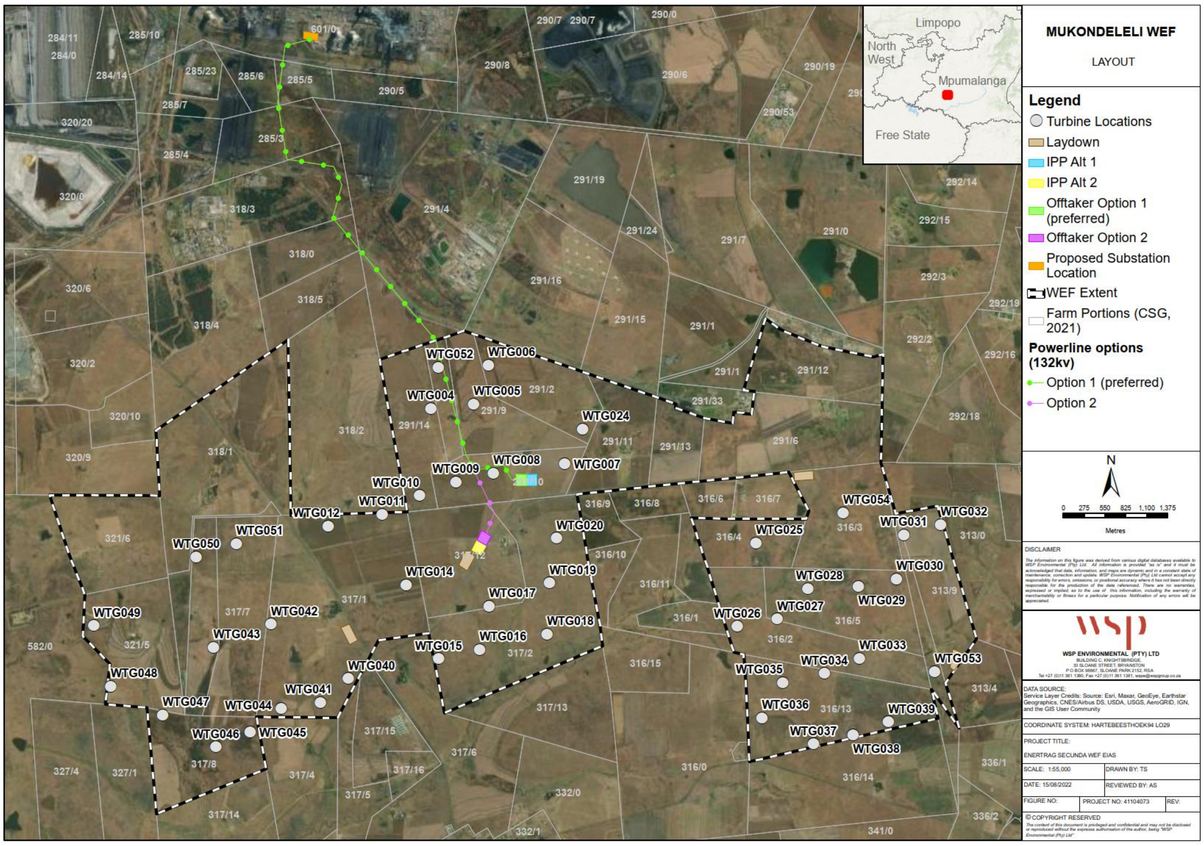


Figure 6-6: Initial Mukondeleli Site Layout Map (up to 54 Turbines)

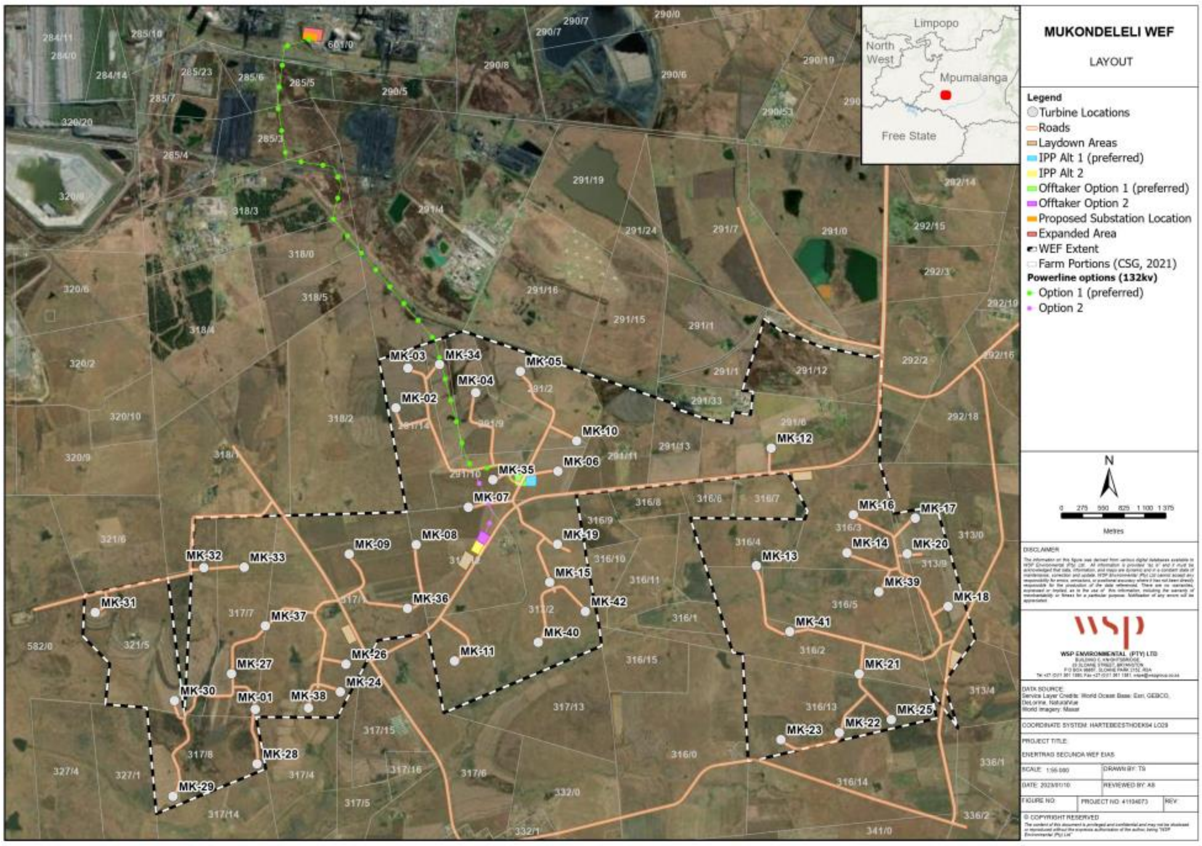


Figure 6-7: Revised Layout for the Mukondeleli WEF (up to 42 Turbines)

6.5.4 LAND USE ALTERNATIVES

Current use of land is a key consideration in terms of finding a suitable site that does not significantly hinder existing land-use practices. The current land use of the site properties is agricultural land-use, mainly used for grain farming and livestock grazing. The proposed development will only exclude an insignificantly small proportion of the land from agricultural production. Construction (and decommissioning) activities are likely to have some nuisance impact for farming operations but are highly unlikely to have an impact on agricultural production.

Agricultural land is preferred as the majority of farming activities can share land use with the operation of the wind facility. As noted in Section 5.1.3 of this EIR, the preferred project (wind farm) facilitates multiple land use functions within the development area. Wind turbines are spread out across the development area allowing multiple land use functions such as operating the wind farm in tandem with agricultural activities or even underground coal mining. This will boost the economic activities in the area which will in turn increase job opportunities in that area and help improve the local community's welfare without jeopardizing the environment.

6.5.5 TECHNOLOGY ALTERNATIVES

The Proponent is considering two types of preferred battery technologies for the BESS, that is, either Solid State Lithium (SSL) or Vanadium Redox Flow (VRF) Battery Energy Storage Systems. It is important to note that the selection of specific technology will only be determined following EPC. Therefore, both technologies are currently being considered.

LITHIUM SOLID STATE BATTERIES

Solid-State Battery consists of multiple battery cells that are assembled together to form modules. Each cell contains a positive electrode, a negative electrode and an electrolyte. The BESS will comprise of multiple battery units or modules housed in shipping containers and/or an applicable housing structure which is delivered pre-assembled to the project site. Containers are usually raised slightly off the ground and layout out is rows. They can be stacked if required although this may increase the risk of events in one container spreading to another container. Supplementary infrastructure and equipment may include substations, power cables, transformers, power converters, substation buildings & offices, HV/MV switch gear, inverters and temperature control equipment that may be positioned between the battery containers. The solid-state batteries that are being considered are Lithium-ion systems.

In Lithium battery technologies, energy storage and release is provided by the movement of lithium ions from the negative electrode to the positive electrode during discharge and back when charging. Solid-State lithium (SSL) batteries have become increasing popular due to their high energy density, low self-discharge and long lifetime and cycling performances.

VANADIUM REDOX FLOW BATTERY

The project will employ utility scale batteries. These energy storage systems can be supplied either as containerized units or as a fixed installation within a building etc. Due to the proposed size of the facility (300MW) the Mukondeleli WEF is currently envisioned as having units housed within a large battery building.

All electrochemical energy storage systems convert electrical energy into chemical energy when charging, and the process is reversed when discharging. With conventional batteries, the conversion and storage take place in closed cells. With redox flow batteries, however, the conversion and storage of energy are separated. Redox flow batteries differ from conventional batteries in that the energy storage material is conveyed by an energy converter. This requires the energy storage material to be in a flowable form. In redox flow batteries, charging and discharging processes can take place in the same cell. Redox flow batteries thus have the distinguishing feature that energy and power can be scaled separately. The power determines the cell size, or the number of cells and the energy is determined by the amount of the energy storage medium. In theory, there is no limit to the amount of energy that can be produced and/or stored thereby allowing for scalability of these systems. VRF battery is considered to have a large cycle life, independent power and energy ratings, relatively poor round trip, moderate cost and no self-discharge.

Figure 6-8 shows the general operating principle of redox flow batteries. The energy conversion takes place in an electrochemical cell which is divided into two half cells. The half cells are separated from each other by an ion-permeable membrane or separator, so that the liquids of the half cells mix as little as possible. The separator ensures a charge balance between positive and negative half cells, ideally without the negative and positive.

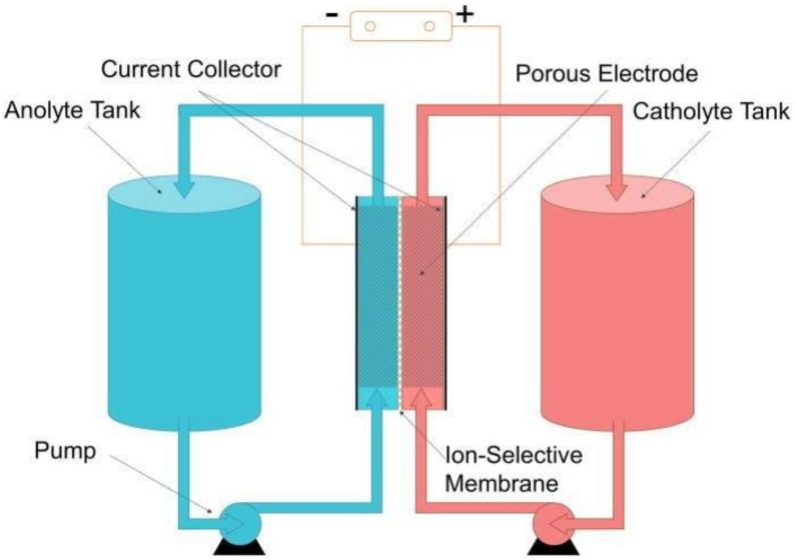


Figure 6-8: Schematic Diagrams of Redox Flow BESS Systems (Source: Wikipedia)

6.5.6 'NO PROJECT' ALTERNATIVE

In the "no project" alternative, the Mukondeleli WEF project will not be developed. In this scenario, there could be a missed opportunity to address the need for increase in renewable energy generation in an effort to mitigate against concerns of climate change and exploitation of non-renewable resources.

The no-go alternative would also not assist Sasol's intent to lead the energy transition in South Africa. Sasol's goal is to reduce its greenhouse gas footprint for Scope 1 and 2 emissions by 30% by 2030 and achieve Net Zero by 2050. This will be achieved through a combination of energy and process efficiencies, strategic partnerships, investments in renewables and a shift to incremental natural gas as a transition feedstock and ultimately green hydrogen and sustainable carbon for the Southern African value chain.

At the core of Sasol's renewable energy strategy is the development of green hydrogen innovations. Green hydrogen is recognised as a key enabler to decarbonisation because of its ability to decarbonise hard-to-abate industries such as aviation, steel and heavy-duty mobility.

The "no project" alternative has been considered in this EIA phase as a baseline against which the impacts of the Mukondeleli WEF project will be assessed.

7 BASELINE ENVIRONMENT

The following chapter presents an overview of the biophysical and socio-economic environment in which the proposed Project is located. It is important to gain an understanding of the Project area and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is being considered.

The description of the baseline environment is essential in that it represents the conditions of the environment before the construction of the proposed Project (i.e. the current, or status quo, environment) against which environmental impacts of the proposed Project can be assessed and future changes monitored.

The area has previously been studied to some extent and is recorded in various sources. Consequently, some components of the baseline have been generated based on literature review. However, where appropriate, baseline information has been supplemented or generated by specialists appointed to undertake baseline and impact assessments for the proposed Project.

The following characteristics of the receiving environment for the proposed Project area are described in **Table 7-1** below.

Table 7-1: Characteristics of the receiving environment

RECEIVING ENVIRONMENT	CHARACTERISTICS
Physical	— Climate — Air Quality — Topography — Geology — Soils and Agricultural Potential — Surface Water — Ecologically Important Landscape Features — Vegetation — Fauna — Avifauna — Site Ecological Importance — Protected Areas
Biological	— Vegetation — Habitats — Biodiversity Conservation Plans — Proposed Protected Areas — Plant Species — Animal Species — Avifauna — Bats
Social and Economic	— Land use — Noise — Transport — Heritage — Palaeontology — Visual Character — Socio-Economic
Health & Safety	— Solid State Lithium Battery Chemical Hazards — Vanadium Redox Flow Battery Hazards — Other Chemicals or Hazards

7.1 PHYSICAL ENVIRONMENT

7.1.1 CLIMATE AND METEOROLOGY

REGIONAL CLIMATE (MUCINA & RUTHERFORD 2006)

The site falls in a strongly seasonal summer-rainfall, cool-temperate region, with very dry winters. The mean annual precipitation of the Soweto Highveld Grassland is 662 mm with a peak in rainfall from November to January. The annual precipitation coefficient of variation is 27%. Mean annual potential evaporation is 2060 mm, while the mean annual soil moisture stress is 75%. Mean annual temperature is 14.8°C and frost is frequent in winter with a mean of 41 days per annum.

RAINFALL

The mean annual rainfall in the region ranges from 667 mm at the farm Zandfontein to 738 mm at the farm Driefontein, both close to Secunda (**Table 7-2**). The mean annual rainfall as measured at Secunda is 693 mm (**Table 7-2, Table 7-3** and **Figure 7-1**). The total annual rainfall at Secunda during dry and wet years respectively may range from 558 mm to 965 mm, indicating a moderate variation in the annual rainfall. The rainy season at Secunda is predominantly from October to March when about 86% of the annual rainfall occurs. December and January are the wettest months and the driest period is from May to August, when less than 15 mm of rain per month is recorded. Maximum rainfall measured over a 24-hour period at Secunda was 82 mm, recorded in November. The highest monthly rainfall recorded was 241 mm, also measured in November.

Table 7-2: Rainfall at some weather stations in the environs of the Mukondeleli site (Weather Bureau, 1998).

	Mean Annual Rainfall (mm)				
Month	Secunda	Zandfontein	Driefontein	Bethal	Standerton
Jan	114	125	121	146	122
Feb	93	97	100	75	87
Mar	64	84	80	61	66
Apr	35	34	44	48	44
May	8	24	21	14	12
June	14	6	7	7	9
July	2	12	9	6	7
Aug	8	5	10	13	12
Sep	33	24	27	28	29
Oct	82	62	71	78	86
Nov	104	100	116	129	117
Dec	136	116	118	106	104
Year	693	667	738	711	695

Table 7-3: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Secunda: 26° 30’ S; 29° 11’ E; 1628 m (Weather Bureau, 1998).

	Rainfall (mm)			
Month	Mean (month)	24 h max	Max per month	Min per month
Jan	114	66	168	50
Feb	93	69	142	41
Mar	64	55	121	31
Apr	35	56	119	2
May	8	12	18	0
June	14	41	75	0
July	2	6	13	0
Aug	8	24	24	0
Sep	33	26	107	0
Oct	82	59	146	0
Nov	104	82	241	0
Dec	136	76	200	89
Year	693	82	965	558

TEMPERATURE

The mean annual temperature for Secunda is 15.8°C (**Table 7-4**) with the extreme maximum and minimum temperatures 33.0°C and -4.3°C respectively. The mean daily maximum for January is 27.2°C and for July it is 18.1°C, whereas the mean daily minimum for January is 13.5°C and for July it is 0.9°C.

Table 7-4: Temperature data (°C) for the Secunda region: 26° 30’ S; 29° 11’ E; 1628 m (Weather Bureau, 1998).

	Temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	27.2	25.9	25.2	23.0	20.8	17.3	18.1	21.5	22.3	24.3	23.8	26.0	27.2
*Ext. Max	33.0	32.5	30.0	30.6	25.5	25.3	25.3	27.0	31.0	32.0	31.0	31.5	33.0
Min	13.5	12.9	12.0	9.8	5.9	2.3	0.9	4.1	6.9	10.0	11.1	13.6	0.9
*Ext. Min	10.1	10.5	7.1	4.2	2.0	-2.6	-4.3	-1.5	1.1	4.3	6.3	8.8	-4.3
Mean	20.4	19.3	18.6	16.3	13.4	9.8	9.5	12.8	14.6	17.1	17.5	19.9	15.8

— Max = mean daily maximum temperature for the month
  *Ext. Max = extreme maximum temperature recorded per month
— Min = mean daily minimum temperature for the month
  *Ext. Min = extreme minimum temperature recorded per month
— Mean = mean monthly temperature for each month and for the year

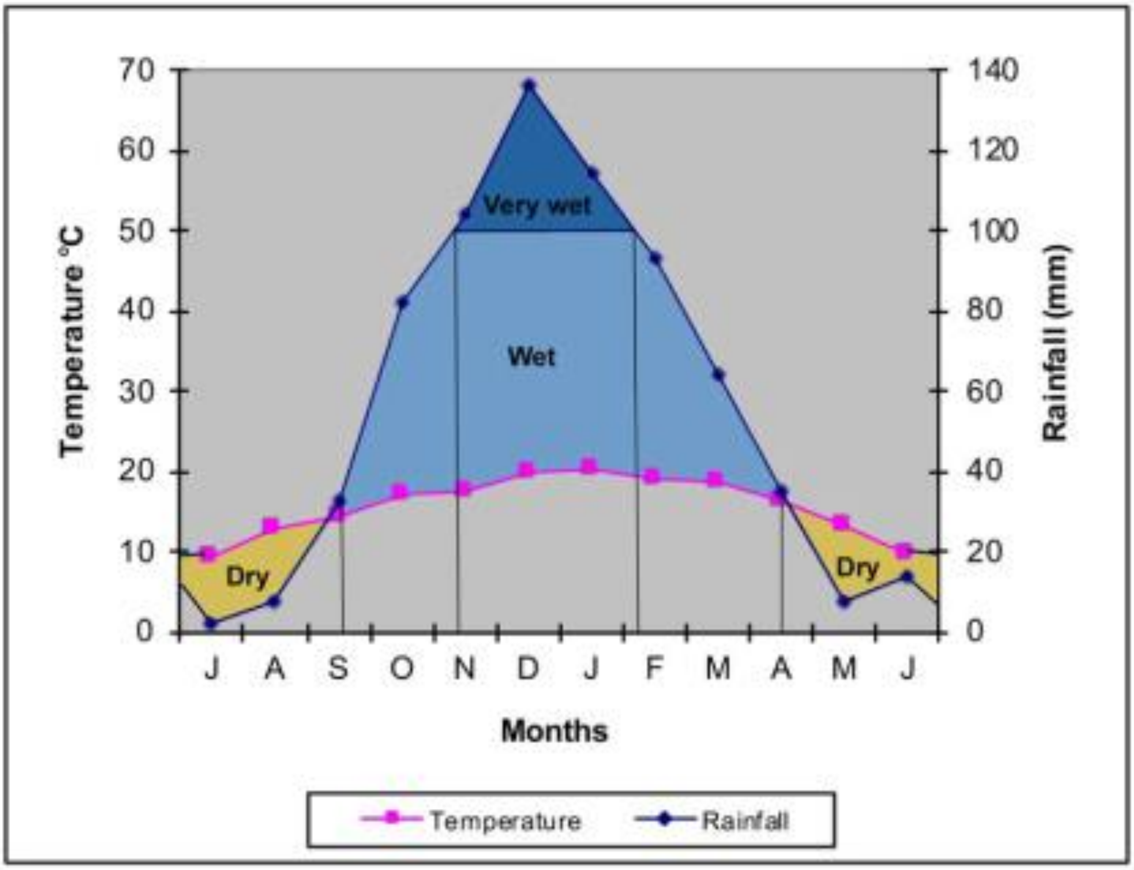


Figure 7-1: Climate diagram for the Secunda region. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve, it indicates a dry period and when the monthly rainfall is higher than 100 mm it indicates a very wet period.

CLOUDINESS AND RELATIVE AIR HUMIDITY

At Bethal weather station, approximately 25 km east of Secunda, cloud cover at 14:00 is the highest from November to January (5.1 – 5.3 eights) and the lowest in June, July and August (1.5 – 1.9eights) (**Table 7-5**). The highest mean relative air humidity (%) at 08:00 occurs during the late summer and autumn months (February to April; 83 – 84%) and the lowest relative air humidity at 14:00 (31%) occurs in early spring (August) (Weather Bureau 1998).

Table 7-5: Cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Bethal: 26° 27' S; 29° 29' E; 1663 m (Weather Bureau, 1998)

	Cloud (0-8)	Relative air humidity %	
	14:00	08:00	14:00
Jan	5.2	80	51
Feb	4.9	83	48
Mar	4.9	83	44
Apr	4.1	84	41
May	2.4	80	34
June	1.6	81	34
July	1.5	79	33
Aug	1.9	75	31
Sept	3.1	74	33
Oct	4.6	75	41
Nov	5.3	77	49
Dec	5.1	77	48
Year	3.7	80	41

7.1.2 BACKGROUND AIR QUALITY

An evaluation of the existing air pollution situation provides an understanding of the potential risk for health impacts. The DFFE has identified District and Metropolitan Municipalities of concern with respect to air quality based on the prevalence of sources of emissions for each source category[10]. The National Framework for Air Quality Management in the Republic of South Africa[11] (hereafter referred to as '*The National Framework*') has rated the Gert Sibande District Municipality, as having "poor" air quality. The District area is thus identified as being in either the upper range of prevalence for one or more emission source categories[12] or middle range in two or more categories relative to other Districts. Municipalities that are classified as having poor air quality require priority attention in terms of air quality management planning.

The development site falls within one of South Africa's key air quality regions known as the Highveld Priority Area (HPA). The HPA is associated with poor air quality and elevated concentrations of criteria pollutants due to the high volume of both industrial and non-industrial emission sources. The HPA was declared on 23 November 2007, covers an area of 31 106km^2 and encompasses multiple municipal jurisdictions including a single metropolitan municipality and nine local municipalities across the Gauteng and Mpumalanga Provinces.

The Air Quality Management Plan (AQMP) for the HPA[13] identifies the Gert Sibande District Municipality as one of the HPA's nine air quality hot spot areas. This classification is based on atmospheric dispersion modelling outputs verified by ambient air quality monitoring data. It is highlighted that the HPA AQMP's assessment is limited to criteria pollutants (specifically, SO_2, NO_2, PM_{10} and O_3) none of which are relevant to the proposed renewable energy complex.

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[10] Source categories include listed activities, domestic fuel burning, vehicle emissions and mining emissions
[11] Department of Environmental Affairs (2018): The 2017 National Framework for Air Quality Management in the Republic of South Africa (No.R.1144 of 2018) Government Gazette, 26 October 2018 (No. 41996).
[12] Emission source categories include listed activities, domestic fuel burning, traffic emissions and mining emissions (The National Framework, pg 50)
[13] DEA (2011): Highveld Priority Area Air Quality Management Plan (URL: https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/HIGHVELD_PRIORITY_AREA_AQMP.pdf)

The air quality within the Mpumalanga Province, especially within the HPA, is the poorest in South Africa. The Highveld region accounts for approximately 90 % of South Africa's scheduled emissions of industrial dust, sulphur dioxide and nitrogen oxides (Wells et al. 1996, as cited in Josipovic et al. 2009).

7.1.3 TOPOGRAPHY

*The following is extracted from the Visual Impact Assessment compiled by SLR Consulting and included as **Appendix H-10**.*

The project area for Mukondeleli WEF is largely located on a slightly elevated plateau where relatively flat to undulating terrain prevails with only gentle slopes in evidence across the site. Turbines will therefore be positioned at relatively higher elevations, resulting in some impact on the skyline. However, topographic variations in the surrounding area are sufficient to limit views of the turbines from some parts of the study area, although across the remainder of the study area there would be little topographic shielding to reduce the visibility of the turbines from many of the locally occurring receptor locations

Slopes across the study area are relatively gentle to low, with steeper slopes being largely associated with the more incised river valleys The main water course in the study area is the Boesmanspruit which occupies a shallow valley to the south-west of the Mukondeleli WEF project area. The topography and slope of the study area are respectively illustrated in **Figure 7-2** and **Figure 7-3** respectively.

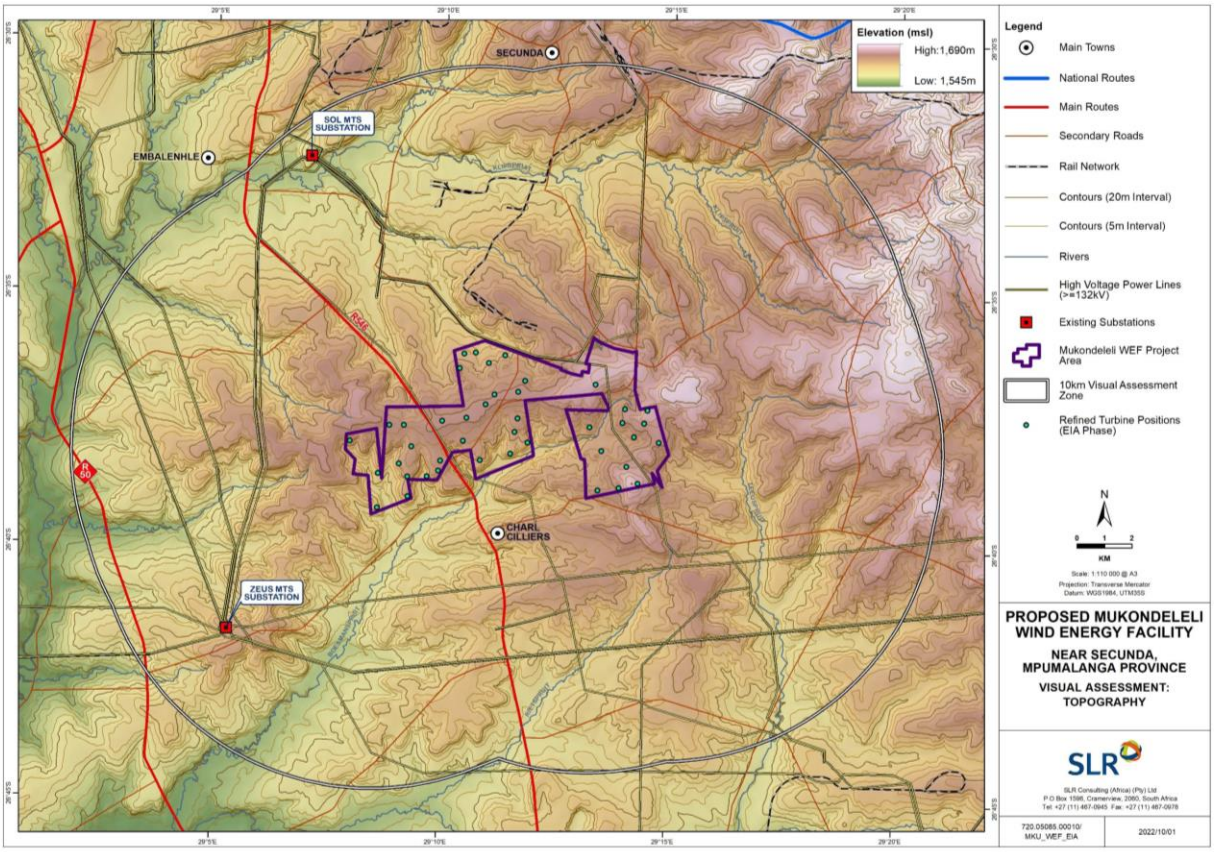


Figure 7-2: Topography at Mukondeleli WEF Site (SLR Consulting, 2022).

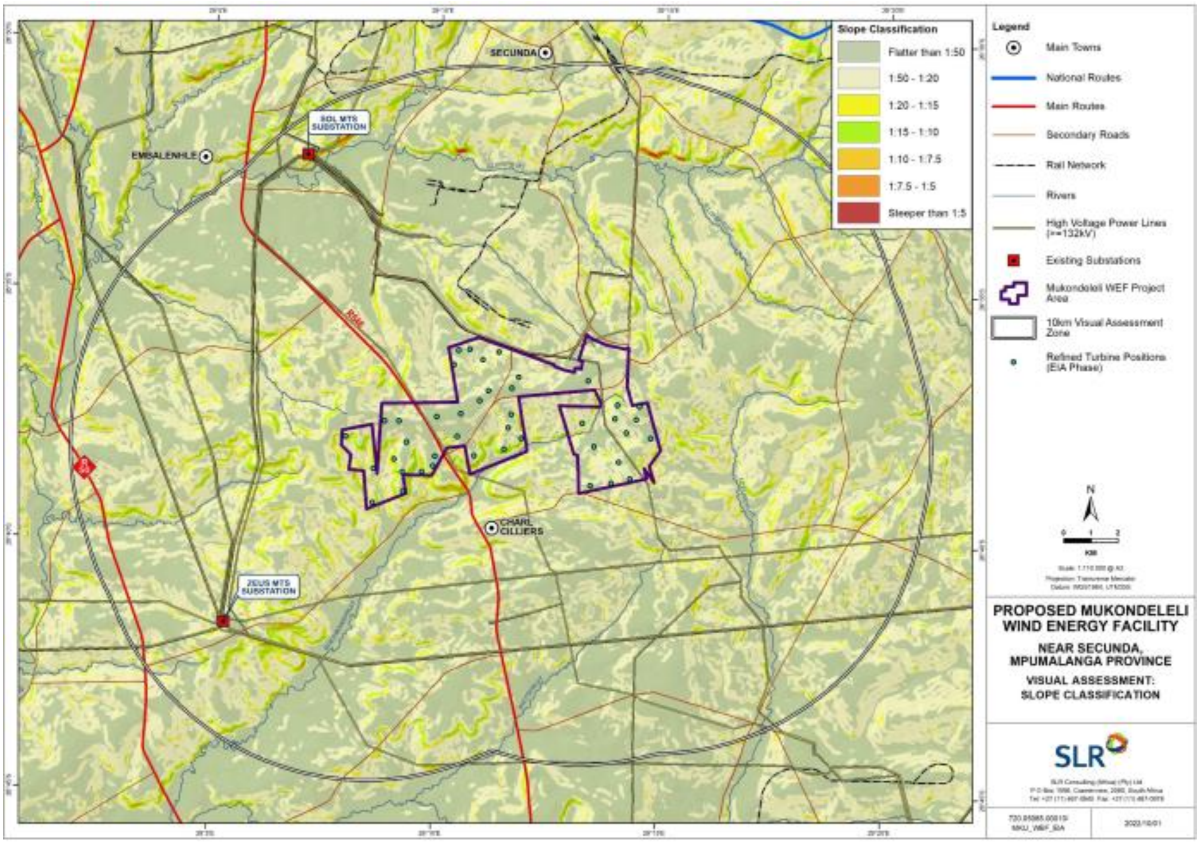


Figure 7-3: Slope classification of Project Area (SLR Consulting, 2022)

7.1.4 GEOLOGY

The following is extracted from the Palaeontological Impact Assessment compiled by Beyond Heritage and included as ***Appendix H-7.***

The project lies in the central part of the main Karoo Basin where large exposures of non-fossiliferous Jurassic dolerite have intruded through the Vryheid Formation. Along the main water courses much younger, Quaternary, sands and alluvium overlie the much older Karoo rocks.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989; Isbell et al., 2012). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the Ecca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In the central and eastern part are the following formations, from base upwards: Pietermaritzburg, **Vryheid** and Volksrust Formations. All of these sediments have varying proportions of sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Overlying the Ecca Group are the rocks of the Beaufort Group that has been divided into two subgroups. As with the older Karoo sediments, the formations vary across the Karoo Basin. Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from this part of the basin. Large exposures of **Jurassic dolerite dykes** occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

An excerpt of the published geological map showing the project areas is presented as **Figure 7-4** and the lithostratigraphy is presented as **Table 7-6**.

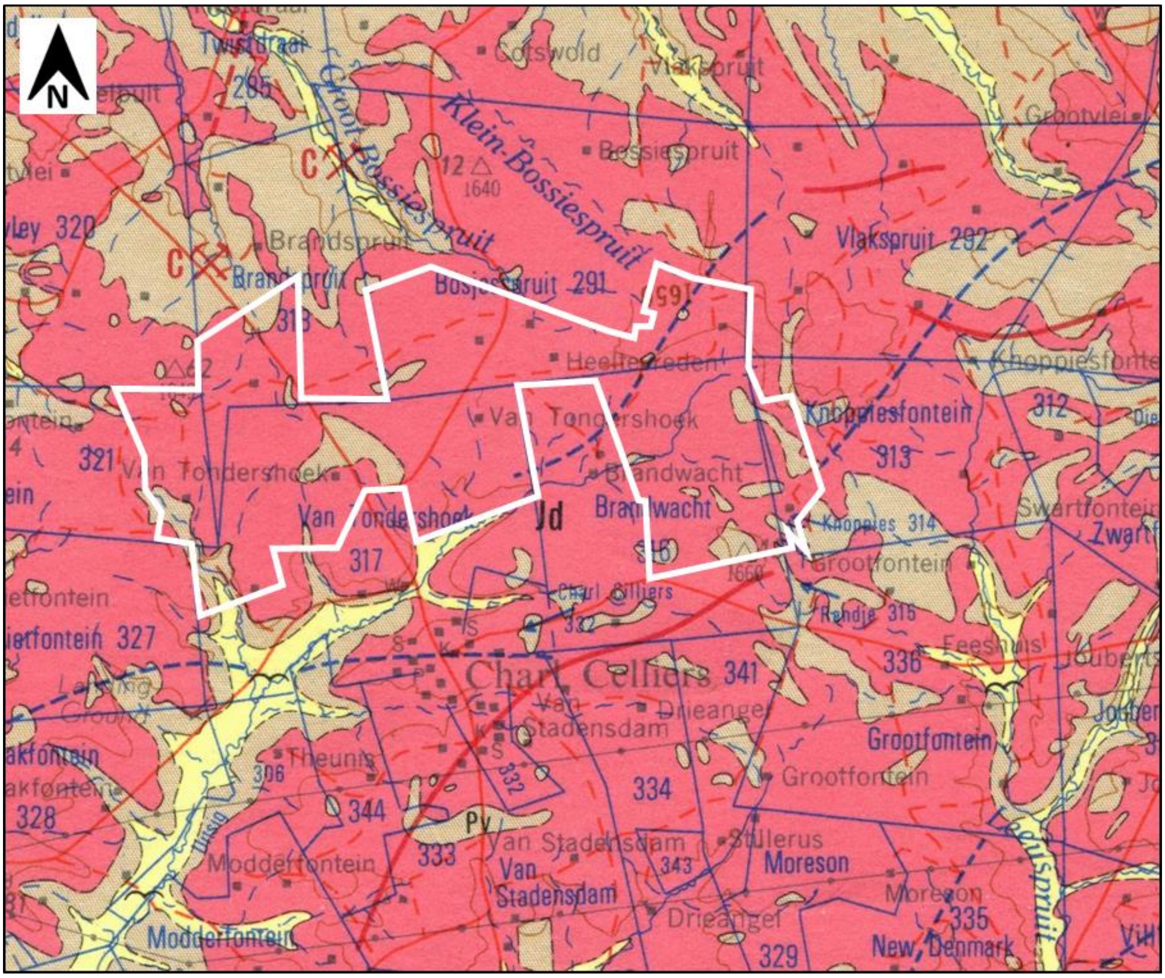


Figure 7-4: Geology Map of the Project Site (Extract from 2628 East Rand Geological Map Sheet)

Table 7-6: Lithostratigraphy of the Area

SYMBOL	GROUP/FORMATION	LITHOLOGY	APPROXIMATE AGE
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 183 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shale, mudstone, coal, sandstone	Middle Permian ca 266 – 260 Ma

ENGINEERING GEOLOGY

*The following is extracted from the Desktop Geotechnical Assessment compiled by WSP Group Afric a(Pty) LTd and included as **Appendix H-13***

Engineering geology relates to the engineering characteristics of the natural earth's material for founding structures and suitability for use as construction materials. The turbine positions are underlain by two different lithologies as listed in **Table 7-7** below.

Table 7-7: Geological Formations Underlying the Turbines

	TURBINES
Dolerite	MK01 to MK08 MK10 to MK17 MK19 MK24 MK26 to MK28 MK30 to MK35 MK27 to MK42
Vryheid Formation	MK09 MK18 MK20 to MK23 MK25 MK29 MK36

ALLUVIUM

Alluvium deposits result from the transportation and deposition of sediment by rivers. The deposits vary in relation to the geology of the catchment area, the site of deposition and the strength of the river. Engineering problems related to alluvial deposits include:

- Sandy materials being potentially collapsible
- Clayey and silty materials being compressible in the long tern
- Clay material being potentially expansive

Alluvium is anticipated in the floodplains located along the powerline route and ponding of surface water is a common problem in such areas.

VRYHEID FORMATION

Shale

Vryheid shale generally weathers to a clayey residual soil which is often compressible and potentially expansive. Expansive soils are those materials that exhibit volume change with a change in moisture content. These materials "shrink" when the moisture content decreases and "heave" or "expand" when the moisture content increases. Where the residual clay profile is thinly developed, it is recommended that the material should be stripped. Where thickly developed, the structural design needs to take cognizance of the potential expansiveness and compressibility of this material.

At the Vhuvhili SEF, the residual shale was profiled as slightly moist, firm to stiff, intact, sandy silty clay with occasional angular gravelly shale rock fragments. The residuum was encountered from a depth of between 0.70m and 0.80m and extended to below the excavation depth of 2.50m.

Shale rock and excavated shale, which presents as a gravel, often deteriorates on exposure. Although shale material can be considered for use in construction, the potential for deterioration needs to be pre-determined in the laboratory. If suitable, the gravel can be used in selected layers in road construction, but seldom as base course. Gravelly shales are occasionally used in the wearing course of gravel roads but not all types are suitable. During construction Karoo shales and siltstones can usually be excavated by ripping, but blasting might occasionally be required.

Slope instability may occur when sliding occurs on bedding planes which are inclined sufficiently. Ingress of water into layers and the resulting high pore-water pressure plays a major role in sliding failures. This is considered highly unlikely as the strata are mostly horizontally disposed.

Sandstone

Vryheid sandstone generally weathers into sandy residual soils. In some cases, the residual sandstone may develop a potentially collapsible grain structure. These collapsible materials exhibit additional settlement upon wetting up without any change in load. This can occur many years after construction and is usually due to an inundation of some kind such as a broken water pipe. If recognised at investigation stage, these collapsible materials can be easily dealt with during construction with some remediation being required.

Sands below the water table are likely to fail during the installation of augered piles and hence the pile system used should be carefully considered.

Residual sandstone does not weather uniformly, leading to dense layers of the horizon being underlain by less competent layers of the same soil.

Slope stability issues can arise in areas where closely intercalated sandstones and mudrock (shale and siltstone) exist. When shales and siltstones slake or disintegrate the exposed sandstone layers are undercut, this can result in rockfalls. Intercalated siltstone layers are relatively impermeable, and impede the flow of water, which leads to pore pressure build up and sliding along the interface. This can only happen if the rock is dipping at an angle, towards the slope face, greater than the friction angle of the material.

Where material is required for the construction of roads and laydown areas, natural sandstone gravel or crushed sandstone bedrock can potentially be a suitable source. Consideration must be given to the presence of excessive pyrite and muscovite which can cause distress where sandstone is used as basecourse. In addition, where chemical stabilization is required the clay matrix of sandstones make them suitable for stabilization with lime. The occurrence, nature, material quality and quantity of sandstone and other potential construction material will have to be assessed during the detailed geotechnical investigation.

Coal Beds

Coal seams are present within the Vryheid Formation with a thickness ranging from centimeters to 10m but are not generally encountered at surface. A number of mines are present in the area.

DOLERITE

Generally, dolerite weathers into a profile becoming coarser with depth eventually grading into dolerite rock. Cobbles and boulders are often present above the rock grading upwards into gravel, sand and finally residual clay. Cobbles and boulders of dolerite, however, are often present throughout the residual profile.

Residual doleritic clay is generally compressible and potentially expansive in the “medium to high” range. Where any structure straddles residual dolerite and a different soil type, the structure should be moved to avoid differential settlement or designed accordingly.

Residual dolerite encountered at relatively shallow depth across the Vhuvhili SEF site was profiled as, slightly moist, medium dense to dense, clayey silty sand with abundant rounded to sub-rounded dolerite gravel, cobbles and boulders. The depth at which residual dolerite was encountered ranged from 0.10m to 0.30m and the horizon extended to a depth of between 0.60m to 2.70m. Refusal was mainly encountered in this horizon due to the presence of dolerite boulders.

Dolerite rock was profiled in some test pits at a depth of between 0.40m to 1.10m. Dolerite rock, cobbles, boulders, gravel and sand are generally durable and are suitable for a variety of purposes. It is commonly quarried and used as a construction material such as for aggregate and road construction

7.1.5 SOILS AND AGRICULTURAL POTENTIAL

The following is extracted from the Agricultural Agro-Ecosystem Specialist Assessment compiled by Beyond Heritage and included as ***Appendix H-1.***

The entire site falls within one land type, the Ea17 land type. The geology is dolerite as well as sandstone, grit and shale of the Vryheid formation of the Ecca group. The soils are predominantly high clay content, dark coloured vertic and melanic soils, underlain by rock in upland positions and clay in bottomland positions. Soil forms are Arcadia, Rensburg, Valsrivier, Swartland, Mayo and Milkwood. The agricultural potential of the soils is limited variously by the very high clay content, shallow depth and drainage limitations.

Because of the favourable climate, grain yields are fairly high but are constrained by the generally shallower soils. Average maize yields are around 5 tons per hectare. The long-term grazing capacity of the farm is fairly high at 5 hectares per large stock unit.

The site is located in a grain farming agricultural region, but the soils vary in their suitability for crop production. Because of the favourable climate and the fairly high grain yields, farmers in the area utilise all suitable soil for grain production. Only soil that is not suitable for grain production is used for cattle and sheep grazing. Limitations that render the soil unsuitable for grain production are depth limitations due to rock or dense clay in the subsoil, and the limited drainage associated with the dense, poorly drained clay layers in the subsoil. The grazing lands are rooigras (*Themeda triandra*) grasslands. Grass fields are burned or mowed from time to time.

Most of the farm portions on which the facility is located, form only a small part of a much bigger farming operations that utilise several different farms

7.1.6 SURFACE WATER

The following is extracted from the Aquatic Biodiversity Assessment compiled by Iggdrasil Scientific Services & Limosella Consulting and included as ***Appendix H-5***

LOCAL AQUATIC FEATURES

A large number of wetlands were recorded on the study site. The wetlands were divided into several types including:

— Seepage wetlands;
— Valley Bottom Wetlands; and
— Depressional Pan wetlands

The wetlands fall into three distinct catchment areas, with wetland 1-8, located in catchment C12E and all draining into Boesmanspruit System. Furthermore, wetland 7 forms the headwaters of the Boesmanspruit System. Wetland 9 and 10 are located in the catchment C11K and drains into the Leeuspruit System. Lastly the remaining wetlands (Wetland 11-19) all drain into the Grootspruit System. Wetland 20 and 21 are also located in catchment C12E but are hydrologically isolated as pan wetlands that drain inward and does not flow into any nearby wetland system (**Figure 7-5)**.

Buffer zones were calculated for the wetlands following Macfarlane et al., (2015):

1. Combination of Seepage and Valley Bottom Wetlands – 61 m
2. Unchannelled Valley Bottom – 35 m
3. Seepage – 35m
4. Combination of Seepage and Valley Bottom Wetlands – 79m
5. Seepage – 35m
6. Seepage – 35m
7. Combination of Seepage and Valley Bottom Wetlands – 79m
8. Valley Bottom – 15m
9. Seepage – 35m
10. Seepage - 35m
11. Seepage – 15 m
12. Combination of Seepage and Valley Bottom Wetlands – 61 m
13. Seepage – 15 m
14. Combination of Seepage and Valley Bottom Wetlands – 61 m
15. Combination of Seepage and Valley Bottom Wetlands – 61 m
16. Seepage – 35m
17. Valley Bottom – 61m
18. Seepage – 15 m

19. Seepage – 15 m
20. Depressional Pan - 15m
21. Depressional Pan - 15m

Figure 7-6 shows the delineated watercourses relative to the study areas together with buffer zones and the 500m DWS regulated area.

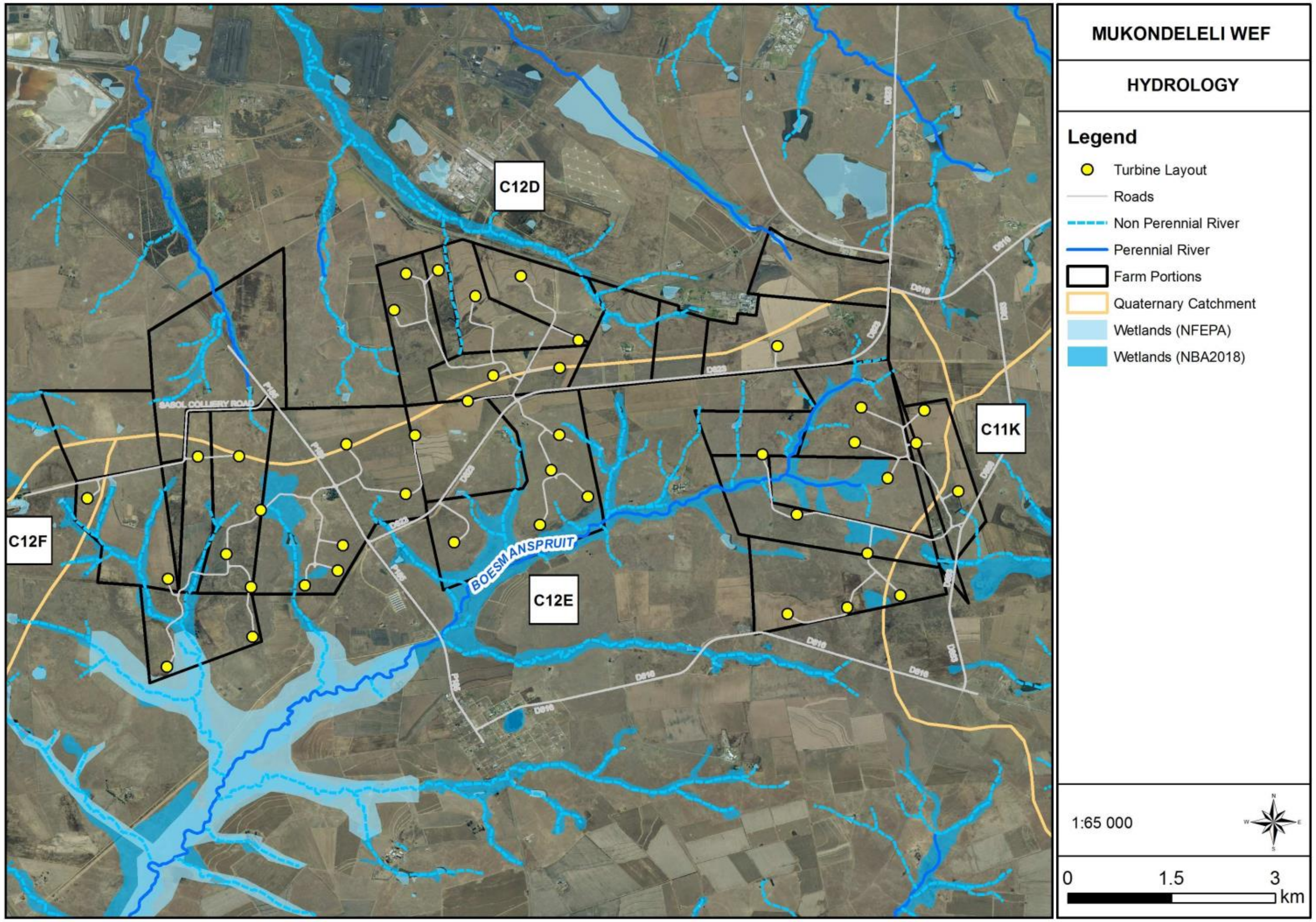


Figure 7-5: Hydrology of the study site and surrounds as per existing spatial layers

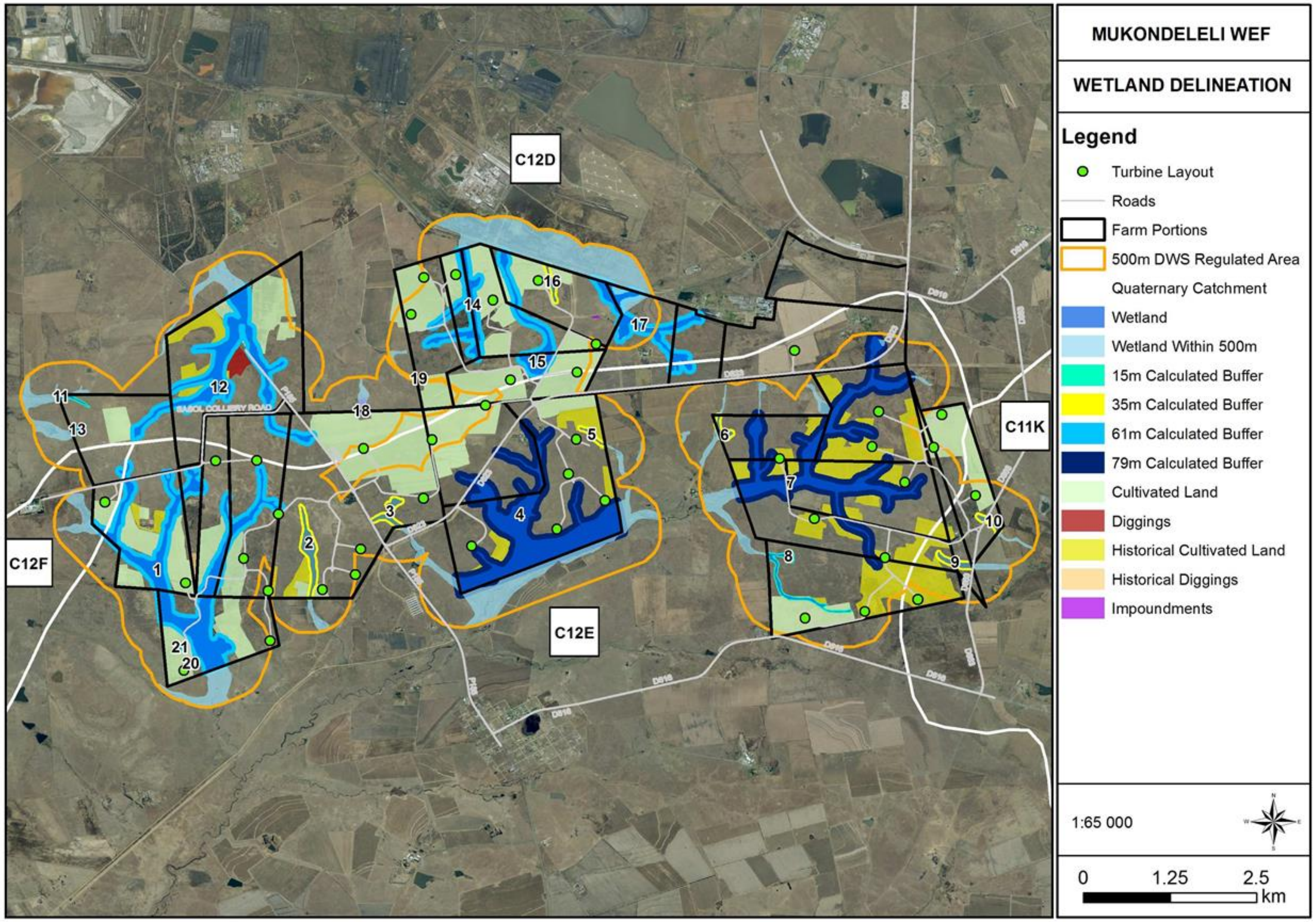


Figure 7-6: Delineated watercourses together with their calculated buffer zones and the 500 m DWS regulated area.

It should be noted that the study occurred during a particularly high rainfall season and the vegetation growth was robust and similar in composition in the wetlands with few exceptions. Due to the high rainfall a few hydrophytic wetland species occurred in areas with poor drainage and prolonged saturation (such as roadsides and small depressions) that would not normally sustain wetland species. The soil of the study areas was characterised by dark clay soils which also may form temporary wet areas during high rainfall events.

Many of the wetlands were fragmented and/or encroached by current and historical agricultural lands. In the case of active agricultural fields where aerial images indicate potential wetness signature, the vegetation and soil was completely transformed and impacted and wetland species were not recorded here, although hydrologically the shallow flow of water in the soil is still a potentially important feature. The wetlands all occur on the same vegetation type known as Soweto Highveld Grassland (Mucina & Rutherford 2006), as well as previously being classified as Moist Clay Highveld Grassland (Low & Rebelo, 1996) and although individual wetlands had some degree of unique vegetation growth, the dominant species were similar in composition. As previously mentioned, the agriculture and grazing, as well as many other recorded impacts affects the plant species composition and increases Alien Invasive Species (AIS) recorded at and near these impacts.

The wetland areas were generally devoid of woody species and where they were recorded dominant species were predominantly AIS such as *Eucalyptus spp., Acacia mearnsii, Populus canescens* and *Salix babylonica.*

The wetlands were characterized by medium species richness with many species recorded with only two potential species of concern recorded*: Crinum bulbispermum, Hypoxis hemerocallidea*. It should also be noted that several plant species of conservation concern including *Kniphofia typhoides, Boophone disticha* and *Eucomis autumnalis.* are known to occur in the area.

The dominant grasses and sedges recorded include: *Aristida congesta, Cynodon dactylon, Cyperus sexangularis, Cyperus congestus, Cyperus esculentus, Cyperus haematocephalus, Cyperus laevigatus, Cyperus longus, var. longus, Cyperus fastigiatus, Harpochloa falx, Imperata cylindrica , Digitaria eriantha, Eragrostis curvula, Eragrostis gummiflua, Eragrostis plana, Eragrostis racemose, Hyparrhenia hirta, Kyllinga erecta Paspalum urvillei, Paspalum dilatatum, Phragmites australis, Schoenoplectus corymbosus, Setaria sphacelata, Sporobolus africanus, Themeda triandra, Typha capensis*.

The dominant forb species recorded include: *Berkheya radula, Berula erecta Crinum bulbispermum, Gladiolus spp, Haplocarpha scaposa, Helichrysum nudifolium, Helichrysum rugulosum, Hypoxis rigidula, Ipomoea crassipes, Monopsis decipiens, Oenothera rosea Oxalis obliquifolia, Persicaria spp, Persicaria lapathifolia Ranunculus multifidus Rumex crispus Vernonia oligocephala*.

Although the wetland areas were dominated by grass and sedges, some AIS were also recorded, especially adjacent to agricultural land and other impacted areas. The dominant AIS recorded include: *Bidens Formosa, Bidens pilosa, Cirsium vulgaris, Conyza bonariensis, Datura stramonium , Senecio inaequidens, Schkuhria pinnata, Solanum spp, Verbena bonariensis, Tagetes minuta, Xanthium strumarium*

FRESHWATER ECOSYSTEMS

In 2014, the Mpumalanga Parks and Tourism Agency developed the MBSP. In essence the MBSP is a map guiding areas of conservation concern for the Mpumalanga Province. The MBSP maps the freshwater ecosystems of Mpumalanga into the following categories:

— CBAs – areas of high biodiversity value, needed to meet biodiversity targets. These areas should be maintained in natural or near natural state;
— ESAs – these areas support CBAs, but are not essential for meeting conservation targets;
— Other Natural Areas – these areas have natural characteristics but have not been earmarked as priority areas for conservation but perform a range of biological as well as ecological functions; and
— Heavily Modified Areas – Areas that have been impacted and have had a significant or complete loss of natural habitat and ecological function.

In terms of the freshwater assessment of the MBSP, the site includes mostly other natural areas and heavily modified areas. The site does contain an ESA and there is a small CBA present to the south of the centre of the site (**Figure 7-7**).

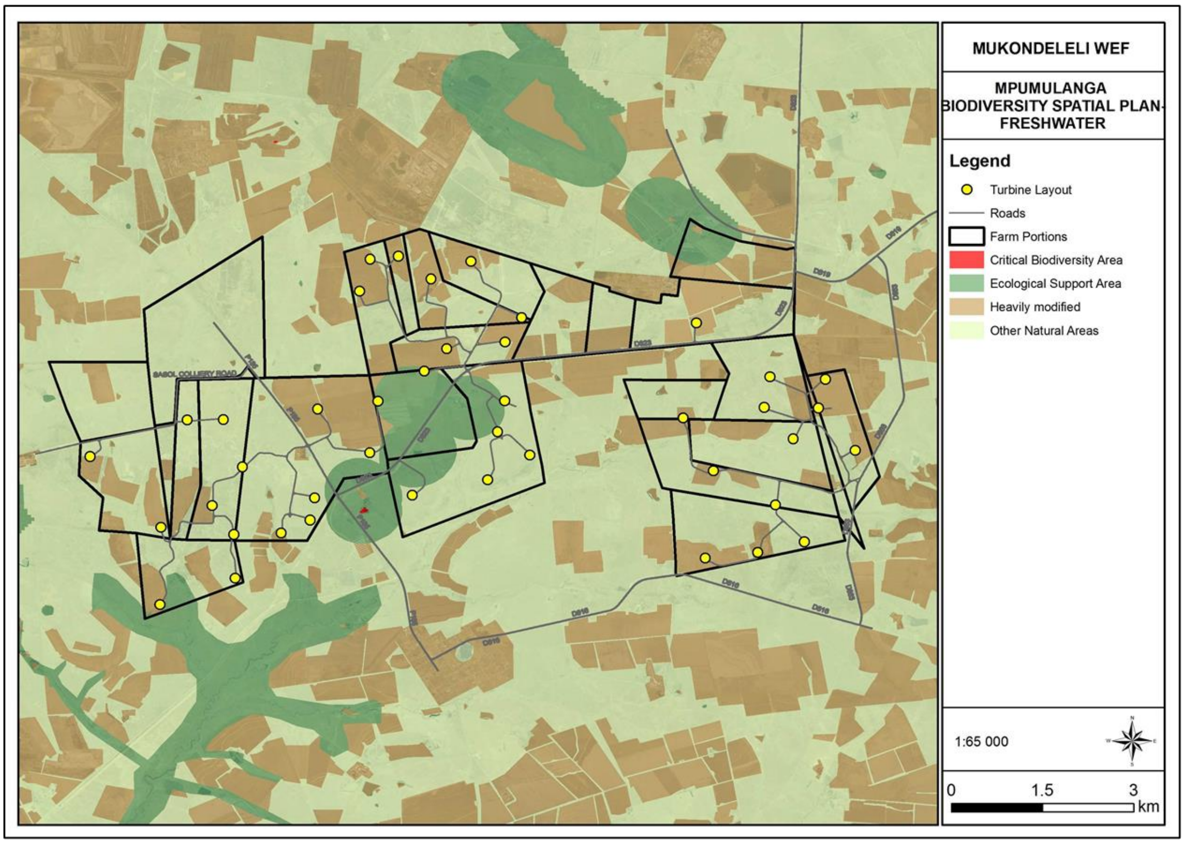


Figure 7-7: The proposed Mukondeleli WEF site in relation to the MBSP aquatic.

PRESENT ECOLOGICAL STATE AND CONSERVATION IMPORTANCE

The Present Ecological State (PES) of a river, watercourse or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The new PES system incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

The PES, EI and ES was determined per Sub Quaternary Reaches (SQR) for Secondary Catchments in South Africa **(Figure 7-8**). The SQRs within close proximity to the site are as follows:

— SQR 1657(PES=E), (EI=Low), (ES=Moderate)
— SQR 1713(PES=D), (EI=Low), (ES=Moderate)
— SQR 1712(PES=C), (EI=High), (ES=High))
— SQR 1709(PES=B), (EI=High), (ES=High)

A PES of a B indicates the reach is largely natural, C indicates the reach is moderately modified, D indicates the reach is largely modified and a PES of E indicates that the reach is seriously modified.

Some of the impacts recorded during the site visit include increased hardened surfaces from roads and service roads, diggings, current and historical farming and grazing, sedimentation, increased water input from artificial channels and slime dams (and other sources from the Sasol Mine), large densities of AIS, numerous furrows and trenches leading to and from the wetland, foreign material input such as sewerage and mine sediment. Some of these impacts relate to reduced water quality such as slime dams and other mining infrastructure.

A summary of the integrity scores for each wetland is listed in **Table 7-8** and illustrated in **Figure 7-9** and **Figure 7-10**.

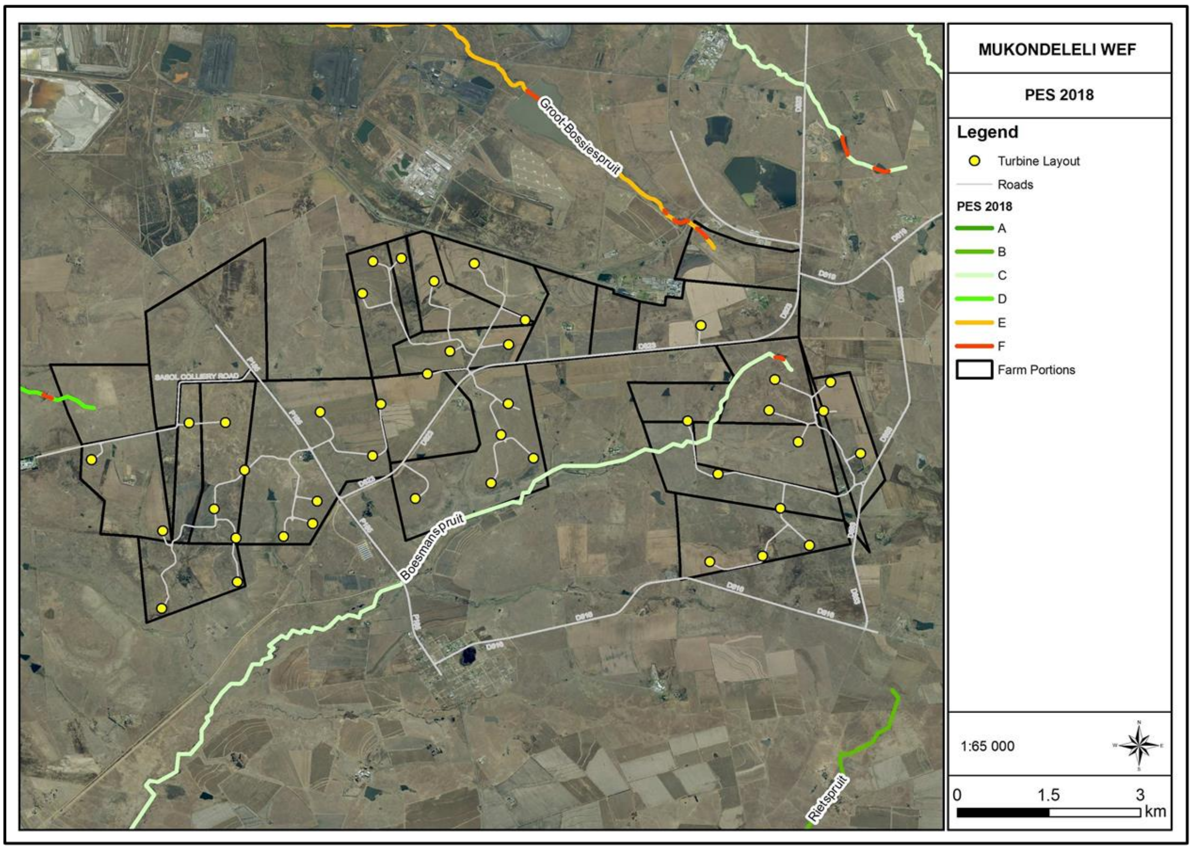


Figure 7-8: Present Ecological state of the rivers and streams surrounding the study site based on the 2018 National Biodiversity Assessment

Table 7-8: Summary of the Integrity Scores for each Wetland

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
1	87	Combination of Seepage and Valley Bottom Wetlands	Drains into Boesmanspruit River. Wetland 7 forms the headwaters of the Boesmanspruit. Wetlands drain south to south east Part of catchmen C12E	61m	D - Largely Modified	*Ecological Importance & Sensitivity* - High *Hydro-Functional Importance* - High *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* –High *Regulating services importance* - High *Provisioning and cultural services importance - Moderate*	Moderate	D – Maintain at D
2	9	Unchannelled Valley Bottom		35m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Moderate *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Moderate *Provisioning and cultural services importance - Moderate*	Moderate	D – Maintain at D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
3	4.33	Seepage		35m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance - Low*	Low	Improve to D
4	102	Combination of Seepage and Valley Bottom Wetlands		79m	C -Moderately Modified	*Ecological Importance & Sensitivity – Very* High *Hydro-Functional Importance* - High *Direct Human Benefits* - High	*Biodiversity maintenance importance* –High *Regulating services importance* - High *Provisioning and cultural services importance - Moderate*	High	Maintain at C

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL*., 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL*., 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL*., 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL*., (2013)
5	1.1	Seepage		35m	C -Moderately Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance - Low*	Low	Maintain at C
6	2.2	Seepage		35m	C -Moderately Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance - Low*	Low	Maintain at C

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
7	66	Seepage and Valley Bottom Wetlands		79m	C -Moderately Modified	*Ecological Importance & Sensitivity – Very* High *Hydro-Functional Importance* - High *Direct Human Benefits* - High	*Biodiversity maintenance importance* –High *Regulating services importance* - High *Provisioning and cultural services importance* - *Moderate*	High	Maintain at C
8	6.25	Valley Bottom		15m	D - Largely Modified	*Ecological Importance & Sensitivity* - Moderate *Hydro-Functional Importance* - Moderate *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Moderate *Provisioning and cultural services importance* - *Low*	Low	Maintain at D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
9	3.0	Seepage	Leeuspruit System. Wetlands drain west. Part of catchment C11K	35m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Maintain at D
10	2.13	Seepage		35m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Improve to D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
11	0.96	Seepage	Grootbessiesprui t System. Wetlands drain North. Part of catchmen C12D	15m	C -Moderately Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance - Low*	Low	Maintain at C
12	49.3	Combination of Seepage and Valley Bottom Wetlands		61m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Moderate *Hydro-Functional Importance* - Moderate *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* – Moderate *Regulating services importance* - Moderate *Provisioning and cultural services importance* - *Moderate*	Moderate	Improve to D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
13	0.81	Seepage		15m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Maintain at D
14	18.3	Combination of Seepage and Valley Bottom Wetlands		61m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Moderate*	Low	Maintain at D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
15	16.8	Combination of Seepage and Valley Bottom Wetlands		61m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Moderate*	Low	Maintain at D
16	1.9	Seepage		35m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Moderate*	Low	Maintain at D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
17	4.13	Valley Bottom		61m	D - Largely Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Moderate	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Moderate*	Low	Maintain at D
18	0.1	Seepage		15m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Improve to D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
19	0.19	Seepage		15m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Improve to D
20	0.16	Depressional Pan	None	15m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance* - *Low*	Low	Improve to D

#	SIZE (HA) EXCLUDING BUFFER	WETLAND TYPE AND DRAINAGE	WETLAND SYSTEM	CALCULATED BUFFER ZONE	WETHEALTH V2 (EC/PES) (MACFARLANE *ET AL.*, 2020)	ECOLOGICAL IMPORTANCE (EI) (ROUNTREE & KOTZE., 2013 AND DWAF, 1999)	WETECOSYSTEM SERVICES V2 (ES) (KOTZE *ET AL.*, 2020)	ENVIRONMENTAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS) (KOTZE *ET AL.*, 2020)	RECOMMENDED ECOLOGICAL CATEGORY (REC) ROUNTREE *ET AL.*, (2013)
21		Depressional Pan		15m	E - Seriously Modified	*Ecological Importance & Sensitivity* - Low *Hydro-Functional Importance* - Low *Direct Human Benefits* - Low	*Biodiversity maintenance importance* –Low *Regulating services importance* - Low *Provisioning and cultural services importance - Low*	Low	Improve to D

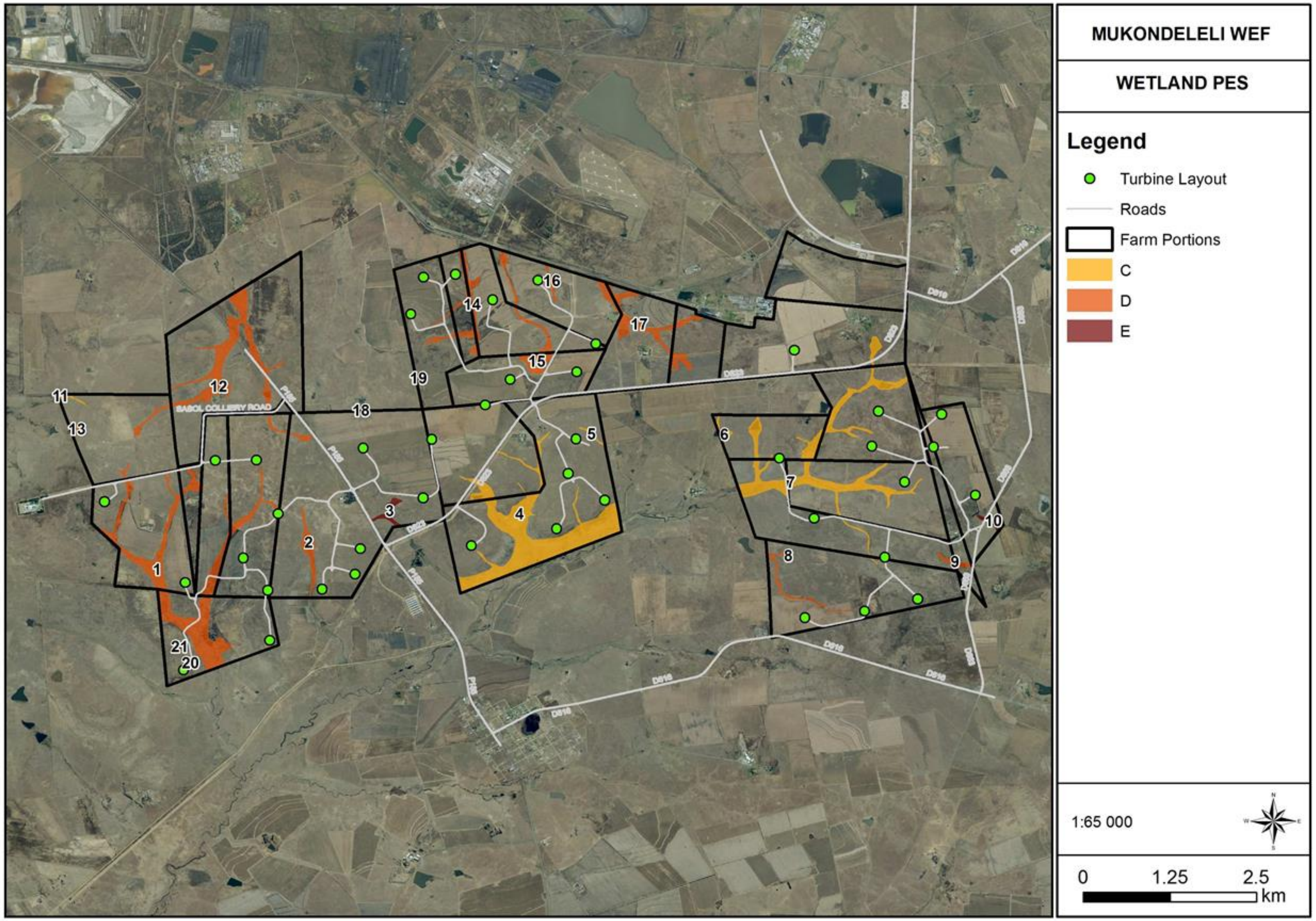


Figure 7-9: Present ecological state of each wetland unit in the proposed Mukondeleli WEF study area (Macfarlane et al., 2020)

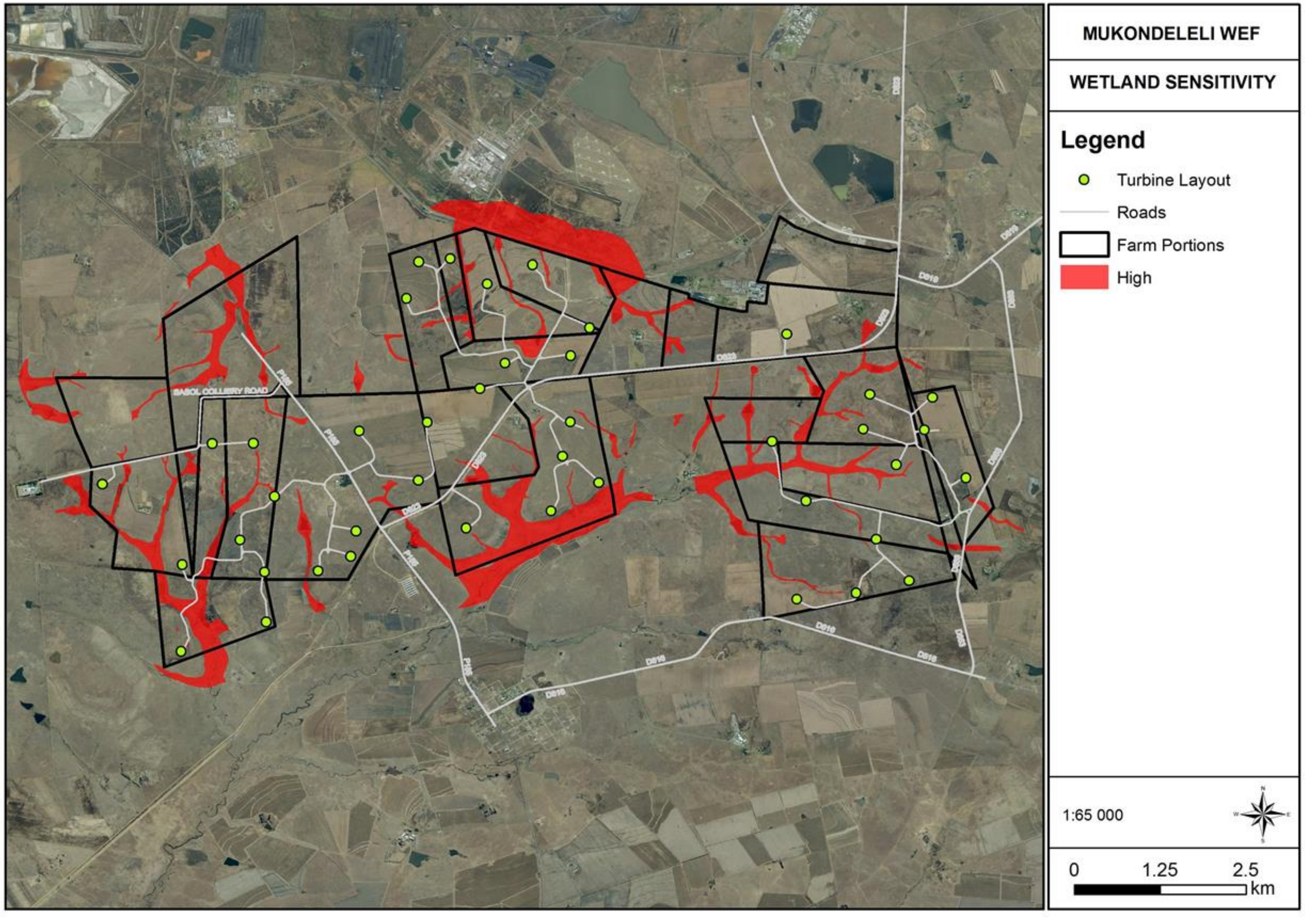


Figure 7-10: Environmental Importance and Sensitivity category (EIS) of the proposed Mukondeleli WEF study area (Kotze et al., 2020)

7.2 BIOLOGICAL ENVIRONMENT

*The following is extracted from the Terrestrial Biodiversity and Species Assessment compiled by Ekotrust cc and included as **Appendix H-4**.*

7.2.1 VEGETATION

The Mukondeleli site is located within the Soweto Highveld Grassland (Gm8) vegetation type (SANBI, 2006-2018) (**Figure 7-11**). This vegetation type covers 14 513 km^2 of Mpumalanga and Gauteng (and to a very small extent also in the neighbouring Free State and North-West provinces) and occurs at an altitude ranging from 1 420m to 1 760m above sea level (Mucina & Rutherford, 2006).

The landscape is gently to moderately undulating on the Highveld plateau, supporting dense tufted grassland dominated by Themeda triandra. Other common grass species include Elionurus muticus, Eragrostis racemosa, Heteropogon contortus and Tristachya leucothrix. In undisturbed places, scattered wetlands, narrow stream alluvia, pans and occasional ridges interrupt the grassland cover. Frost and frequent grass fires during winter play an important role in limiting the occurrence of trees and shrubs in the region.

The most prominent grass species include *Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis capensis, Eragrostis chloromelas, Eragrostis curvula, Eragrostis plana, Heteropogon contortus, Setaria sphacelata, Themeda triandra and Tristachya leucothrix. The forb layer is characterised by Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Haplocarpha scaposa, Helichrysum nudifolium, Helichrysum rugulosum, Justicia anagalloides, Selago densiflora, Senecio coronatus, Hilliardiella elaeagnoides and Wahlenbergia undulata.*

Although the conservation status of this vegetation type was listed as “Endangered” by Mucina & Rutherford (2006) it is listed as “Vulnerable” by NEMA (2011) and the National Biodiversity Assessment (Skowno et al. 2018). Very few statutorily conserved areas occur in this vegetation type and almost half of it has been transformed, mostly by cultivation, plantations, mining and urbanisation.

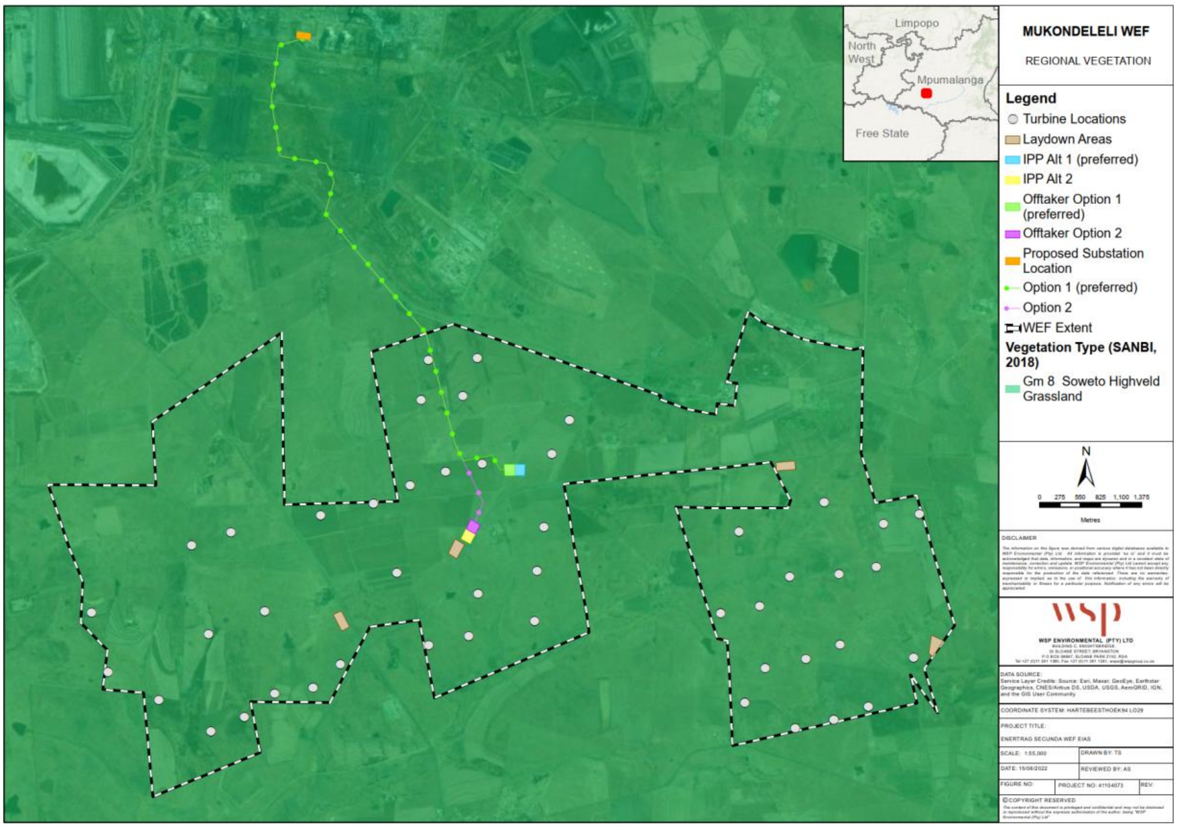


Figure 7-11: Regional Vegetation.

CONSERVATION STATUS OF THE VEGETATION TYPE

On the basis of a scientific approach used at national level by SANBI (Driver *et al*., 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie, 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in **Figure 7-12**, as determined by best available scientific approaches (Driver *et al*., 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al*., 2005).

According to scientific literature (Driver *et al*., 2005; Mucina *et al*., 2006) this vegetation type was listed as "Endangered". Very few statutorily conserved areas occur in this vegetation type and almost half of it has been transformed, mostly by cultivation, plantations, mining and urbanisation

Determining ecosystem status (Driver *et al*., 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

Figure 7-12: Ecosystem Status (Driver et al. 2005)

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the NEM:BA, lists national vegetation types, and other ecosystems defined in the Act, that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. The Soweto Highveld Grassland is listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).

7.2.2 HABITATS

During the field survey, 34 sampling sites were surveyed at the proposed Mukondeleli WEF. However, a further 46 sample plots were surveyed on the Vhuvhili and Impumelelo sites in the nearby region and the total of 80 sample plots were used to improve the identification and description of habitat types in the area. Based on species composition, six habitats (plant communities) were distinguished, described and mapped on the Mukondeleli site (**Figure 7-13**). A further four units were also distinguished, i.e. croplands, infrastructure, disturbed areas and dams.

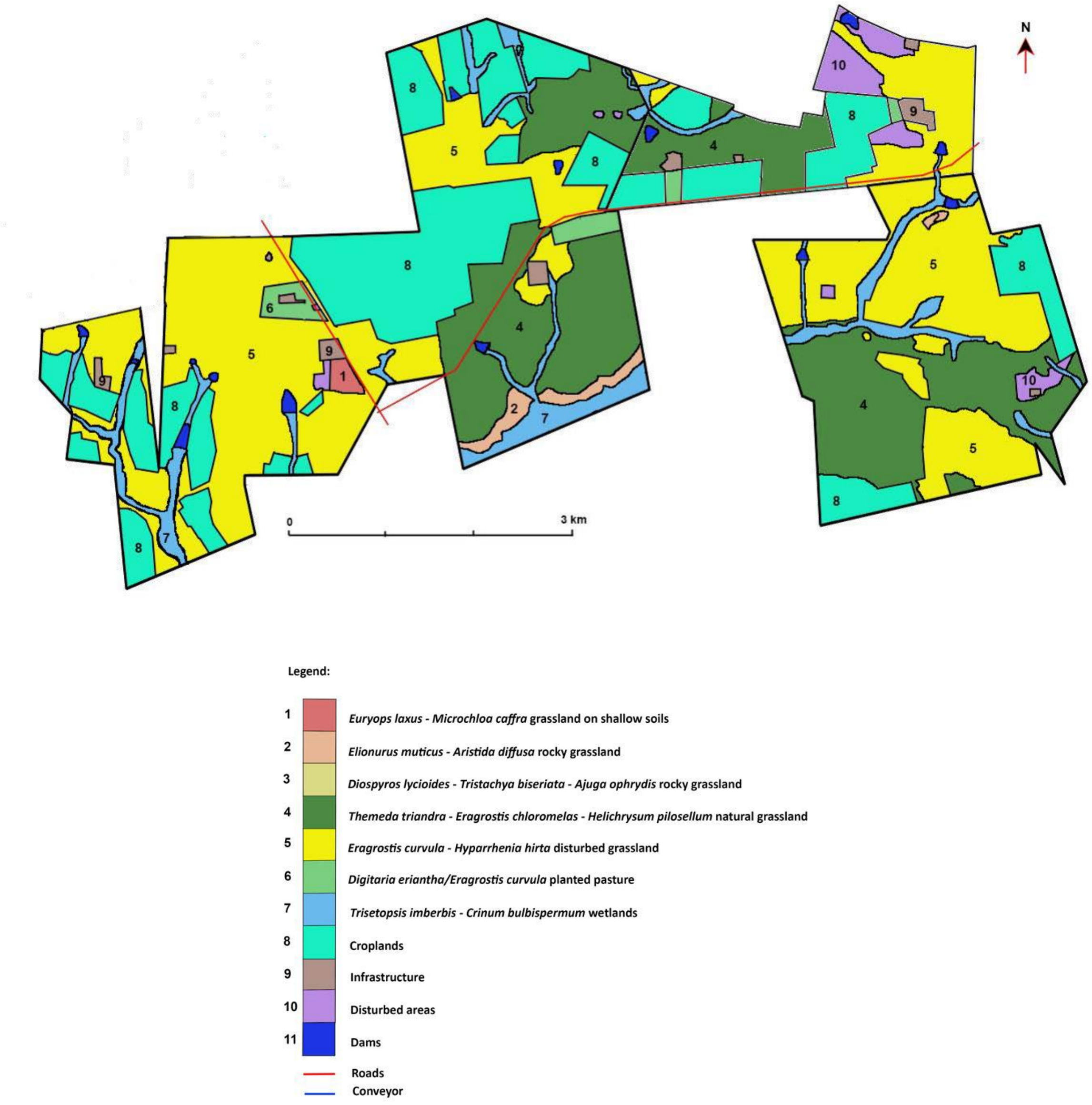


Figure 7-13: Vegetation map of the Mukondeleli site.

List of plant communities and other units identified in the region:

- 1. Euryops laxus - Microchloa caffra grassland on shallow soils
- 2. Elionurus muticus - Aristida diffusa rocky grassland
- 3. Diospyros lycioides - Tristachya biseriata - Ajuga ophrydis rocky grassland (not on Mukondeleli)
- 4. Themeda triandra - Eragrostis chloromelas - Helichrysum pilosellum natural grassland
- 5. Eragrostis curvula - Hyparrhenia hirta disturbed grassland
- 6. Digitaria eriantha/Eragrostis curvula planted pasture
- 7. Trisetopsis imberbis - Crinum bulbispermum wetlands
- 7a. Trisetopsis imberbis - Leersia hexandra wetlands
- 7b. Andropogon appendiculatus - Cyperus longus wetlands
- 7c. Typha capensis - Phragmites australis wetlands
- 8. Cropland
- 9. Infrastructure

HABITAT 1. *EURYOPS LAXUS - MICROCHLOA CAFFRA* GRASSLAND ON SHALLOW SOILS

This rocky grassland occurs in a small patch on the plains in the western parts of the Mukondeleli site (**Figure 7-13** & **Figure 7-14**). It occurs on shallow soils on rocky sheets. Surface rocks and gravel cover less than 10% of the area. The shallow, dark-brown, clayey soils are derived from dolerite.

Figure 7-14: Community 1 – *Euryops laxus - Microchloa caffra* grassland on shallow soils.

The diagnostic species of this habitat (community) include *Euryops laxus, Microchloa caffra, Dipcadi ciliare, Panicum repens, Jamesbrittenia stricta, Colchicum striatum, Huernia hystrix* and *Oropetium capense.*

- The grass layer is well-developed and covers approximately 78% of the area. The dominant grass species include Eragrostis plana, Eragrostis chloromelas, Themeda triandra and Eragrostis curvula. Other grass species include Microchloa caffra, Panicum repens, Tragus berteronianus, Oropetium capense, Aristida diffusa and Setaria incrassata.
- Herbaceous species have a mean canopy cover of approximately 15%. The most common species include Euryops laxus, Jamesbrittenia stricta, Hermannia cf. coccocarpa, Tulbaghia acutiloba, Geigeria burkei, Monsonia angustifolia, Hibiscus trionum and the sedges Cyperus rupestris, Cyperus semitrifidus and Cyperus capensis.
- The prominent succulent species include Euphorbia clavarioides, Huernia hystrix and Crassula cf. setulosa.
- The most common geophytes include Dipcadi ciliare, Colchicum striatum, Gladiolus robertsoniae and Ledebouria cf. minima.
- The following alien invasive plant species was recorded in this community: Solanum elaeagnifolium.

Threatened (red listed) and/or protected species recorded in plant community 1:

- IUCN list: *Gladiolus robertsoniae**
- NEM:BA (ToPS): None
- MNCA: *Gladiolus robertsoniae*, Crinum bulbispermum*, Huernia hystrix**
- CITES: *Euphorbia clavarioides**
- Endemic species: None
- NFA: None

*In community 1, but not recorded on Mukondeleli

HABITAT 2. ELIONURUS MUTICUS - ARISTIDA DIFFUSA ROCKY GRASSLAND

This rocky grassland covers a small area in the south of the western section of the Mukondeleli site (**Figure 7-13** & **Figure 7-15).** Surface rocks and gravel cover up to 30% of the area. The shallow to intermediate deep, dark-brown, clayey soils are derived from dolerite.

Figure 7-15: Community 2 – *Elionurus muticus - Aristida diffusa* rocky grassland

The diagnostic species of this habitat (community) include *Melinis repens* and *Kohautia*.

— Shrubs cover on average 1% of the area and the most prominent species are *Diospyros lycioides* and *Searsia rigida*.
— Dwarf shrubs cover less than 1% of the habitat and include *Erythrina zeyheri* and *Felicia muricata*.
— The grass layer is well developed and covers approximately 93% of the area. The dominant grass species *include Elionurus muticus, Eragrostis chloromelas, Themeda triandra and Aristida diffusa*. Other common grass species include *Eragrostis racemosa, Eragrostis capensis, Eragrostis curvula, Brachiaria serrata, Melinis repens* and *Cymbopogon pospischilii*.
— Herbaceous species have a mean canopy cover of approximately 6%. The most common species include *Dianthus mooiensis, Hermannia depressa, Hilliardiella elaeagnoides, Berkheya radula, Berkheya setifera, Helichrysum rugulosum, Haplocarpha scaposa* and *Conyza podocephala*.
— The prominent succulent species include *Euphorbia clavarioides* and *Aloe transvaalensis*.
— The most common geophytes include *Hypoxis rigidula, Boophone disticha* and *Dipcadi viride.*
— The following alien invasive plant species was recorded in this community: *Solanum elaeagnifolium*.

Threatened (red listed) and/or protected species recorded in plant community 2:

— IUCN list: None
— NEM:BA (ToPS): None
— NFA: None
— MNCA: *Aloe transvaalensis**, *Boophone disticha**
— CITES: *Euphorbia clavarioides, Aloe transvaalensis**
— Endemic species: None

*In community 2, but not recorded on Mukondeleli

HABITAT 3. DIOSPYROS LYCIOIDES - TRISTACHYA BISERIATA - AJUGA OPHRYDIS ROCKY GRASSLAND

This rocky grassland does not occur on the Mukondeleli site.

HABITAT 4. THEMEDA TRIANDRA - ERAGROSTIS CHLOROMELAS - HELICHRYSUM PILOSELLUM NATURAL GRASSLAND

This natural grassland occurs on the plains and gentle footslopes and covers large areas of the Mukondeleli site (**Figure 7-13** & **Figure 7-16**). Surface rocks and gravel are absent and the deep, dark-brown, clayey soils are derived from dolerite.

Figure 7-16: Community 4 – *Themeda triandra - Eragrostis chloromelas - Helichrysum pilosellum* natural grassland.

There is no diagnostic species group that differentiates this community. However, the presence of species groups 6, 7 & 8 and the absence of species groups 1 – 5 differentiate this community:

- The grass layer is well developed and covers approximately 88% of the area. The dominant grass species include *Themeda triandra, Eragrostis chloromelas, Setaria incrassata, Elionurus muticus* and *Brachiaria serrata.* Other common grass species include *Eragrostis curvula, Eragrostis planiculmis, Hyparrhenia hirta, Setaria nigrirostris, Eragrostis plana, Lolium perenne* and *Cynodon dactylon.*
- Herbaceous species have a mean canopy cover of approximately 8%. The most common species include *Helichrysum pilosellum, Gazania krebsiana, Scabiosa columbaria, Indigofera hedyantha, Berkheya radula, Berkheya setifera, Helichrysum rugulosum, Ipomoea crassipes, Asclepias stellifera, Jamesbrittenia aurantiaca, Oenothera rosea, Oenothera tetraptera, Senecio inaequidens, Conyza podocephala, Senecio erubescens, Hermannia erodioides, Pseudognaphalium luteo-album* and *Convolvulus saggitatus.*
- The succulent species recorded were *Aloe transvaalensis* and *Euphorbia clavarioides.*
- The most common geophytes include *Hypoxis rigidula, Hypoxis acuminata, Hypoxis hemerocallidea, Pelargonium minimum* and *Ledebouria* cf. *revoluta.*
- Sedges include *Bulbostylis humilis, Cyperus esculentus, Kyllinga erecta* and *Abildgaardia ovata.*
- The following alien invasive plant species were recorded in this community: Cirsium vulgare, Verbena bonariensis, Verbena brasiliensis, *Solanum elaeagnifolium, Cuscuta campestris* and *Datura ferox.*

Threatened (red listed) and/or protected species recorded in plant community 4:

- IUCN list: None
- NEM:BA (ToPS): None
- NFA: None
- MNCA: *Aloe ecklonis, Aloe transvaalensis, Gladiolus crassifolius, Gladiolus dalenii, Boophone disticha**
- Mpumalanga Rare species list: *Hypoxis hemerocallidea**
- CITES: *Euphorbia clavarioides*, Aloe transvaalensis, Aloe ecklonis*
- Endemic species: None

*In community 4, but not recorded on Mukondeleli

HABITAT 5. ERAGROSTIS CURVULA - HYPARRHENIA HIRTA DISTURBED GRASSLAND

This mixture of degraded natural grassland and old abandoned croplands covers large areas of the Mukondeleli site. It is found on the plains and gentle footslopes of the undulating countryside **(Figure 7-13** & **Figure 7-17**). Surface rocks and gravel are absent and the deep, dark-brown to black, clayey soils are derived from dolerite.

Figure 7-17: Community 5 – *Eragrostis curvula - Hyparrhenia hirta* disturbed grassland.

There is no diagnostic species group that differentiates this community. However, the presence of species groups 9, 10 & 11 and the absence of species groups 1 – 8 differentiate this community from the others.

- Dwarf shrubs cover less than 1% of the habitat and include *Seriphium plumosum*.
- The grass layer is well developed and covers approximately 83% of the area. The dominant grass speciesBinclude *Eragrostis curvula, Hyparrhenia hirta, Themeda triandra, Setaria incrassata, Eragrostis plana, Eragrostis chloromelas* and *Paspalum dilatatum*. Other common grass species include *Setaria nigrirostris, Setaria sphacelata, Cynodon dactylon, Hyparrhenia tamba, Elionurus muticus,Brachiaria serrata, Aristida bipartita* and *Eragrostis planiculmis.*
- Herbaceous species have a mean canopy cover of approximately 14%. The most common species are *Senecio erubescens, Oenothera tetraptera, Hermannia erodioides, Solanum elaeagnifolium, Pseudognaphalium luteo-album, Schkuhria pinnata, Ranunculus multifidus, Senecio inaequidens, Oenothera rosea,*

Asclepias stellifera, Asclepias cf. gibba, Berkheya setifera, Berkheya radula, Helichrysum rugulosum, Helichrysum aureo-nitens, Leobordea divaricata and Scabiosa columbaria.

— The only succulent species recorded in Habitat 5 was *Aloe transvaalensis.*
— Geophytes include *Gladiolus crassifolius, Cyrtanthus stenanthus, Hypoxis rigidula, Hypoxis argentea, Ledebouria* cf. *revoluta, Haemanthus humilis, Pelargonium luridum* and *Boophone disticha.*
— Sedges include *Abildgaardia ovata, Kyllinga erecta* and *Cyperus esculentus*.
— The following alien invasive plant species were recorded in this community: Cirsium vulgare, Verbena bonariensis, Verbena brasiliensis, Solanum elaeagnifolium and Cuscuta campestris.

Threatened (red listed) and/or protected species recorded in plant community 5:

— IUCN list: None
— NEM:BA (ToPS) None
— NFA: None
— MNCA: Aloe transvaalensis, Crinum bulbispermum*, Cyrtanthus stenanthus, Gladiolus crassifolius
— Mpumalanga Rare species list: Hypoxis hemerocallidea*
— CITES: Euphorbia clavarioides*, Aloe transvaalensis,
— Endemic species: None

*In community 5, but not recorded on Mukondeleli

HABITAT 6. DIGITARIA ERIANTHA/ERAGROSTIS CURVULA PLANTED PASTURE

This planted pasture is found on the plains at two small sites in the western part of the Mukondeleli site consisting mostly of *Eragrostis curvula* pasture (**Figure 7-13** & **Figure 7-18**). Surface rocks and gravel are absent and the deep, dark-brown, clayey soils are derived from dolerite.

Figure 7-18: Community 6 – *Eragrostis curvula* planted pasture

There is no diagnostic species group that differentiates this community. However, the presence of species groups 11 and the absence of species groups 1 – 10 differentiate this community

- The grass layer is dominated by either *Digitaria eriantha* or *Eragrostis curvula* and covers more than 90% of the community. Other grass species include *Eragrostis chloromelas, Hyparrhenia hirta, Setariasphacelata* and *Paspalum dilatatum*.
- Herbaceous species have a mean canopy cover of approximately 3%. The most common species include *Senecio erubescens, Pseudognaphalium luteo-album, Hibiscus trionum, Cosmos bipinnatus* and *Nasturtium officinale.*
- The following alien invasive plant species were recorded in this community: *Solanum elaeagnifolium* and *Cuscuta campestris*

Threatened (red listed) and/or protected species recorded in plant community 6:

- IUCN list: None
- NEM:BA (ToPS): None
- NFA: None
- MNCA: None
- CITES: None
- Endemic species: None

HABITAT 7. TRISETOPSIS IMBERBIS - CRINUM BULBISPERMUM WETLANDS

These streams, wetlands, vleis and floodplains are associated mostly with the Boesmanspruit, Groot-Bossiespruit and the Watervalrivier and their tributaries and occur across most of the Mukondeleli site (**Figure 7-13** & **Figure 7-19**). Surface rocks are occasionally present. The alluvial soils are mostly deep, dark brown to black, clayey soils.

Figure 7-19: Community 7 – *Trisetopsis imberbis - Crinum bulbispermum* wetlands.

The diagnostic species of this habitat (community) include *Ischaemum fasciculatum, Andropogon appendiculatus, Fingerhuthia sesleriiformis* and *Galium capense*

- The grass layer is well developed and covers approximately 90% of the area. The dominant grass species include *Trisetopsis imberbis, Leersia hexandra, Paspalum dilatatum, Setaria nigrirostris, Ischaemum fasciculatum and Andropogon appendiculatus. Other grass species include Eragrostis plana, Fingerhuthia sesleriiformis, Bromus catharticus, Themeda triandra, Eragrostis curvula, Harpechloa falx and Pennisetum clandestinum.*
- Herbaceous species have a mean canopy cover of approximately 10%. The most common species are *Galium capense, Plantago lanceolata, Oenothera rosea, Oenothera tetraptera, Berkheya radula, Haplocarpha scaposa, Ranunculus multifidus, Gomphocarpus fruticosus, Cosmos bipinnatus* and *Lepidium africanum.*
- Common geophytes include *Crinum bulbispermum, Ledebouria cf. revoluta* and *Hypoxis argentea*.
- Sedges include, amongst others, *Cyperus longus, Cyperus esculentus* and *Schoenoplectus cf. muricinux*.
- The following alien invasive plant species were recorded in this community: *Cirsium vulgare, Verbena bonariensis, Verbena brasiliensis, Solanum elaeagnifoliu* and *Datura ferox*.

Threatened (red listed) and/or protected species recorded in plant community 7:

- IUCN list: None
- NEM:BA (ToPS): None
- NFA: None
- MNCA: Boophone disticha*, Crinum bulbispermum, Haemanthus humilis
- CITES: None
- Endemic species: None

*In community 7, but not recorded on Mukondeleli

Three subcommunities are distinguished on the Mukondeleli site :

- **7a. *Trisetopsis imberbis - Leersia hexandra* wetlands**

  The species characterising this subcommunity include *Trisetopsis imberbis, Paspalum dilatatum, Bromus catharticus, Eragrostis curvula, Leersia hexandra* and *Ischaemum fasciculatum.*
- **7b. *Andropogon appendiculatus* - Cyperus longus wetlands**

  The dominant species in this subcommunity are *Andropogon appendiculatus, Fingerhuthia sesleriiformis, Setaria incrassata, Harpechloa falx, Dimorphotheca caulescens, Crinum bulbispermum* and *Haplocarpha scaposa.*
- **7c. *Typha capensis – Phragmites australis* wetlands**

  The species that characterise this subcommunity include *Typha capensis, Phragmites australis, Schoenoplectus cf. muricinux, Eragrostis plana, Paspalum dilatatum, Setaria nigrirostris, Ranunculus multifidus* and *Crinum bulbispermum*.

Other units that were distinguished on the Mukondeleli site include the following:

8. CROPLAND

These croplands are currently utilised mainly for maize production.

9. INFRASTRUCTURE

These include farm houses and associated infrastructure as well as industrial areas.

10. DISTURBED AREAS

These sites include mine dumps, diggings and areas disturbed by farming activities (**Figure 7-20**).

11. DAMS

These include farm dams in the study area (**Figure 7-21**)

Figure 7-20: Mine dumps or diggings in the western part of Mukondeleli.

Figure 7-21: One of the farm dams on the Mukondeleli site.

7.2.3 BIODIVERSITY CONSERVATION PLANS

The MBSP (Mpumalanga Parks and Tourism Agency, 2014) classifies the natural vegetation of the province according to the following categories:

- Protected Areas (sub-divided into three categories);
- CBAs (sub-divided into "Irreplaceable" and "Optimal");
- Other natural areas;
- ESAs (sub-divided into four categories); and
- Modified (sub-divided into Heavily or Moderately modified.

Figure 7-22 shows the features in the study area within the classes listed above.

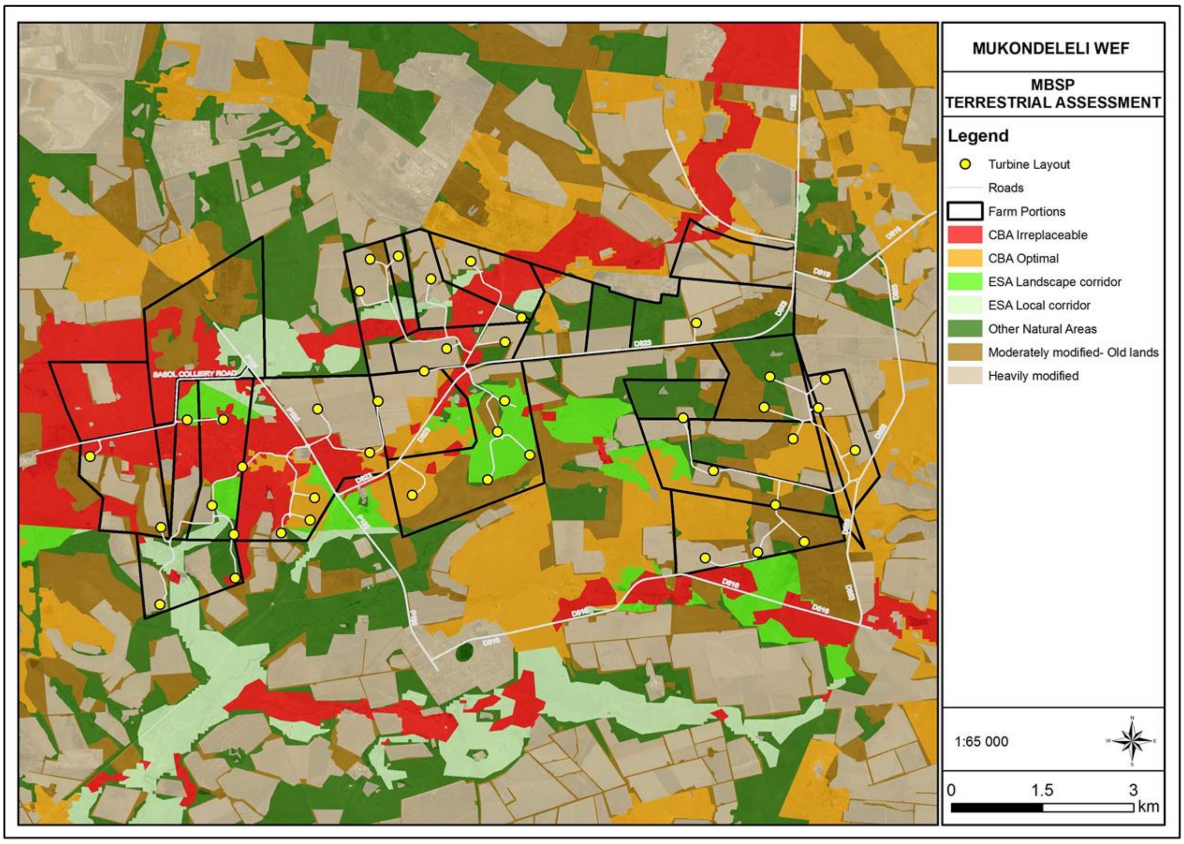


Figure 7-22: Biodiversity Map of the Project Area according to the MBSP Terrestrial

7.2.4 PROPOSED PROTECTED AREAS (NPAES FOCUS AREAS)

According to the National Protected Areas Expansion Strategy 2008 (NPAES2008), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**. A draft National Protected Areas Expansion Strategy was published for public comment in 2018 but is deliberately not available as a spatial dataset. It does, however, reference the Mpumalanga Protected Area Expansion Strategy, in which priority areas are identified in terms of High, Medium and Low priorities. The site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).

7.2.5 PLANT SPECIES

A list of plant species (the term species is used here in a general sense to denote species, subspecies and varieties that could be found in the region (quarter degree grids: 2628 DB; 2629 CA; 2629 CB) was downloaded from the South African Biodiversity Institute's website (SANBI: newposa.sanbi.org – accessed November 2021) The New Posa data search yielded 147 plant species. During the field surveys, 290 plant species were recorded on the Enertrag sites and additionally eight species were listed for the region (data supplied by M. Lötter, MTPA). Combined, these sources yielded 396 species for the region of which 30 are protected species according to the MNCA (1998).

The South African Threatened Species Programme website (redlist.sanbi.org) of SANBI; the National Forests Act (Act No. 84 of 1998) (NFA 2021); the National Environmental Management: Biodiversity Act (NEMBA 2007c) (ToPS list); CITES (2021) appendices and the lists of red listed or protected plant species of MNCA (1998) were consulted to classify the species in the study area into the relevant IUCN or protected categories.

SCREENING TOOL

The screening tool rated the sensitivity of the Plant Species Theme as medium and highlighted Sensitive Species 1252 and 691. Neither of the two species listed by the Screening Tool were encountered on site.

IUCN RED-LISTED SPECIES

Khadia beswickii and *Nerine gracilis* are the only IUCN threatened species occurring in the region. Near Threatened (NT), Data Deficient (DDD) and Data Deficient (Taxonomically) (DDT) species are not classified as threatened according to the IUCN classification.

SPECIES OF CONSERVATION CONCERN

According to the South African National Biodiversity Institute (SANBI 2020), SCCs include all species that have been assessed according the IUCN Threatened or Red-List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD), as well as range-restricted species which are not declining and are nationally listed as Rare or Critically Rare. The DD category is split into those that are taxonomically unresolved (DDT) and those where insufficient data (DDD) are available to make a judgement on endangered status.

The Taxonomically Data Deficient (DDT) species were excluded as SCC since taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of extinction risk is not possible.

The SCC species listed for the region are:

— Argyrolobium campicola = NT
— Gladiolus robertsoniae = NT
— Habenaria barbertoni = NT
— Khadia beswickii = VU (data supplied by M. Lötter, MTPA)
— Kniphofia typhoides = NT (data supplied by M. Lötter, MTPA)
— Nerine gracilis = VU (data supplied by M. Lötter, MTPA)
— Stenostelma umbelluliferum = NT

None of these species were recorded on the Mukondeleli site.

PROTECTED SPECIES

A total of 30 plant species are listed as Schedule 11 Protected plant species in the region according to the MNCA (1998). Most of these species are members of the *Amaryllidaceae* and *Orchidaceae*. Five of the 30 protected plant species were recorded during the site survey in December 2021. The five species recorded are:

— *Aloe ecklonis*
— *Aloe transvaalensis*
— *Boophone disticha**
— *Crinum bulbispermum*
— *Cyrtanthus stenanthus*
— *Eucomis autumnalis*
— *Gladiolus crassifolius*

— *Gladiolus dalenii**
— *Gladiolus robertsoniae*
— *Haemanthus humilis*
— *Haemanthus sp.**
— *Huernia hystrix**

**species not recorded on the Mukondeleli site*

Another five species are on the Mpumalanga Red list (Lötter, 2015) although not included in the MNCA (1998) list for Mpumalanga:

— *Drimia angustifolia* = LC
— *Hypoxis hemerocallidea* = LC
— *Khadia beswickii* = VU
— *Nerine gracilis* = VU
— *Trachyandra erythrorrhiza* = NT

TOPS LIST

No species classified as protected within the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA 2007c) is listed for the study area and none were found at the Mukondeleli site.

CITES APPENDICES

Appendix II of CITES lists species that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. Thirteen (13) Appendix II species are listed for the region including mostly (10) species of the Orchidaceae. *Aloe ecklonis, Aloe transvaalensis and Euphorbia clavarioides* are CITES-listed species that were recorded on the Mukondeleli site.

PROTECTED TREE SPECIES

No nationally protected tree species is listed for the site (NFA, 2021) and none were recorded during the site visit.

ENDEMIC SPECIES

No endemic species were listed for the Soweto Highveld Grassland Vegetation Type (Mucina & Rutherford, 2006).

7.2.6 ANIMAL SPECIES

MAMMALS

The site falls within the distribution range of 52 mammal species (http://vmus.adu.org.za)

SCREENING TOOL

The screening tool rated the sensitivity of the Animal Species Theme as high and highlighted the following species:

— Aves - *Circus ranivorus* (African Marsh Harrier);
— Aves - *Sagittarius serpentarius* (Secretarybird);
— Insecta - *Lepidochrysops procera; and*
— Mammalia - *Crocidura maquassiensis* (Maquassie Musk Shrew).

The avifaunal and bat components will be addressed by the avifaunal and bat specialists. The Maquassie Musk Shrew Crocidura maquassiensis, classified as Vulnerable (Taylor et al. 2016), was not listed in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province.It was not listed in the MTPA database for the farms participating in the proposed Mukondeleli WEF development and was not recorded on site during the survey. It depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. The main threats are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. Crocidura maquassiensis has not been reported from Gauteng, North West Province or Mpumalanga post-1999 and thus there is a very low probability for it to occur on site..

IUCN THREATENED MAMMAL SPECIES

Three IUCN threatened mammal species were listed for the environs of the Mukondeleli site on the website of the Animal Demography Unit, University of Cape Town (**Table 7-9**).

Table 7-9: Mammal species of conservation concern with a likelihood of occurring on site

SCIENTIFIC NAME	COMMON NAME	STATUS
Ourebia ourebi	Oribi	Endangered
Felis nigripes	Black-footed Cat	Vulnerable, protected
Panthera pardus	Leopard	Vulnerable, protected

Seven mammal species were listed for the environs of the Mukondeleli site as Near Threatened (a category that is not a threatened category in the IUCN classification but qualifies as SCC) (**Table 7-10**).

Table 7-10: Near Threatened Mammal Species at the project site

SCIENTIFIC NAME	COMMON NAME	STATUS
Amblysomus septentrionalis	Highveld Golden mole	Near Threatened
Atelerix frontalis	Southern African hedgehog*	Near Threatened
Leptailurus serval	Serval*	Near Threatened
Otomys auratus	Southern African vlei rat	Near Threatened
Aonyx capensis	African Clawless otter	Near Threatened
Poecilogale albinucha	African Striped weasel	Near Threatened
Crocidura mariquensis	Swamp musk shrew	Near Threatened

*Mammals that were either sighted or confirmed by the landowners.

MPUMALANGA: PROVINCIALLY PROTECTED MAMMAL SPECIES

Six of the 52 mammal species are Schedule 2: Protected Game in Mpumalanga. The following mammal species were recorded on the Mukondeleli site (**Table 7-11**).

Table 7-11: : Provincially Protected Mammal Species

SCIENTIFIC NAME	COMMON NAME
Raphicerus campestris	Steenbok
Atelerix frontalis	Southern African hedgehog

NATIONALLY THREATENED OR PROTECTED SPECIES: TOPS

According to ToPS legislation (NEMBA), one mammal species is listed as Endangered (**Table 7-12**), one mammal species is listed as Vulnerable (**Table 7-13**) and six species are Protected (**Table 7-14**). The following definitions are applicable:

— Endangered: Indigenous species facing a high risk of extinction in the wild in the medium-term future, although they are not critically endangered.

— Vulnerable: Indigenous species facing a high risk of extinction in the wild in the medium-term future, although they are not critically endangered or endangered.

— Protected species: Indigenous species of high conservation value or national importance that require national protection

Table 7-12: ToPS Endangered Species

SCIENTIFIC NAME	COMMON NAME
Ourebia ourebi	Oribi

Table 7-13: ToPS Vulnerable Species

SCIENTIFIC NAME	COMMON NAME
Panthera pardus	Leopard

Table 7-14: ToPS Protected Species

SCIENTIFIC NAME	COMMON NAME
Aonyx capensis	African clawless otter
Ateerix frontalis	Southern African hedgehog*
Connochaetes gnou	Black wildebeest*
Felis nigripes	Black-footed cat
Leptailurus serval	Serval*
Vulpes chama	Cape fox

*Mammals that were either sighted or confirmed by the landowners.

CITES

Table 7-15 outlines the mammal species occurring in the region which are CITES listed.

Table 7-15: CITES Mammal Species

SCIENTIFIC NAME	COMMON NAME	STATUS
Aonyx capensis	African Clawless otter	Appendix II
Leptailurus serval	Serval*	Appendix II
Caracal caracal	Caracal	Appendix II
Panthera pardus	Leopard	Appendix I

*Mammals that were either sighted or confirmed by the landowners.

REPTILES

A total Thirty-two (32) reptile species are listed for the region. The list includes one IUCN threatened (Vulnerable) species, i.e. the Giant Girdled Lizard (*Smaug giganteus*) and one Near-threatened species, i.e. *Chamaesaura aenea* (Coppery Grass Lizard).

Provincially protected reptile species include 15 Schedule 2 Protected reptiles and 17 Schedule 5 reptiles. The Giant Girdled Lizard (*Smaug giganteus*) is listed as Endangered according to the ToPS list (NEMBA 2007c). The only reptile that has been recorded on the Mukondeleli site is the rinkhals *Hemachatus haemachatus*. Two CITES-listed species are listed for the region surveyed (**Table 7-16**).

Table 7-16: CITES-listed Reptile Species

SCIENTIFIC NAME	COMMON NAME
Smaug giganteus	Giant Girdled Lizard (Ouvolk)
Cordylus vittifer	Common Girdled Lizard

AMPHIBIANS

Fourteen species were listed for the region and all have an IUCN status of Least Concern. None of the frog species listed for the region has a MNCA or ToPS protected status (MNCA 1998, NEMBA 2007c).

LEPIDOPTERA

Only one of the 62 species of the Lepidoptera listed for the region is IUCN listed as Endangered, i.e. *Chrysoritis aureus* (Golden opal).

The Screening Tool listed *Lepidochrysops procera* as a sensitive species for the site. However, it was not listed in the ADU website (http://vmus.adu.org.za), the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. Although *Lepidochrysops procera* has a IUCN status of Least Concern, it is a habitat specialist and is rated as Rare. It is not regarded as sensitive in the National Sensitive Species List of SANBI and is not exploited, collected, traded or utilised in a targeted manner (http://nssl.sanbi.org.za/species/lepidochrysops-procera accessed October 2021). Its habitat is rocky areas in grassland (and grassy areas in savanna), where its larval host plant, *Ocimum obovatum*, occurs. *Lepidochrysops procera* is unlikely to occur on site because its host plant was not recorded on site.

SCORPIONS

One scorpion species is listed for the 2629C and 2628D locus.

SPIDERS

All baboon spiders are provincially Schedule 7 protected. The listed baboon spider *Harpactira hamiltoni* is a ToPS protected species (NEMBA 2007c).

7.2.7 AVIFAUNA

*The following is extracted from the Avifauna Impact Assessment compiled by Chris van Rooyen Consulting and included as **Appendix H-2***

IMPORTANT BIRD AREAS

The project site is not located in an Important Bird Area (IBA). The closest IBAs are the Amersfoort-Bethal-Carolina IBA SA018 – approximately 27km east of the Mukondeleli WEF – and the Devon Grasslands IBA SA130 – approximately 27.5km west of the Mukondeleli WEF (Marnewick et al., 2015). It is not envisaged that the proposed WEF will impact on avifauna in the IBAs due to the distance from the project area of impact (PAOI).

PROTECTED AREAS

According to the South African Protected Areas database (SAPAD), the closest protected area is the Devon Protected Area, which is located approximately 38km north-west of the proposed development area. No further information could be obtained about the nature reserve. However, from an avifaunal perspective the state of the habitat and land use at the development areas is more important than the legal status. It is not envisaged that the proposed WEF will impact on avifauna in either of the IBAs due to the distance from the Devon Protected Area.

BIOMES AND VEGETATION TYPES

The PAOI is located within the Soweto Highveld Grassland (Gm8) vegetation ecotype within the Mesic Highveld Grassland Bioregion (SANBI, 2018). This vegetation type covers 14 513 km² of Mpumalanga and Gauteng (and to a very small extent also in the neighbouring Free State and North-West provinces) and occurs at an altitude ranging from 1420 m to 1760 m above sea level (Mucina et al., 2006). The site does not fall within any Centre of Endemism (Van Wyk & Smith, 2001).

Soweto Highveld Grassland is a summer rainfall vegetation (662 mm per annum, mostly September to April), which experiences a cool-temperate climate (mean annual temperature 14.8°C) with thermic continentality. Temperature ranges between 28°C (January) to -0.6°C (July). Frost and frequent grass fires during winter play an important role in limiting the occurrence of trees and shrubs in the region (Mucina et al., 2006). The landscape is gently to moderately undulating on the Highveld plateau, supporting dense tufted grassland dominated by *Themeda triandra*, with a notable herbaceous forb component. In places which have not been disturbed, scattered wetlands, narrow stream alluvia, pans and occasional ridges interrupt the grassland cover.

The conservation status of this vegetation type is listed as "Endangered" by (Mucina & Rutherford (2006). Very few statutorily conserved areas occur in this vegetation type and almost half has been transformed mostly by cultivation, plantations, mining, and urbanisation.

BIRD HABITAT

Whilst much of the distribution and abundance of the bird species in the development areas can be explained by the dominant biomes and vegetation types, it is also important to examine the modifications which have changed the natural landscape, and which may influence the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The bird habitat classes In the development areas are described below:

GRASSLAND

There are large areas of natural grassland remaining in the development area (**Figure 7-23**). The grassland varies from dense stands of relatively high grass to areas of heavily grazed short grass. The wind priority species which could have the potential to use the natural grassland in the development are listed in **Table 7-17.**

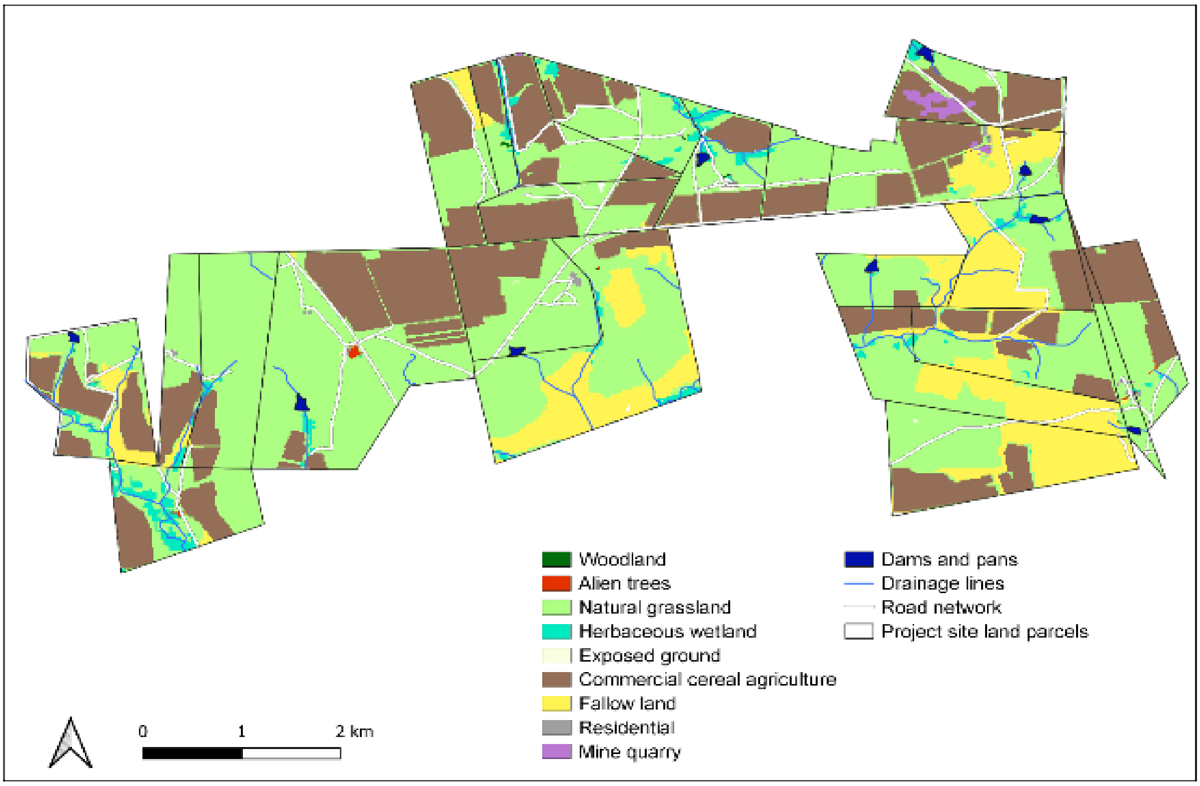


Figure 7-23: Land-cover and land-use within the Project Site Development Area according to the 2018 national land-cover surveys (DEA & DALRRD, 2019)

Table 7-17: Wind priority species which may use the natural grasslands in the development area. Red List species are highlighted in red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Amur Falcon	Least Concern	Least Concern	High
Black-Winged Kite	Least Concern	Least Concern	High
Black-Winged Pratincole	Near Threatened	Near Threatened	Medium

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Blue Crane	Vulnerable	Near Threatened	Medium
Blue Korhaan	Near Threatened	Least Concern	High
Common Buzzard	Least Concern	Least Concern	Medium
Greater Kestrel	Least Concern	Least Concern	Medium
Jackal Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	High
Marsh Owl	Least Concern	Least Concern	High
Northern Black Korhaan	Least Concern	Least Concern	Medium
Secretarybird	Endangered	Vulnerable	Medium
Spotted Eagle-Owl	Least Concern	Least Concern	Medium
White Stork	Least Concern	Least Concern	Medium
African Marsh Harrier	Least Concern	Endangered	Low
Grey-winged Francolin	Least Concern	Least Concern	Low
Long-crested Eagle	Least Concern	Least Concern	Low
Pallid Harrier	Near Threatened	Near Threatened	Low
Red-footed Falcon	Near Threatened	Near Threatened	Low

DRAINAGE LINES AND WETLANDS

There are several streams, floodplains, and associated wetlands throughout the PAOI, and grasslands are prone to inundation during the summer wet season. Surface rocks are present in some places along the streams. The alluvial soils are mostly deep dark brown to black clayey soils. The wind priority species which could have the potential to use the drainage lines and wetlands in the development are listed in **Table 7-18.**

Table 7-18: Wind priority species which may use the drainage lines and wetlands in the development area. Red List species are highlighted in red.

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Black-winged Pratincole	Near Threatened	Near Threatened	Medium
Blue Crane	Vulnerable	Near Threatened	Medium
Caspian Tern	Least Concern	Vulnerable	Medium
Greater Kestrel	Least Concern	Least Concern	Medium
Marsh Owl	Least Concern	Least Concern	High
African Fish Eagle	Least Concern	Least Concern	Low
African Marsh Harrier	Least Concern	Endangered	Low

DAMS AND PANS

There are several small and moderately sized dams, as well as a few small pans, mostly associated with the Klipspruit River and its tributaries (**Figure 7-23**). The wind priority species which could have the potential to use the dams and pans in the development are listed in **Table 7-19**.

Table 7-19: Wind priority species which may use the dams and pans in the development area. Red List species are highlighted in red.

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Black-winged Pratincole	Near Threatened	Near Threatened	Medium

Blue Crane	Vulnerable	Near Threatened	Medium
Caspian Tern	Least Concern	Vulnerable	Medium
Greater Flamingo	Least Concern	Near Threatened	Medium
Secretarybird	Endangered	Vulnerable	Medium
African Fish Eagle	Least Concern	Least Concern	Low
African Marsh Harrier	Least Concern	Endangered	Low

AGRICULTURAL LANDS

Agricultural activity present within the Mukondeleli WEF comprises cultivated commercial annuals non-pivot cropland (**Figure 7-23)** predominately dedicated towards maize production. Some fields are lying fallow or are in the process of being re-vegetated by grass. The wind priority species which could have the potential to use the agricultural habitats in the development are listed in **Table 7-20**.

Table 7-20: Wind priority species which may use the agricultural habitats in the development area. Red List species are highlighted in Red

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Amur Falcon	Least Concern	Least Concern	High
Black-winged Pratincole	Near Threatened	Near Threatened	Medium
Blue Crane	Vulnerable	Near Threatened	Medium
Common Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	Medium
Red-footed Falcon	Near Threatened	Near Threatened	Low

ALIEN TREES

The development area contains few trees (**Figure 7-23**). Most trees are alien species, particularly Eucalyptus, Australian Acacia (Wattle), and Salix (Willow) species. Trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have trees growing in them. The wind priority species which could have the potential to use the alien trees in the development are listed in **Table 7-21**.

Table 7-21: Wind priority species which may use the alien trees in development area. Red list species are highlighted in red.

SPECIES NAME	GLOBAL STATUS	REGIONAL STATUS	OCCURRENCE LIKELIHOOD
Amur Falcon	Least Concern	Least Concern	High
Black Sparrowhawk	Least Concern	Least Concern	Medium
Black-winged Kite	Least Concern	Least Concern	Medium
Common Buzzard	Least Concern	Least Concern	Medium
Greater Kestrel	Least Concern	Least Concern	Medium
Jackal Buzzard	Least Concern	Least Concern	Medium
Lanner Falcon	Least Concern	Vulnerable	Medium
Secretarybird	Endangered	Vulnerable	Medium
Spotted Eagle-Owl	Least Concern	Least Concern	Medium
White Stork	Least Concern	Least Concern	Medium
African Fish Eagle	Least Concern	Least Concern	Low
Long-crested Eagle	Least Concern	Least Concern	Low
Red-footed Falcon	Near Threatened	Near Threatened	Low

PRIORITY SPECIES

A total of 189 species could potentially occur within the broader area where the project site is located. Twenty-three (23) of these bird species are classified as wind priority species, of which seventeen (17) are considered to regularly occur in the development PAOI, with fifteen (15) such species having been recorded during the Site Sensitivity Verification field surveys.

Fifteen Red Data List species are associated with the broader area. Three Red List species have a medium to high probability of occurrence within the PAOI–- Blue Korhaan, Greater Flamingo, and Secretarybird. The remaining twelve Red List species have a low probability of occurrence – African Marsh Harrier, Black-winged Pratincole, Blue Crane, Caspian Tern, Curlew Sandpiper, European Roller, Greater Painted-snipe, Lanner Falcon, Maccoa Duck, Pallid Harrier, Red-footed Falcon, and Sentinel Rock Thrush.. The possibility of priority species occurring in the PAOI, and potential long-term impacts are listed in **Table 7-22**.

Figure 7-24 shows the spatial distribution of the priority species recorded during transect counts and incidental sightings over all four seasons of the pre-construction monitoring.

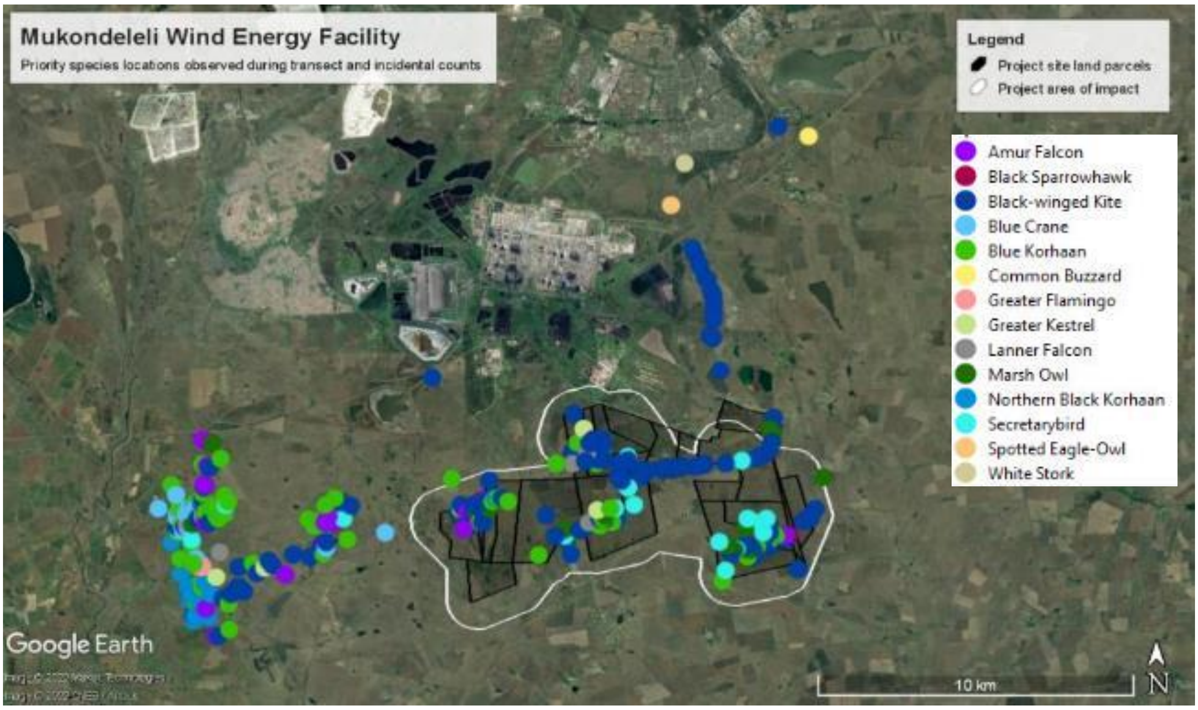


Figure 7-24: The location of priority species recorded through transect counts and incidental sightings. The area to the west of the PAOI is the control area

Table 7-22: Wind priority species which could occur in the broader area, including those recorded during Site Sensitivity Verification field surveys

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	WIND COLLISION WITH TURBINES	WIND DISPLACEMENT – HABITAT TRANSFORMATION	WIND DISPLACEMENT– DISTURBANCE	POWERLINE – ELECTROCUTION MV LINES	POWERLINE – COLLISION MV LINES
African Fish Eagle	*Haliaeetus vocifer*	LC	LC	1.22	0.00		L		x	x		x	x	x	x	x	
African Marsh Harrier	*Circus ranivorus*	LC	EN	1.22	0.00		L	x	x	x			x	x	x	x	
Amur Falcon	*Falco amurensis*	LC	LC	34.15	2.941	x	H	x			x	x	x	x	x	x	
Black Sparrowhawk	*Accipiter melanoleucus*	LC	LC	0.00	0.00	x	M					x	x	x	x	x	
Black-winged Kite	*Elanus caeruleus*	LC	LC	70.73	23.53	x	H	x				x	x	x	x	x	
Black-winged Pratincole	*Glareola nordmanni*	NT	NT	0.00	0.00	x	M	x	x	x	x		x	x	x		
Blue Crane	*Grus paradisea*	VU	NT	1.22	2.941	x	M	x	x	x	x		x		x		x
Blue Korhaan	*Eupodotis caerulescens*	NT	LC	17.07	2.941	x	H	x					x	x	x		x
Caspian Tern	*Hydroprogne caspia*	LC	VU	1.22	5.882		M		x	x			x				
Common Buzzard	*Buteo buteo*	LC	LC	8.537	0.00	x	M	x			x	x	x	x	x	x	
Greater Flamingo	*Phoenicopterus roseus*	LC	NT	4.878	5.882	x	M			x			x				x
Greater Kestrel	*Falco rupicoloides*	LC	LC	6.098	2.941	x	M	x	x			x	x	x	x	x	
Grey-winged Francolin	*Scleroptila afra*	LC	LC	1.22	0.00		L	x					x	x	x		
Jackal Buzzard	*Buteo rufofuscus*	LC	LC	4.878	0.00		M	x				x	x	x	x	x	
Lanner Falcon	*Falco biarmicus*	LC	VU	4.878	0.00	x	M	x			x	x	x	x	x	x	
Long-crested Eagle	*Lophaetus occipitalis*	LC	LC	3.659	0.00		L	x				x	x	x	x	x	

SPECIES NAME	SCIENTIFIC NAME	GLOBAL STATUS	REGIONAL STATUS	FULL PROTOCOL	AD HOC PROTOCOL	RECORDED DURING MONITORING	OCCURRENCE LIKELIHOOD	GRASSLAND	DRAINAGE LINES AND WETLANDS	DAMS AND PANS	AGRICULTURE	ALIEN TREES	WIND COLLISION WITH TURBINES	WIND DISPLACEMENT – HABITAT TRANSFORMATION	WIND DISPLACEMENT– DISTURBANCE	POWERLINE – ELECTROCUTION MV LINES	POWERLINE – COLLISION MV LINES
Marsh Owl	*Asio capensis*	LC	LC	24.39	2.941	x	H	x	x				x	x	x	x	x
Northern Black Korhaan	*Afrotis afraoides*	LC	LC	0.00	0.00	x	M	x					x	x	x		x
Pallid Harrier	*Circus macrourus*	NT	NT	1.22	0.00		L	x					x	x	x	x	
Red-footed Falcon	*Falco vespertinus*	NT	NT	1.22	0.00		L	x			x	x	x	x	x	x	
Secretarybird	*Sagittarius serpentarius*	EN	VU	8.537	0.00	x	M	x		x		x	x	x	x		x
Spotted Eagle-Owl	*Bubo africanus*	LC	LC	6.098	0.00	x	M	x				x	x	x	x	x	x
White Stork	*Ciconia ciconia*	LC	LC	3.659	0.00	x	M	x				x	x		x		x

AVIFAUNA SENSITIVITY

The following specific environmental sensitivities were identified from an avifaunal perspective:

— **Very high sensitivity all infrastructure exclusion zones: 100m buffers around dams and pans, and 32m buffers around drainage lines and associated wetlands**
Wetlands and pan/dam edges are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for Blue Crane (Globally Vulnerable, Regionally Near Threatened) African Marsh Harrier (Globally Least Concern, Regionally Endangered), and Caspian Tern (Globally Least Concern, Regionally Vulnerable). Turbine blade swept area should not fall within these buffer zones. Road and grid line crossings across these features should be restricted to what is unavoidable.

— **High sensitivity limited development zone: High sensitivity grassland**
Grassland on shallow soils, rocky grassland, and natural grassland. Development in the remaining high sensitivity grassland in the project site must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species, including several SCC. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), Black-winged Pratincole (Global and SA status Near-threatened), Secretarybird (Global status Endangered, SA status Vulnerable), Pallid Harrier (Global and SA status Near-threatened), Lanner Falcon (SA status Vulnerable).

Figure 7-25 indicates the avifaunal sensitivities identified in the course of the study, from a wind energy perspective.

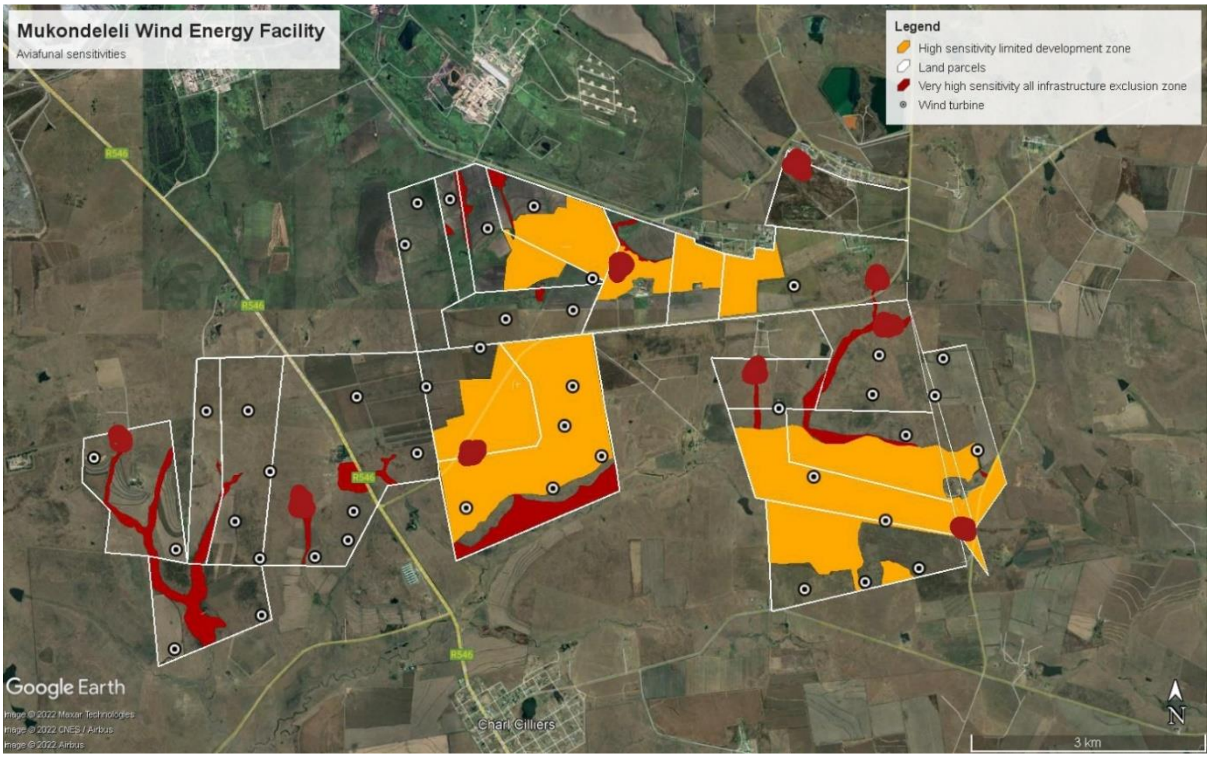


Figure 7-25: Avifauna Sensitivity Zones at the Mukondeleli WEF (Chris van Rooyen Consulting, 2022)

7.2.8 BATS

The following is extracted from the Bat Impact Assessment compiled by Animalia and included as ***Appendix H-3.***

Table 7-23 indicates the species of bat which have been confirmed to occur on site, those unconfirmed species which may potentially occur on site, as well as those occurring in the broader area of the site based on literature review. For each species, the risk of impact by wind energy infrastructure was assigned by MacEwan et al. (2020) based on their distributions, altitudes at which they fly, and foraging ecology.

There are several bat species in the vicinity of the site that occur commonly in the area. Some of these species are of special importance based on their likelihood of being impacted by the proposed WEF, due to high abundances and certain behavioural traits. They have also been dominating records of fatalities at wind energy facilities in South Africa. The relevant species are discussed below.

TADARIDA AEGYPTIACA

The Egyptian free-tailed bat, *Tadarida aegyptiaca*, is a Least Concern species (SANBI Red List 2016) as it has a wide distribution and high abundance throughout South Africa, and is part of the free-tailed bat family (Molossidae). It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem et al. 2020). This species is protected by national legislation in South Africa (ACR 2020).

Egyptian free-tailed bats roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. It has also adapted to roosting in buildings, in the roofs of houses in particular (Monadjem et al. 2020). Thus, man-made structures and large trees on the site would be important roosts for this species.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem et al. 2020).

After a gestation of four months, a single pup is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August. Maternity colonies are apparently established by females in November.

The Egyptian free-tailed bat is considered to have a high risk of fatality on wind energy facilities due to turbine collisions (MacEwan et al. 2020). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause for concern as these species have more significant ecological roles than the rarer bat species, and are currently displaying moderate to high numbers of mortalities at nearby operating wind farms.

LAEPHOTIS CAPENSIS

Laephotis capensis is commonly called the Cape serotine (formerly *Neoromicia capensis*) and has a conservation status of Least Concern (SANBI Red List 2016) as it is found in high numbers and is widespread over much of Sub-Saharan Africa. High mortality rates of this species due to wind turbines would be a cause for concern as precisely because of its abundance. As such, it has a more significant role to play within local ecosystems than the rarer bat species.

The Cape serotine roosts individually or in small groups of two to three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will use most man-made structures as day roosts which can be found throughout the site and surrounding areas (Monadjem et al. 2020). They do not undertake migrations and thus are considered residents of the site.

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occur. They give birth to twins during late October and November, but single pups, triplets and quadruplets have also been recorded (van der Merwe 1994 and Lynch 1989).

They are tolerant of a wide range of environmental conditions as they survive and prosper across arid and semi-arid areas to montane grasslands, forests, and savannas; indicating that they may occupy several habitat types across the site, and are amenable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter, but can occasionally forage in open spaces. They are thought to have a medium to high likelihood of fatality due to wind turbines (MacEwan et al. 2020) and are currently displaying moderate to high numbers of mortalities at operational wind farms in South Africa.

MINIOPTERUS NATALENSIS

Miniopterus natalensis, commonly referred to as the Natal long-fingered bat, occurs widely across the country but mostly within the southern and eastern regions, and is listed as Least Concern (Monadjem et al. 2020). This bat is a cave-dependent species and identification of suitable roosting sites may be more important in determining its presence in an area than the presence of surrounding vegetation. It occurs in large numbers when roosting in caves with approximately 260 000 bats observed making seasonal use of the De Hoop Guano Cave in the Western Cape, South Africa. Culverts and mines have also been observed as roosting sites for either single bats or small colonies. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem et al. 2020).

Mating and fertilisation usually occur during March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem et al. 2020 & van de Merwe 1979).

The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines if a wind farm is placed within a migratory path (MacEwan et al. 2020). The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route and such turbines are not effectively mitigated. Very little is known about the migratory behaviour and paths of M. natalensis in South Africa with migration distances exceeding 150 kilometres. If the site is located within a migratory path, the bat detection systems should detect higher numbers and activity of the Natal long-fingered bat in spring and autumn; this will be examined over the course of the 12-month monitoring survey.

A study by Vincent et al. (2011) on the activity and foraging habitats of Miniopteridae found that the individual home ranges of lactating females were significantly larger than that of pregnant females. It was also found that the bats predominately made use of urban areas (54%) followed by open areas (19.8%), woodlands (15.5%) orchards and parks (9.1%) and water bodies (1.5%) when selecting habitats. Foraging areas were also investigated with the majority again occurring in urban areas (46%), however a lot of foraging also occurred in woodland areas (22%), crop and vineyard areas (8%), pastures, meadows and scrubland (4%) and water bodies (4%).

MacEwan et al. (2020) advise that *M. natalensis* faces a medium to high risk of fatality due to wind turbines. This evaluation was based on broad ecological features and excluded migratory information. The species is currently displaying low to moderate numbers of mortalities at operational wind farms in South Africa.

Table 7-23: Species currently confirmed on site, previously recorded in the area, or potentially occurring. Roosting and foraging habitats in the study area, conservation status and risk of impact are also briefly described per species (Monadjem et al. 2020).

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT ON SITE	POSSIBLE FORAGING HABITAT UTILISED ON SITE	RISK OF IMPACT (MACEWAN *ET AL.* 2020 FOR WIND)
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.	High
Mops (Chaerephon) pumilus	Little free-tailed bat	Confirmed on site	Least Concern (2016 Regional Listing)	Hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of habitats.	High
Laephotis (Neoromicia) capensis	Cape serotine	Confirmed on site	Least Concern (2016 Regional Listing)	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. Predominantly a medium height clutter edge forager on site.	High

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT ON SITE	POSSIBLE FORAGING HABITAT UTILISED ON SITE	RISK OF IMPACT (MACEWAN *ET AL.* 2020 FOR WIND)
Laephotis zuluensis	Zulu serotine	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Predominantly a medium height clutter edge forager on site.	Medium – High
Pipistrellus rusticus	Rusty pipistrelle	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Prefers vegetation edges and clutter with open water sources.	Medium – High
Pipistrellus hesperidus	Dusky pipistrelle	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts under the bark of trees, and possibly roofs of buildings.	Prefers vegetation edges and clutter with open water sources.	Medium – High
Miniopterus natalensis	Natal long-fingered bat	Confirmed on site, also Wonderboom Cave	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.	High
Eptesicus hottentotus	Long-tailed serotine	Confirmed on site	Least Concern (2016 Regional Listing)	It is a crevice dweller roosting in rock crevices in the larger area, as well as other crevices in buildings.	It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally.	Medium – High
Myotis tricolor	Temmink's myotis	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium – High

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT ON SITE	POSSIBLE FORAGING HABITAT UTILISED ON SITE	RISK OF IMPACT (MACEWAN *ET AL.* 2020 FOR WIND)
				as culverts under roads.		
Myotis welwitschii	Welwitsch's bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area, may also take residence in suitable hollows such as culverts under roads.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium – High
Rhinolophus clivosus	Geoffroy's horseshoe bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Low
Scotophilus dinganii	Yellow-bellied house bat	Confirmed on site	Least Concern (2016 Regional Listing)	Roofs of buildings and other suitable hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	High
Cloeotis percivali	Percival's short-eared trident bat	Confirmed in 100km radius, also Wonderboom Cave	Endangered (2016 Regional Listing)	Caves and mine tunnels present in the larger area.	Vegetation clutter forager, clumps of trees on site.	Low
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Roosts in dense foliage of large, leafy trees in the larger area, and may travel several kilometres each night to reach fruiting trees.	Feeds on fruit, nectar, pollen and flowers. If and where available on or near site.	High

SPECIES	COMMON NAME	OCCURRENCE IN AREA*	CONSERVATION STATUS (SANBI & EWT, 2016)	POSSIBLE ROOSTING HABITAT ON SITE	POSSIBLE FORAGING HABITAT UTILISED ON SITE	RISK OF IMPACT (MACEWAN *ET AL.* 2020 FOR WIND)
Eidolon helvum	African straw-coloured fruit bat	Possible as migrant	Least Concern (2016 Regional Listing) (Globally Near threatened)	Non-breeding migrant with sparse scattered records.	Feeds on fruit, nectar, pollen and flowers, if and where available on site.	High
Taphozous mauritianus	Mauritian tomb bat	Confirmed in 100km radius	Least Concern (2016 Regional Listing)	Prefers roosting on the walls of buildings and the trunks of large trees. Appears vigilant while roosting even during daytime.	Open-air forager that prefers grasslands where it hunts for moths and sometimes butterflies in the late afternoon.	High

RELATION BETWEEN BAT ACTIVITY AND WEATHER CONDITIONS

Several sources of literature describe how numerous bat species are influenced by weather conditions (O'Farrell et al. 1967, Rachwald 1992, Arnett et al. 2010). Weather may influence bats in terms of lowering activity, changing the time of emergence and flight duration. It is also important to note that environmental factors are never isolated and therefore a combination of these factors can have synergistic or otherwise contradictory influences on bat activity. For example, a combination of high temperatures and low wind speeds will be more favourable to bat activity than low temperatures and low wind speed, whereas low temperature and high wind speed will be the least favourable for bats. Below are short descriptions of how wind speed, temperature and barometric pressure influences bat activity.

If it is found during operation that the wind farm is causing unsustainable numbers of bat fatalities, an analysis can be performed to determine the wind speed and temperature range within which 80% of bat passes were detected. The results of such an analysis may be used, if necessary, to inform mitigation measures for turbines based on conserving 80% of detected bat passes. This is keeping in mind the synergistic or otherwise contradictory effects that the combination of wind speeds and temperatures can have on bat activity.

WIND SPEED

Some bat species show reduced activity in windy conditions. Strong winds have been found to suppress flight activity in bats by making flight difficult (O'Farrell et al. 1967). Several studies at proposed and operating wind facilities in the United States have documented discernibly lower bat activity during 'high' wind speeds (Arnett et al. 2010).

Wind speed and direction also affect availability of insect prey, as insects on the wing often accumulate on the lee side of wind breaks such as tree lines (Peng et al. 1992). At edges exposed to wind, flight activity of insects, and therefore bats, may be suppressed while at edges to the lee side of wind, bat activity may be greater.

TEMPERATURE

Flight activity of bats generally increases with temperature. Flights are of shorter duration on cooler nights and extended on warmer nights. Rachwald (1992) noted that distinct peaks of activity disappeared in warm weather such that activity was mostly continuous through the night. During nights of low temperatures bats intensified foraging shortly after sunset (Corbet and Harris 1991).

Peng (1991) found that many families of aerial dipteran insects (flies) preferred warm conditions for flight. A preference among insects for warm conditions has been reported by many authors suggesting that temperature is an important regulator of bat activity, through its effects on insect prey availability.

CONSERVATION AND PROTECTED AREAS, KNOWN SENSITIVITIES AND CAVES/ROOSTS WITHIN 30KM AND 100KM OF THE SITE

There are no protected or formally conserved areas within 30km of the Mukondeleli WEF site. The Devon Protected Environment is the nearest protected area, lying 38km from site at the closest point (**Figure 7-26**). This has no bearing on the current site and will not be discussed further.

Dolomite is known to be prone to good cave formation, and many bat colonies are supported in such caves in the country, particularly in the province of Gauteng. At its nearest, the dolomitic geology of the greater area extends to approximately 60km north-west of the WEF (**Figure 7-27**). Museum records of bats collected from one cave within approximately 100km of the site exist. Specimens of *Rhinolophus clivosus*, *Cloeotis percivali*, and *Miniopterus natalensis* were collected from Wonderboom cave (93km to the north), although the Strategic Environmental Assessment (SEA) wind energy buffer of 50km for large bat roosts does not extend to the area of influence around the proposed Impumelelo WEF. Should any possible cave/roost locations be found to be supporting large enough bat colonies within 50km of the proposed site, this will have implications for the development.

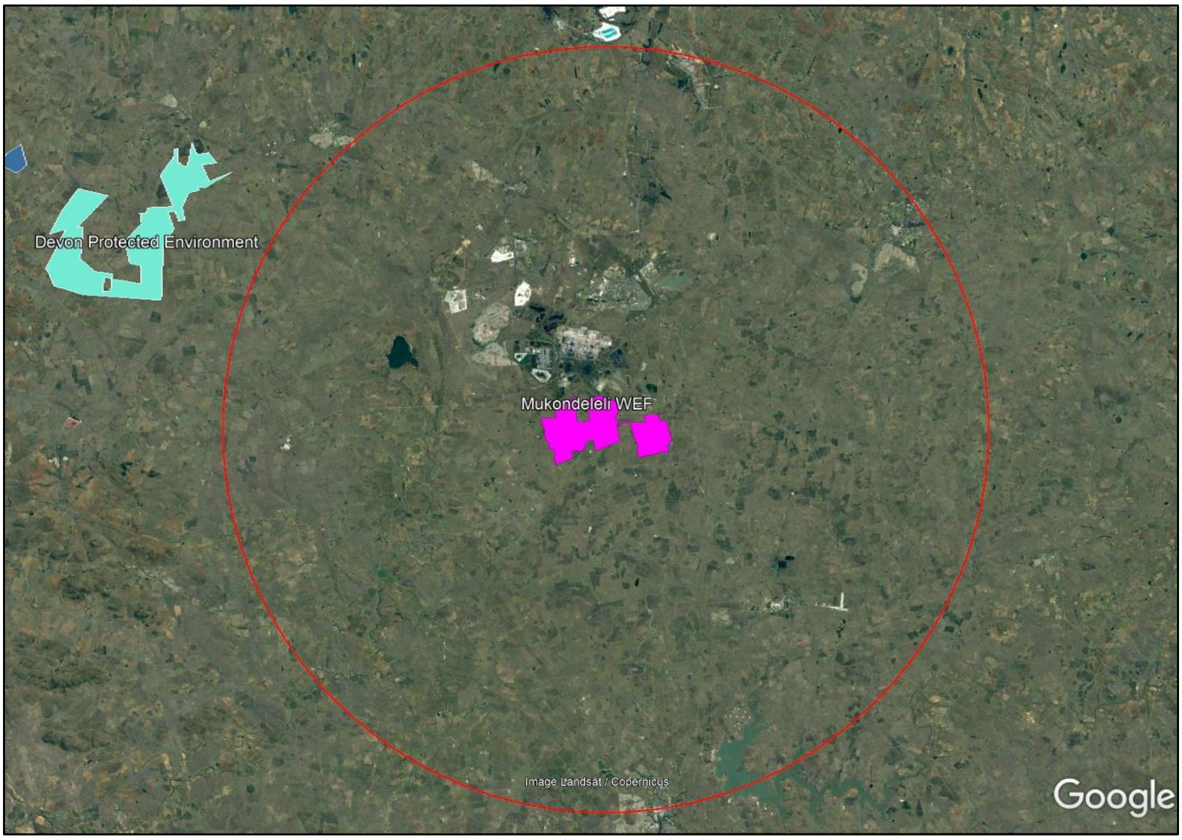


Figure 7-26: Protected areas within or surrounding a radius of 30km (red line) around the Mukondeleli Wind Energy Facility (fuschia polygon) (DEA, 2021)

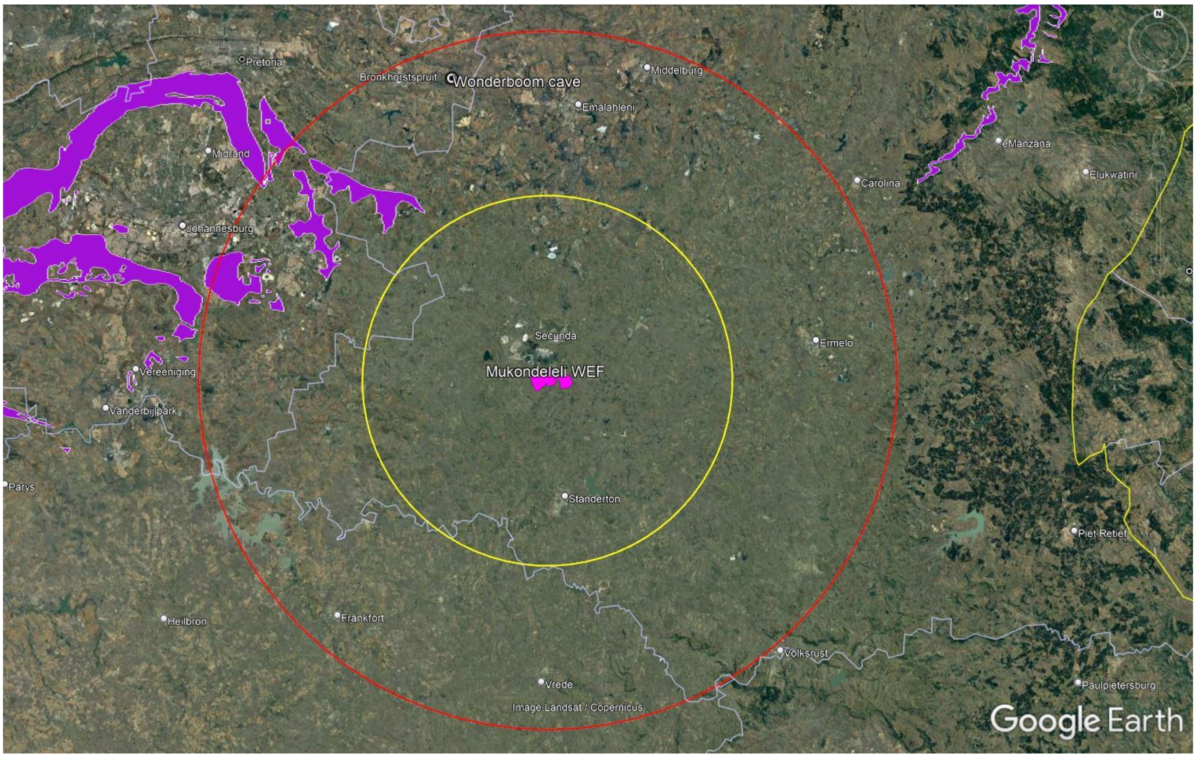


Figure 7-27: Approximate 100km radius (red circle) surrounding Mukondeleli Wind Energy Facility (fushia polygon). Dolomite geology represented in purple (SEA data), and known bat roosts depicted with white circles. Wonderboom Cave does not fall within 50km of site (yellow circle)

BAT SENSITIVITY

Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences, where high sensitivities and their buffers are no-go zones for turbines and turbine blade overhang (**Table 7-24** and **Table 7-25**). In other words, no turbine blades may intrude into high sensitivity buffers. Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity, but turbines are allowed to be constructed in medium sensitivity areas.

Figure 7-28 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

During the Scoping Phase a total of 10 turbines were intruding into high bat sensitivity buffer. The EIA Phase turbine layout is respecting the bat sensitivity map and turbine positions were adjusted by the applicant to avoid high bat sensitivity buffers. Therefore, no turbines are intruding into any high bat sensitivity buffers with the EIA Phase layout.

Table 7-24: Description of parameters used in the development of the sensitivity map

LAST REVISION	AUGUST 2022
High sensitivities and 200m buffers	Valley bottom wetlands
	Pans and depressions
	Dams
	Drainage lines capable of supporting riparian vegetation
	Other water bodies and other sensitivities such as manmade structures, buildings, houses, barns, sheds, stands of tall trees.
Moderate sensitivities and 150m buffers	Seasonal wetlands
	Seasonal drainage lines

Table 7-25: The significance of sensitivity map categories for each infrastructure component for the Mukondeleli WEF

SENSITIVITY	TURBINES	ROADS AND CABLES	INTERNAL OVERHEAD TRANSMISSION LINES	BUILDINGS (INCLUDING SUBSTATION, BATTERY STORAGE FACILITY AND CONSTRUCTION CAMP/YARDS)
High Sensitivity	These areas are 'no-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) may not intrude into these areas.	Preferably keep to a minimum within these areas where practically feasible.	Allowed inside these areas.	Avoid these areas.
High Sensitivity buffer	These areas are 'no-go' zones and turbines may not be placed in these areas. Turbine blades (blade overhang) may not intrude into these areas.	Allowed inside these areas.	Allowed inside these areas.	Preferably keep to a minimum within these areas where practically feasible.
Moderate Sensitivity	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.
Moderate Sensitivity buffer	Turbines within these areas may require priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them.	Allowed inside these areas.	Allowed inside these areas.	Allowed inside these areas.

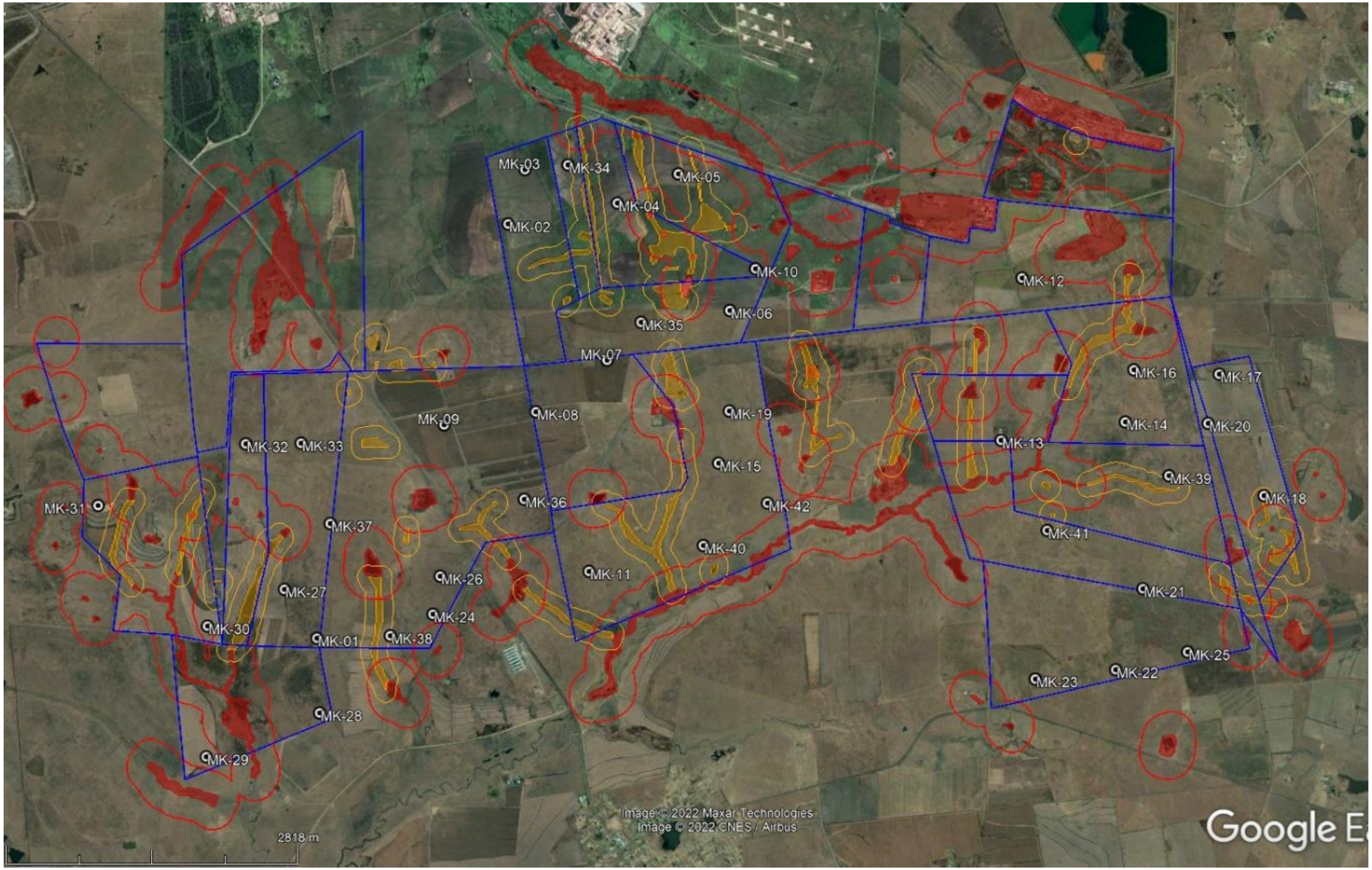


Figure 7-28: Bat sensitivity map of the site. Site area indicated in a blue boundary. Sensitivity polygons are provided in .kml format with this report. Shaded red = high sensitivity; Red line = 200m high sensitivity buffer; Shaded orange = moderate sensitivity; Orange line = 100m moderate sensitivity buffer

7.3 SOCIAL ENVIRONMENT

7.3.1 LAND USE

*The following is extracted from the Visual Impact Assessment compiled by SLR Consulting (Pty) Ltd and included as **Appendix H-10**.*

According to the South African National Land Cover dataset (2020 SA National Land Cover (© GEOTERRAIMAGE - 2020), much of the visual assessment area is classified as "Cultivated Land" interspersed with significant areas of "Grassland". Tracts of forested land and numerous water bodies are scattered throughout the study area (**Figure 7-29**).

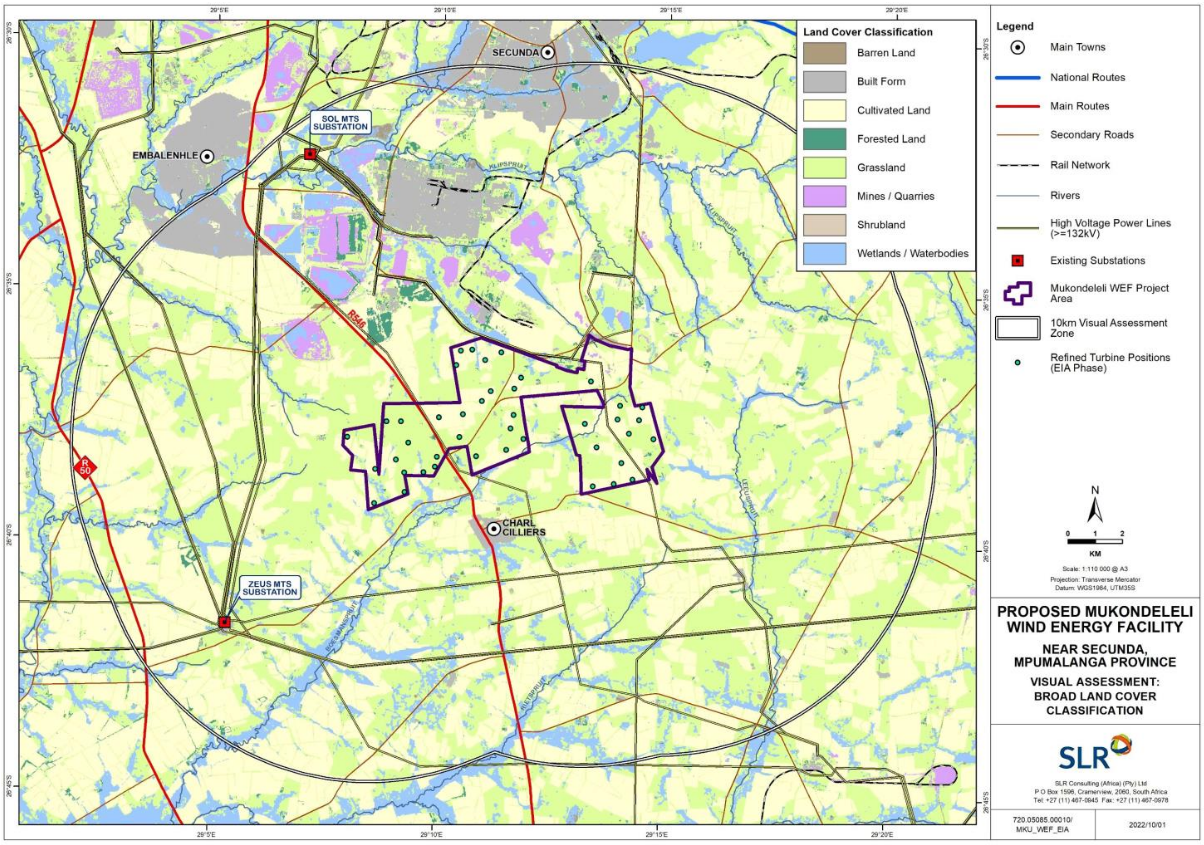


Figure 7-29: National Landcover Classification

Commercial agriculture is the dominant activity in the study area, with the main focus being maize cultivation (Figure 7-30 and Figure 7-31) with some limited livestock and game farming. There are multiple farm portions in the study area, resulting in a relatively moderate density of rural settlement with many scattered farmsteads in evidence. Built form in much of the study area comprises farmsteads, ancillary farm buildings and workers' dwellings, industries, mining activities, rubbish dumps, gravel access roads, power and telephone lines and fences.

Figure 7-30: Maize cultivation to the east of the Mukondeleli WEF project area.

Figure 7-31: View of cattle grazing to the north of the Mukondeleli WEF project area.

High levels of human influence are however visible in the northern and north-western sector of the study area. Significant portions of the towns of Embalenhle and Secunda encroach into the study area and the peri-urban areas are dominated by industrial / mining activity (**Figure 7-32**). In addition, the Sasol Secunda synthetic fuel plant (**Figure 7-33)** is located to the north of the Mukondeleli WEF project area, and this facility together with the associated infrastructure related to the supply and storage of coal (**Figure 7-34**) as well as electrical infrastructure has resulted in significant transformation in the landscape. Associated with the Sasol plant is the nearby Riaan Rademan Training Academy (**Figure 7-35**) and adjacent electrical substation, contributing further to the overall transformation of the landscape in this area. In addition, mining and quarrying activity, including the Bosjesspruit Mine and associated infrastructure in the areas immediately north of the Mukondeleli WEF project area have further degraded the visual landscape (**Figure 7-36**).

Figure 7-32: View southwards from Secunda towards the Sasol Fuel Plant.

Figure 7-33: Sasol Synthetic Fuel Plant dominating the skyline to the north of the Mukondeleli WEF project area

Figure 7-34: Coal dumps adjacent to the Sasol Fuel Plant

Figure 7-35: Riaan Rademan Training Academy

Figure 7-36: Landscape transformation and degradation immediately north of the Mukondeleli **WEF project area.**

To the south of the Mukondeleli WEF project area, the small town of Charl Cilliers (Figure 7-37) and the Zeus Substation form significant areas of transformation (Figure 7-38).

Figure 7-37: Approach (from the south on the R546) to the town of Charl Cilliers.

Figure 7-38: Zeus Substation south-west of the Mukondeleli WEF project area.

Other evidence of significant human influence in the area includes some smaller scale mining activity in the southern sector of the study area (Irenedale Sasol Colliery) with some associated service industry as well as road, rail, telecommunications and electricity infrastructure (**Figure 7-39**).

Figure 7-39: 400kV power lines High voltage power lines to the south of the Mukondeleli WEF project area

7.3.2 NOISE CLIMATE

*The following is extracted from the Noise Impact Assessment compiled by Enviro Acoustic Research and included as **Appendix H-11**.*

Based on a desktop assessment as well as information gained during the site visits, there are a number of industrial activities and mines located within, or close to the PFA that may influence ambient sound levels in the area. These projects include:

— SASOL Nitro (and a number of associated industries), located to the northern part of the WEF;

— Brandspruit mine, located to the north-west of the WEF;
— Brandspruit Shaft, located to the west of the WEF;
— An unnamed poultry farm to the south of the WEF;
— A conveyor belt running between the Bossjesspruit Shaft and the SASOL Industrial complex; and
— Bossjesspruit Coal Mine (and associated ventilation fan), located to the north-east of the WEF.

Potential noise-sensitive developments, receptors and communities (NSR) were identified using tools such as Google Earth® up to a distance of 2 000 m (recommendation SANS 10328:2003) from WTG locations (**Figure 7-40** and **Figure 7-41**). Two potential receptors (that could include a number of people and animals) was identified. A list of the closest NSR is presented in **Table 7-26**. Other noise-sensitive areas are indicated in green polygons. Also indicated on this figure are generalized 500, 1 000 and 2 000 m buffer zones. Generally, noises from wind turbines:

— could be significant within 500 m, with receptors[14] staying within 500 m from operational WTG subject to noises at a potentially sufficient level to be considered disturbing;
— are normally limited to a distance of approximately 1,000m from operational wind turbines (subject to WTG layout, as the WTG cumulatively contribute to noise levels with 2,000m from WTG). Night-time ambient sound levels could be elevated and the potential noise impact measurable; and
— likely to be audible up to a distance of 2,000m at night. Noises from the WTG are of a low concern at distances greater than 2,000m, although the sound of the WTGs may be audible at greater distances during certain metrological phenomena (sound levels are generally very low at distances greater than 2,000m).

Table 7-26: Locations of identified NSR and perceived use of structures

POTENTIAL NOISE-SENSITIVE DEVELOPMENT / RECEPTOR(S) (NSR)	WGS 84 LONGITUDE	WGS 84 LATITUDE	UTM 35S X	UTM 35S Y	COMMENT
1	29.15732	-26.6225	714780	7053562	Residence, noise sensitive
2	29.15863	-26.6268	714902	7053084	Residence, noise sensitive
3	29.1593	-26.6267	714969	7053095	Residence, noise sensitive
4	29.15988	-26.6267	715027	7053097	Residence, noise sensitive
5	29.15942	-26.6273	714980	7053026	Residence, noise sensitive
6	29.16116	-26.6273	715153	7053022	Residence, noise sensitive
7	29.16459	-26.6319	715486	7052509	Residence, noise sensitive
8	29.14644	-26.632	713678	7052527	Residence, noise sensitive
9	29.13817	-26.6353	712849	7052179	Residence, noise sensitive
10	29.18751	-26.6238	717784	7053373	Residence, noise sensitive
11	29.18754	-26.6268	717781	7053032	Residence, noise sensitive
12	29.21064	-26.613	720107.6	7054522	Residence, noise sensitive
13	29.24454	-26.6365	723438	7051864	Residence, noise sensitive
14	29.22944	-26.6074	721991	7055116	Residence, noise sensitive
15	29.24418	-26.643	723390	7051145	Residence, noise sensitive
16	29.24457	-26.6433	723428	7051110	Residence, noise sensitive

[14] Depending on the layout as well as the specific sound power emission levels of the selected wind turbine.

POTENTIAL NOISE-SENSITIVE DEVELOPMENT / RECEPTOR(S) (NSR)	WGS 84 LONGITUDE	WGS 84 LATITUDE	UTM 35S X	UTM 35S Y	COMMENT
17	29.24467	-26.6439	723437	7051041	Residence, noise sensitive
18	29.24447	-26.6445	723416	7050976	Residence, noise sensitive
19	29.21107	-26.6287	720120	7052784	Residence, noise sensitive
20	29.21081	-26.6305	720091	7052584	Residence, noise sensitive
21	29.21064	-26.6311	720073	7052515	Residence, noise sensitive
22	29.20989	-26.6312	719998	7052505	Residence, noise sensitive
23	29.20954	-26.6309	719964	7052539	Residence, noise sensitive
24	29.20966	-26.63	719978	7052643	Residence, noise sensitive
25	29.20934	-26.6316	719943	7052466	Residence, noise sensitive
26	29.23096	-26.6074	722142	7055108	Residence, noise sensitive
27	29.19932	-26.6259	718956	7053118	Residence, noise sensitive
28	29.20291	-26.6126	719339	7054586	Residence, noise sensitive
29	29.23028	-26.6086	722072	7054973	Residence, noise sensitive
30	29.23074	-26.6088	722118	7054954	Residence, noise sensitive
31	29.21764	-26.6207	720790	7053664	Residence, noise sensitive
32	29.21898	-26.6183	720928	7053918	Residence, noise sensitive
33	29.2186	-26.617	720893	7054072	Residence, noise sensitive
34	29.25117	-26.6298	724112	7052596	Residence, noise sensitive
35	29.25188	-26.6314	724179	7052409	Residence, noise sensitive
36	29.23201	-26.6084	722245	7054996	Residence, noise sensitive
37	29.24911	-26.6435	723880	7051073	Residence, noise sensitive
38	29.24983	-26.6441	723950	7051013	Residence, noise sensitive
39	29.23232	-26.609	722275	7054931	Residence, noise sensitive
40	29.26194	-26.625	725194	7053101	Residence, noise sensitive
41	29.2216	-26.6516	721125	7050227	No access to verify, assumed noise sensitive
42	29.25267	-26.6571	724208	7049564	Residence, noise sensitive
43	29.17571	-26.6487	716561	7050629	Residence, noise sensitive
44	29.17707	-26.6491	716696	7050577	Residence, noise sensitive
45	29.17785	-26.6498	716772	7050504	Residence, noise sensitive
46	29.17809	-26.6501	716796	7050467	Residence, noise sensitive
47	29.17747	-26.6501	716734	7050466	Residence, noise sensitive
48	29.17484	-26.6516	716469	7050311	Residence, noise sensitive
49	29.1743	-26.6518	716415	7050293	Residence, noise sensitive
50	29.17286	-26.6524	716271	7050228	Residence, noise sensitive

POTENTIAL NOISE-SENSITIVE DEVELOPMENT / RECEPTOR(S) (NSR)	WGS 84 LONGITUDE	WGS 84 LATITUDE	UTM 35S X	UTM 35S Y	COMMENT
51	29.17215	-26.6525	716200	7050213	Residence, noise sensitive
52	29.16687	-26.6479	715683	7050734	Residence, noise sensitive
53	29.16498	-26.6522	715486	7050254	Residence, noise sensitive
54	29.15042	-26.6576	714027	7049689	Residence, noise sensitive
55	29.13318	-26.6276	712366	7053041	Residence, noise sensitive
56	29.14711	-26.6194	713769	7053925	Residence, noise sensitive
57	29.14824	-26.6189	713882	7053972	Residence, noise sensitive
58	29.15879	-26.6202	714930	7053817	Residence, noise sensitive
59	29.15971	-26.6188	715024	7053967	Residence, noise sensitive
60	29.15897	-26.6183	714952	7054024	Residence, noise sensitive
61	29.15999	-26.6177	715054	7054091	Residence, noise sensitive
62	29.24844	-26.6562	723788	7049672	Residence, noise sensitive
63	29.17372	-26.6565	716349	7049765	Residence, noise sensitive

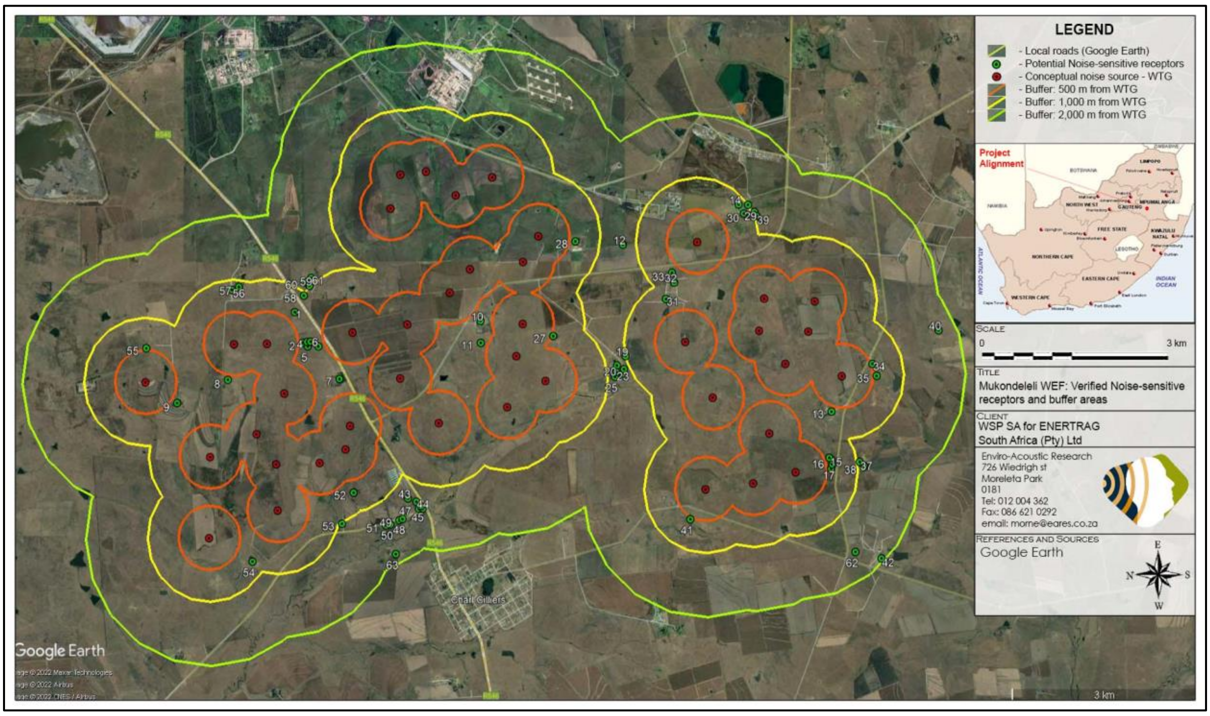


Figure 7-40: Study area and potential noise-sensitive receptors close to the Mukondeleli WEF

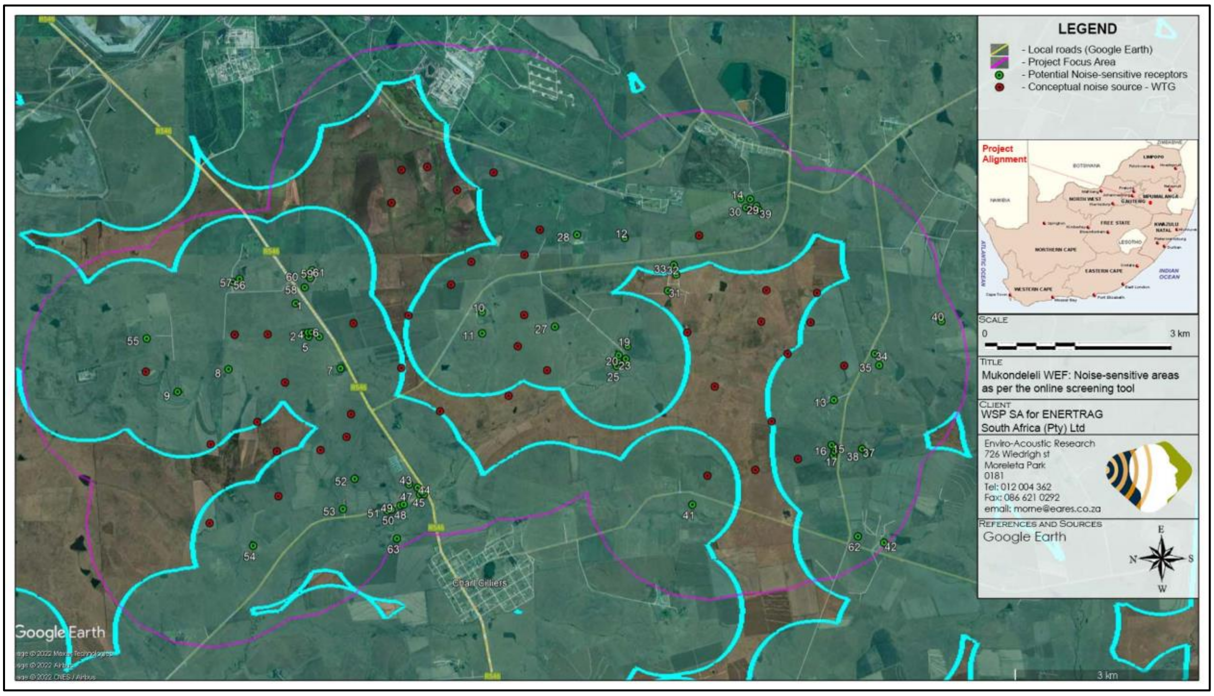


Figure 7-41: Study area and potential noise-sensitive areas identified by the online screening tool

PROPOSED WIND TURBINE

The wind energy market is fast changing and adapting to new technologies and site-specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. As such the Developer has been evaluating several turbine models, however the selection will only be finalized at a later stage once a most optimal wind turbine is identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered). The Developer indicated that they are considering a number of different wind turbines, however, due to various reasons, a developer does not want to reveal the actual WTG that they may consider, whether for commercial/economic reasons, possible Non-Disclosure Agreements etc. As the noise propagation modelling requires the details of a wind turbine, it was selected to use the worst-case sound power emission levels of the Vestas V163 WTG.

It is important to note that the exact details of the actual WTG are irrelevant to noise analysis, as the major factors that determine the noise levels are:

— The layout of the WEF (which would include the number of WTG as well as the distance from various receptors); and
— The sound power emission levels ("SPL") of the WTG (or noise source) selected/that the developer is considering, or may require acoustic assessment.

Minor factors in the noise levels are:

— The spectral characteristics of the WTG;
— Temperature and Humidity;
— Noise abatement technologies implemented by the manufacturer;
— Topography and wind shear effects;
— Ground surface characteristics.

Factors that do influence SPL are:

— The hub height of the WTG (the declared SPL level already include this factor);
— The rotor diameter of the WTG (the declared SPL level already include this factor);
— The manufacture of the WTG, the model name or number (the declared SPL level already include this factor).

The sound power emission levels are provided by the manufacturer either as the apparent SPL, maximum warranted SPL, a calculated SPL (for new WTG where the noise levels were not previously measured) or measured sound power levels as reported in terms of IEC 61400-11 or IEC 61400-14. It is unique for each make and model and the sound power levels already include the effect of the hub height, rotor diameter and abatement technologies.

There are smaller WTG with higher SPL, with larger WTG with a lower SPL. Therefore, the generating capacity, hub height or rotor diameter of the potential WTG should not be used to assume the noise levels.

Therefore, due to these factors, the total generating capacity of the WEF project may be less or more, when considering the individual generating capacity of the WTG (used for this noise specialist study) as well as the number of WTG in the layout. This however will not influence the findings of this noise specialist study.

SUMMARY OF AMBIENT SOUND LEVELS

The measurement run conducted from 20 - 23 September 2022 resulted in approximately 1,155 daytime and 576 night-time measurements. Each measurement was collected over a 10-minute period and included a number of sound level descriptors, including equivalent values, minimum and maximum levels, a number of statistical sound levels as well as spectral data. Confidence levels in the resulting data are high. Based on the sound measurements:

- Measurement Location WEMLTSL01
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the two full 16-hour daytime periods, the daytime LAeq,i value is 47.2 dBA, with a rating level similar to a rural noise district. The arithmetic average of the various 10-minute LAeq,i measurements are 44.9 dBA;
    - based on the three 8-hour night-time periods, the average night-time LAeq,i value is 45.3 dBA, with a rating level typical of an urban noise district. The arithmetic average of the various 10-minute LAeq,i night-time measurements are 39.5 dBA;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSR. The equivalent:
    - based on the two full 16-hour daytime periods, the LAeq,f value is 42.7 dBA, with the arithmetic average being 37.0 dBA. This is acceptable for residential use, with the sound levels typical of the day-time levels associated with a rural environment;
    - based on the three full 8-hour night-time periods, the average LAeq,f value is 42.2 dBA, with the arithmetic average being 37.0 dBA. This is acceptable for night-time residential use;
  - The statistical LA90 levels are elevated, higher than expected for a rural environment for the day- (33.8 dBA90) and the night-time (32.5 dBA90) periods.
- Measurement Location WEMLTSL02
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the two full 16-hour daytime periods, the daytime LAeq,i value is 53.1 dBA, with a rating level similar to an urban noise district. The arithmetic average of the various 10-minute LAeq,i measurements are 48.4 dBA;
    - based on the three 8-hour night-time periods, the average night-time LAeq,i value is 47.7 dBA, with a rating level typical of an urban to busy urban (with main roads, workshops and businesses) noise district. The arithmetic average of the various 10-minute LAeq,i night-time measurements are 41.3 dBA. This ambient sound level is higher than expected when considering the rural development character of the area;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSR. The equivalent:
    - based on the two full 16-hour daytime periods, the LAeq,f value is 47.7 dBA, with the arithmetic average being 44.4 dBA. This is acceptable for residential use, with the sound levels higher of the day-time levels associated with a rural environment;

    - based on the three full 8-hour night-time periods, the average LAeq,f value is 43.3 dBA, with the arithmetic average being 39.0 dBA. This is acceptable for night-time residential use;
  - The statistical LA90 levels are elevated, higher than expected for a rural environment for the day- (37.6 dBA90) and the night-time (34.9 dBA90) periods.
- Measurement Location WEMLTSL03
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSR. The equivalent:
    - based on the two full 16-hour daytime periods, the LAeq,f value is 51.6 dBA, with the arithmetic average being 49.9 dBA. This is acceptable for residential use and higher than the day-time sound levels associated with a rural environment;
    - based on the three full 8-hour night-time periods, the average LAeq,f value is 48.3 dBA, with the arithmetic average being 44.4 dBA. Night-time ambient sound levels are elevated though acceptable for residential use;
  - The statistical LA90 levels are significantly elevated, higher than expected for a rural environment for the day- (44.5 dBA90) and the night-time (40.2 dBA90) periods.
- Measurement Location WEMLTSL04
  - The impulse-weighted sound level is used in South Africa to define the ambient sound levels as well as the rating level. Thus:
    - based on the two full 16-hour daytime periods, the daytime LAeq,i value is 56.0 dBA, with a rating level similar to an urban noise district. The arithmetic average of the various 10-minute LAeq,i measurements are 50.6 dBA;
    - based on the three 8-hour night-time periods, the average night-time LAeq,i value is 51.6 dBA, with a rating level typical of a busy urban (with main roads, workshops and businesses) noise district. The arithmetic average of the various 10-minute LAeq,i night-time measurements are 40.2 dBA;
  - The fast-weighted sound level is generally used internationally to define the ambient sound levels. The author generally recommends the use of this sound descriptor to assist to protect the soundscape at the identified NSR. The equivalent:
    - based on the two full 16-hour daytime periods, the LAeq,f value is 48.4 dBA, with the arithmetic average being 45.8 dBA. This is acceptable for residential use;
    - based on the three full 8-hour night-time periods, the average LAeq,f value is 46.2 dBA, with the arithmetic average being 37.8 dBA. This is ideal for night-time residential use;
  - The statistical LA90 levels are significantly elevated, higher than expected for a rural environment for the day- (37.5 dBA90) and the night-time (33.4 dBA90) periods.

Based on the ambient sound levels measured:

- approximately 1,155 10-minute measurements were collected during the day, with the highest sound level measured being 71.5 dBA and the lowest sound level being than 26 dBA;
- approximately 576 10-minute measurements were collected during the night-time period, with the highest sound level measured being 58.6 dBA and the lowest sound level being 23.6 dBA; and
- considering the average of the 10-minute equivalent sound levels at the four measurement locations, daytime fast-weighted sound levels were 45.2 dBA with night-time fast-weighted sound levels being 39.5 dBA.

Considering the results of the ambient sound levels and the developmental character of the area, ambient sound levels were typical of a rural to suburban environment and the acceptable zone sound level (noise rating level) during low and no-wind conditions would be typical of a:

- Rural noise district for the daytime period (45 dBA); and,
- Rural noise district for the night-time period (35 dBA).

Considering measurements collected over the past decade at numerous locations during different seasons, ambient sound levels will likely increase as wind speeds increase, as illustrated on **Figure 7-42** and **Figure 7-43**. The sound level data collected for this project is also illustrated on these figures, which also illustrates the trend of increasing ambient sound levels as wind speeds increase.

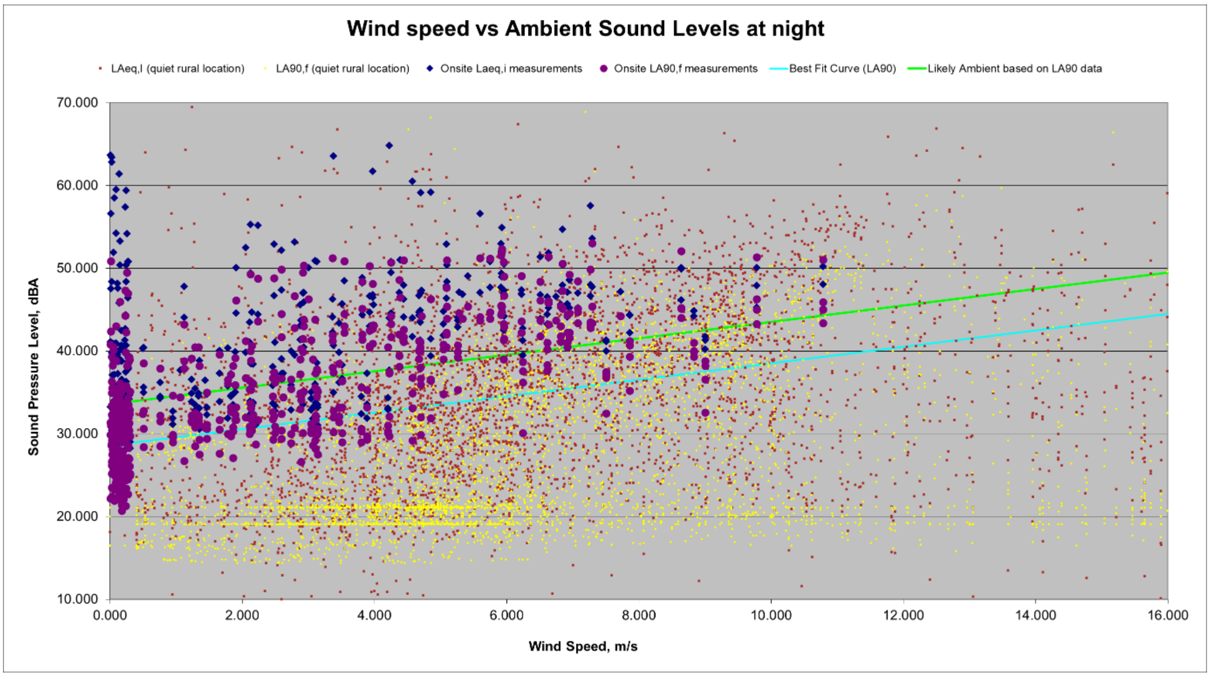


Figure 7-42: **Daytime ambient sound levels measured in vicinity of project**

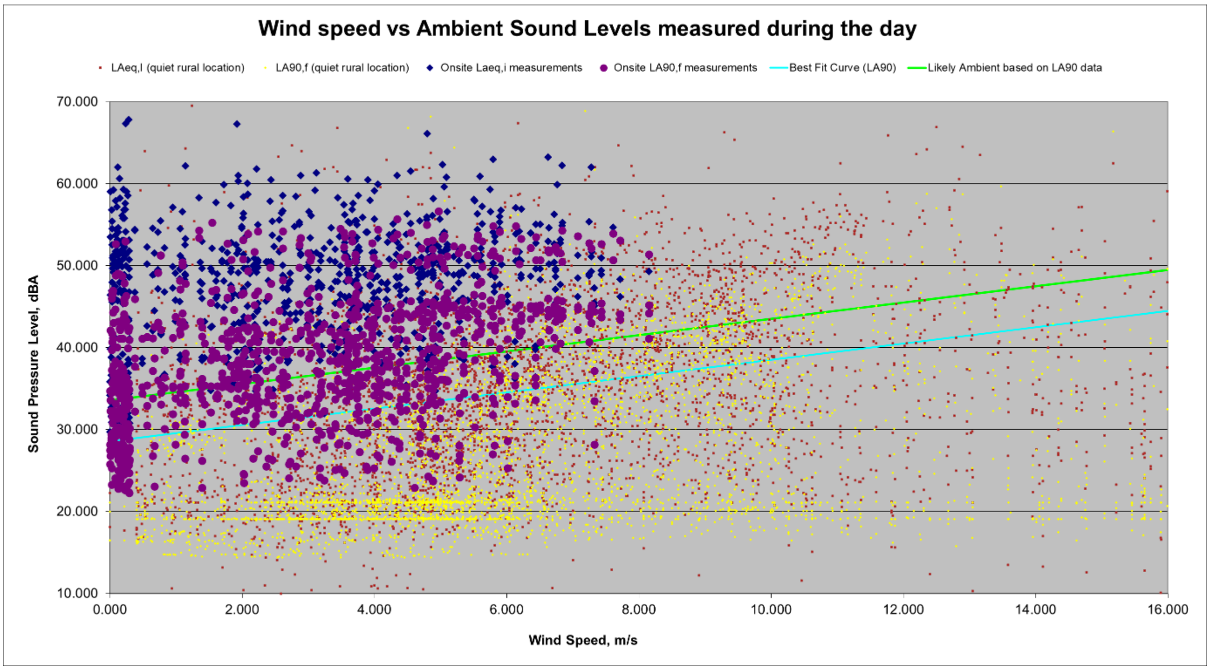


Figure 7-43: **Night-time ambient sound levels measured in vicinity of project**

7.3.3 TRANSPORT NETWORK

*The following is extracted from the Transport Impact Assessment compiled by JG Afrika (Pty) Ltd and included as **Appendix H-9***

SURROUNDING ROAD NETWORK

The proposed Mukondeleli WEF site is located south of Secunda, Mpumalanga Province. The road network surrounding the site includes the D823 traversing the centre of the site in a west to east direction, the P185/1 traversing the west side of the site in a south to north direction, as well as the D2183 and D863 to the east of the site. The road classification of the surrounding road network as per the Road Infrastructure Strategic Framework for South Africa (RISFSA) is shown in **Figure 7-44** below (sourced form Mpumalanga RAMS system).

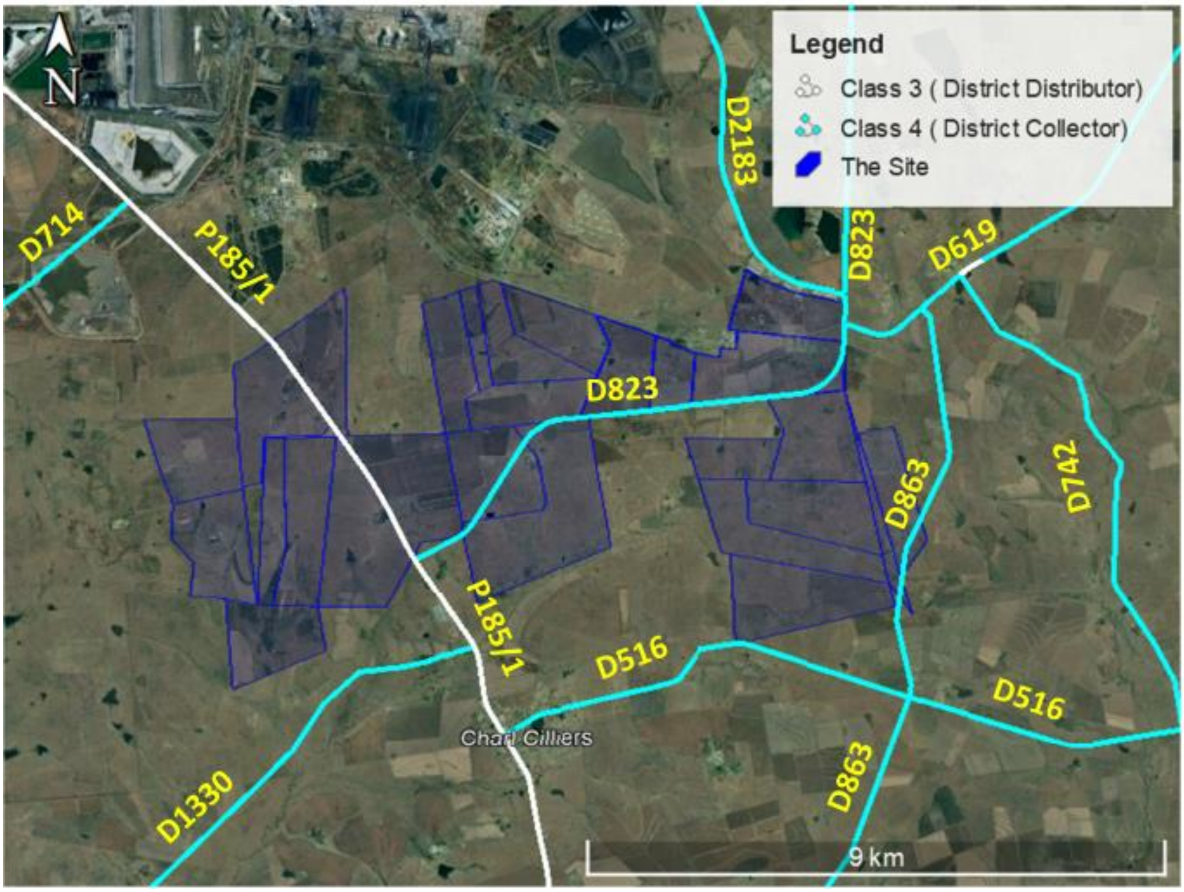


Figure 7-44: Road Classification of surrounding road network.

PROPOSED ACCESS ROUTE

Seven (7) site access points are accommodated at the site (**Figure 7-45**). The access points are proposed off the P185/1 (i.e., R546), D823, and D863. The P185/1 and D823 are surfaced single carriage way road with one lane per direction while the D863 is a gravel road. All proposed access points are located off existing access roads with the exception of Access 03. Based on the TRH 26 road classification and access management manual the recommended minimum spacing for full intersections on class 4 roads is 600 to 800m in rural settings. Access 3 is ±600m east of the D83-D185/1 intersection and ±2.3km west of access 04. No access spacing restrictions are envisaged for the existing access points and Access 03 meets access spacing requirements (**Figure 7-45**).

Sight lines from the access points are within the recommended limits.

The final site access points will be based on the access investigation findings, geometric considerations, and site layout restrictions.

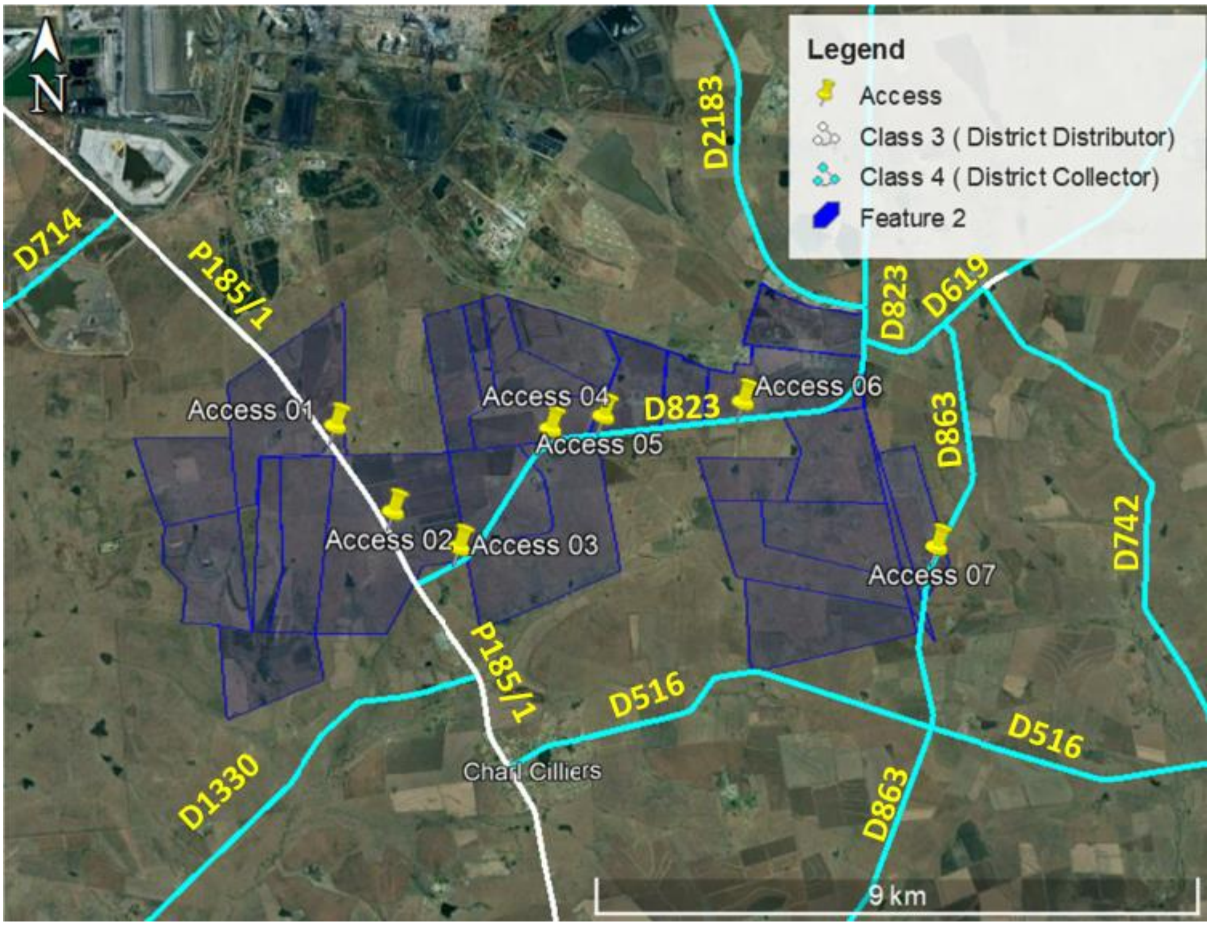


Figure 7-45: Recommended site access points

The access points to the site will need to be able to cater for construction and abnormal load vehicles. A minimum road width of 8m is recommended for the access points and the internal roads can have a minimum width of 5m. The radius at the access point needs to be large enough to allow for all construction vehicles to turn safely.

It is recommended that the site access be controlled via a boom and gatehouse. It is also recommended that security staff be stationed on site at the access booms during construction. A minimum stacking distance of 25m is recommended between the road edge of the external road and the boom.

All road markings and signage need to be in accordance with the South African Road Traffic Signs Manual (SARTSM).

TRAFFIC VOLUME INFORMATION

Based on the Mpumalanga Road Asset Management System, the 2018 Annual Average Daily Traffic (AADT) on the P185/1 is rated as high, while the AADT on the D823 is rated as medium (**Table 7-27**). Traffic congestion is therefore expected on the road sections close to the site access points. The rest of the routes in the surrounding road network experiences low to medium levels of AADT.

Table 7-27: The 2018 Annual Average Daily Traffic (AADT) on the P185/1 (Source: Mpumalanga Provincial Road Asset Management System (RAMS), n.d.)

Road No#	from_km	to_km	2018 Link AADT	surface	Volume category
D1330	0	8.66	81	Gravel	Low-Medium
D2183	7.25	14.21	291	paved	Low
D516	30.06	34.45	846	Paved	Low-Medium
D516	34.45	41.29	805	Paved	Low-Medium
D619	4.43	9.91	298	Gravel	High
D619	9.91	10.33	218	Paved	Low
D619	10.33	11.12	112	Paved	Low
D619	11.12	12.51	43	Paved	Low
D823	0	8.52	1771	paved	Medium
D823	8.52	8.94	1771	paved	Medium
D823	8.94	9.04	574	paved	Low-Medium
D823	9.04	18.14	574	gravel	Very High
D863	37.89	46.95	45	Gravel	Low
D863	46.95	53.39	72	Gravel	Low-Medium
P185/1	25.97	30.26	1584	Paved	Medium
P185/1	30.26	31.74	1586	Paved	Medium
P185/1	31.74	33.36	1657	Paved	Medium
P185/1	33.36	40.59	3900	Paved	High

An estimated 4% annual traffic growth is deemed suitable for the area. This is based on historical AADT data obtained from Mpumalanga RAMS system (**Figure 7-46**).

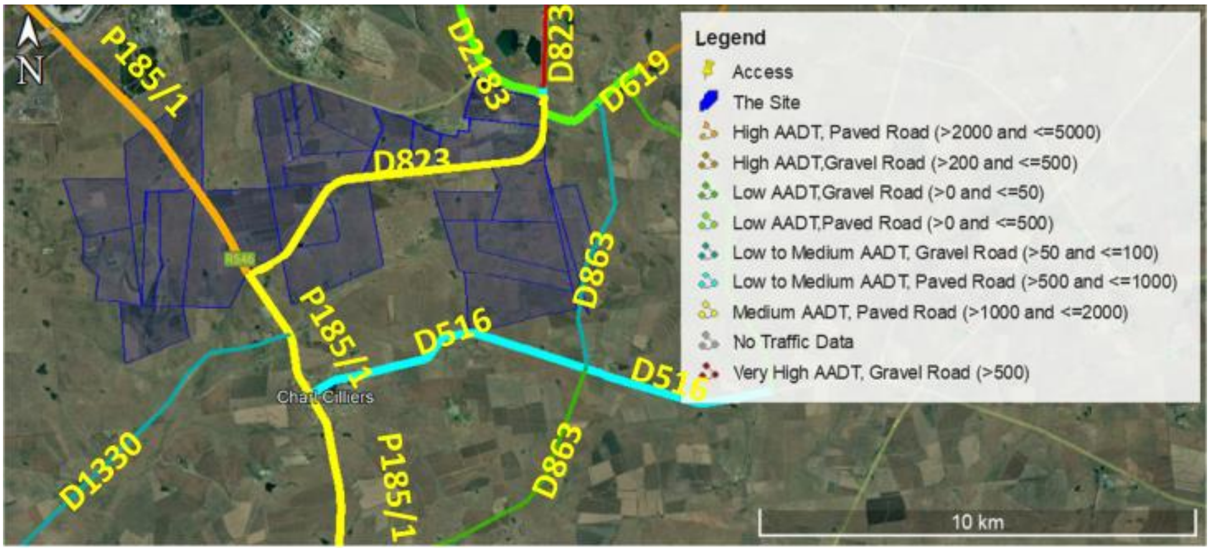


Figure 7-46: Link AADT (Mpumalanga Provincial Road Asset Management System (RAMS), n.d.)

INTERNAL ROADS

The geometric design and layout for the internal roads from the access points needs to be established at detailed design stage. Existing structures and services, such as drainage structures, signage, street lighting and pipelines will need to be evaluated if impacting on the roads. It needs to be ensured that gravel sections remain in good condition and will need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed.

The geometric design constraints encountered due to the terrain should be taken into consideration by the geometric designer. Preferably, the internal roads need to be designed with smooth, relatively flat gradients (recommended to be no more than 8%) to allow a larger transport load vehicle to ascend to the respective laydown areas.

TRANSPORTATION OF MATERIALS, PLANT AND PEOPLE TO THE PROPOSED SITE

It is assumed that the materials, plant, and workers will be sourced from the surrounding towns as far as possible. The closest towns to the site are Secunda, Trichardt, Evander, Embalenhle, Kinross and Bethal (**Figure 7-47**).

Figure 7-47: Surrounding Towns

7.3.4 HERITAGE AND CULTURAL RESOURCES

*The following is extracted from the Heritage Impact Assessment and Palaeontological Impact Assessment compiled by Beyond Heritage and included as **AppendixH-6** and **AppendixH-7** respectively.*

PALAEONTOLOGY

The palaeontological sensitivity of the area under consideration is presented in **Figure 7-48**. The site for development mainly is in the Jurassic dolerite but there are a few outcrops of the Vryheid Formation.

The **Vryheid Formation** lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins, but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. There are also delta-front deposits, evidence of delta switching, and fluvial deposits with associated meandering rivers, braided streams, back swamps or interfluves and abandoned channels (Cadle et al., 1993; Cairncross, 1990; 2001; Johnson et al., 2006). Coal seams originated where peat swamps developed on broad abandoned alluvial plains, and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

Since dolerite is an igneous (volcanic) rock, it does not preserve any fossils. In fact, the dolerite usually destroys any fossils in its near vicinity that were present in the sediments through which it has intruded.

Figure 7-48: : SAHRIS palaeosensitivity map for the site for the proposed Mukondeleli WEF (within the white polygon. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as having a few very highly sensitive areas on the Vryheid Formation (red) but mostly on zero sensitive rocks (grey) for the dolerite.

ARCHAEOLOGY

Mpumalanga does not include an extensive Early Stone Age record (Esterhuysen & Smith 2007). Although the Middle and Late Stone Age periods have not yet been comprehensively studied, evidence for these periods has been excavated from Bushman Rock Shelter in the Ohrigstad District (Esterhuysen & Smith 2007) and it is known that San communities lived near Lake Chrissie as recently as the 1950s (e.g., Schlebusch *et al.* 2016).

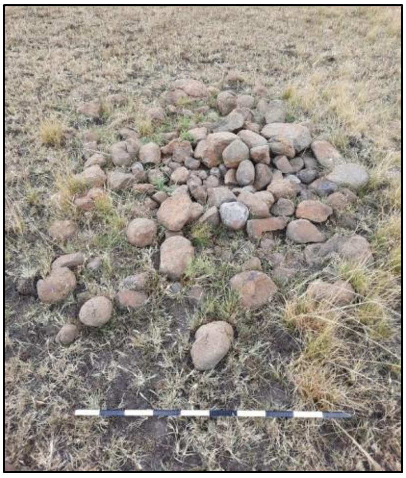
The archaeological remains of Iron Age settlements are more frequently found in the province. The archaeology of farming communities of southern Africa encompasses three phases. The Early Iron Age (200-900 AD) represents the arrival of Bantu-speaking farmers in southern Africa. Living in sedentary settlements often located next to rivers, these farmers cultivated sorghum, beans, and cowpeas, and kept livestock. The Middle Iron Age (900-1300 AD) is mostly confined to the Limpopo Province with the most notable site in southern Africa located in the Limpopo Valley; Mapungubwe Hill probably represents the earliest 'state' in this region. The Late Iron Age (1300-1840s AD) marks the arrival and spread of ancestral Eastern Bantu-speaking Nguni and Sotho-Tswana communities into southern Africa. The location of Late Iron Age settlements is usually on or near hilltops for defensive purposes. The Late Iron Age as an archaeological period ended by 1840 AD, when the Mfecane caused major socio-political disruptions in southern Africa (Mitchell 2002; Huffman 2007).

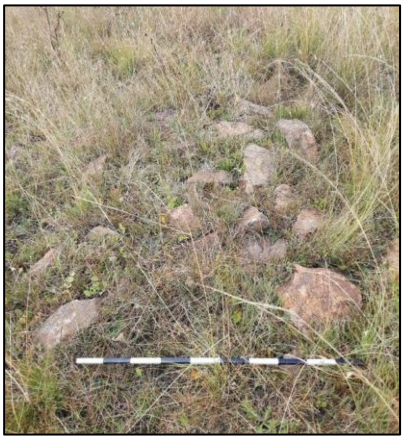
Dates from Early Iron Age sites indicated that by the beginning of the 5th century AD Bantu-speaking farmers had settled in the Mpumalanga lowveld. Subsequently, farmers continued to move into and between the lowveld and highveld of Mpumalanga. By 1500 AD the escarpment was populated by chiefdoms, including Pedi and Bokoni communities. These chiefdoms would have had trade relations with Ndundza, Swazi and Zulu kingdoms, exchanging salt, cattle and metals as evidenced by the archaeological record (Esterhuysen & Smith 2007; Delius *et al.* 2012).

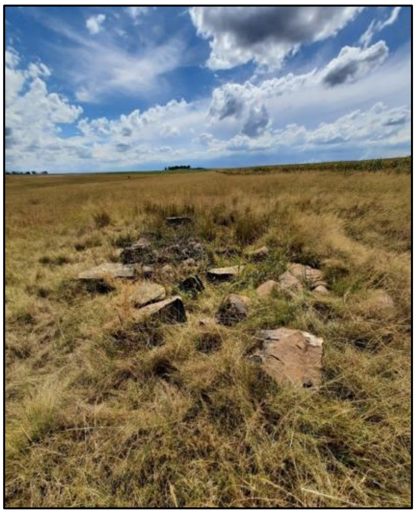
A number of archaeological resources were recorded in the study area. These are listed in **Table 7-28** and then individually described and illustrated below.

Table 7-28: List of heritage finds recorded during the field survey.

WAYPOINT	LOCATION	NATURE	GRADE
MD001	26° 38' 00.2292" S29° 13' 27.1487" E 	Graves Small cemetery measuring some 10 m by 4 m and located about 140 m west of the stone ruin at MD002 and with which it is assumed to be associated. One grave has a rectangular granite headstone bearing the date 29-9-63. A second grave as a cement surround but no visible headstone, while the third is covered by a packed stone mound. The cemetery is situated next to a fence line and, from some remaining poles, seems to have been fenced off at some stage. The dated grave is 59 years old (i.e. not heritage) but the others are likely older, and the site is therefore assumed to be heritage	IIIA
MD002	26° 37' 59.8224" S29° 13' 32.7181" E 	Archaeological – stone feature The site is associated with the graves at MD001 and consists of various stone walled ruins, some which are completely overgrown with thickets of trees. At MD002 are the remains of a packed stone structure that is completely degraded and overgrown. A small section of one wall of the original structure is still standing. The thicket of trees at MD003 contains large amounts of stone blocks that are assumed to originate from a demolished structure. MD004 is a very degraded stone kraal measuring 11 m by 21 m and located in grassland between the two thickets. The three features are roughly in a straight line stretching over a distance of some 320 m	GPA
MD003	26° 37' 50.0880" S29° 13' 30.5941" E		GPC
MD004	26° 37' 54.6888" S29° 13' 32.7827" E 		GPA
MD005	26° 37' 52.0262" S29° 11' 04.3514" E	Archaeological – stone feature Remnants of a packed stone foundation of a demolished structure measuring some 10 m by 10 m and with some pieces of building rubble located nearby. The rubble includes modern bricks and cement	GPC

WAYPOINT	LOCATION	NATURE	GRADE
			
MD006	26° 37' 31.2203" S29° 11' 38.3388" E 	Not heritage Three oval shaped piles of stones, each measuring approximately 1.5 m by 2 m. The area encompassing the three mounds is about 10 m by 3 m in dimension. The site is located near a fence line in an area used for grazing. Although unlikely given their informal appearance, they could be stone grave dressings marking graves. However, historical aerial photography shows that a ploughed field extended right up to this location in the past and shows that the rocks were indeed cleared from that field. The site is thus not considered a heritage resource	---
MD007	26° 36' 53.2908" S29° 10' 57.9253" E 	Archaeological – stone features Large ruined historical farmstead complex. The complex includes multiple degraded structures such as the farmhouse, a small rondavel, a small brick structure and a broken-down cattle handling area. The main farmhouse is built from stone and cement and includes multiple rooms with brick and cement garage that seems to be a recent addition to the main house ruin. The rondavel is also built from red bricks. The main house is about 20 by 30 m in size, while the overall farm complex measures some 100 m by 100 m	GPA
MD008	26° 36' 34.8805" S29° 10' 44.8319" E	Possible grave Two possible stone packed graves lying about 25 m northwest of the ruins at MD009. The features are very degraded and difficult to define. Sisal bush growing on top of the site. The two mounds lie in an area of about 4 m by 4 m. There is no interpretive evidence to be gained from the historical aerial photography shown under	IIIA

WAYPOINT	LOCATION	NATURE	GRADE
		MD009. Therefore, for precautionary reasons they are given a grading of IIIA	
MD009	26° 36' 35.2692" S29° 10' 45.5449" E 	Archaeological – stone features Remains of a demolished sandstone ruin. Various small foundations and demolished features are situated within close proximity of the main ruin. The main ruin is about 11 m by 6 m, while the larger area encompassing all demolished features is about 50 m by 50 m	GPB
MD010	26° 38' 27.7655" S29° 08' 26.9880" E 	Possible grave Possible stone packed grave situated some 90 m from a small stream and about 20 m from the edge of a ploughed field. The area is used for grazing. The stone feature as visible is about 1 m by 1.5 m in size. Although possibly representing stones cleared from the adjacent field, it is further than expected from the field. It is a low mound with a fairly distinctive grave-like shape and, for precautionary reasons, the site is considered a possible grave	IIIA
MD011	26° 38' 37.7592" S29° 08' 30.6383" E	Archaeological – stone feature Remains of a demolished stone structure measuring about 4 m by 4 m	GPC

WAYPOINT	LOCATION	NATURE	GRADE
			
MD012	26° 37' 13.5985" S29° 09' 56.4911" E 	Archaeological – stone features Large, ruined historical farmstead containing multiple partially demolished or collapsed structures built mostly of stone blocks. Modern additions were added in recent times and built from brick. The various structures include a large farmhouse built mostly from stone blocks but with some modern brick elements, various smaller stone structures relating to the main farmhouse, a large stone kraal or walled field situated just north of the main farmstead and measuring about 110 m by 130 m and with smaller enclosures inside its western end, several other outbuildings to the west of the house. Most of the structures are fairly degraded. Most of the walling is still standing, but all roofs and joinery have been removed. The structures are all within an area of about 200 m by 200 m and the site lies outside the study area but very close to the boundary	GPA
MD013	26° 37' 07.9300" S 29° 14' 03.0000" E	Archaeological – stone features	GPA
MD014	26° 37' 22.7600" S 29° 11' 22.8600" E	Archaeological – stone features	GPA
MD015	26° 38' 29.8400" S 29° 09' 55.7800" E	Possible graveyard one further possible graveyard has been identified from aerial photography. There is a strongly likelihood that this is a graveyard and it has been allocated a grade of IIIA for precautionary reasons	IIIA

WAYPOINT	LOCATION	NATURE	GRADE
			

The sites recorded are all stone-walled sites assumed to be the dwellings and associated structures of white farmers. Most likely have their roots in the 19th century but would have fallen into disuse during the 20th century. Historical buildings were often purposefully demolished so that the stones could be reused elsewhere on the farms and this may explain the very limited runnel at most of the sites. It is possible that abandoned houses may have been used by farm labourers before their eventual demolition and, as such, the possibility of still-born babies having been buried there must be considered. The chances of this happening are, however, very small and such remains would likely not be findable during earthmoving.

HISTORICAL ASPECTS AND THE BUILT ENVIRONMENT

During the mid-17th century, the Dutch East India Company established a trading post at modern-day Cape Town. Simultaneously, the Portuguese colonised Lourenço Marques (Maputo), Mozambique. As such, the Mpumalanga landscape became a thoroughfare for local and foreign traders. However, the increasing intensity of interaction among indigenous peoples and European merchants led to intensified competition over control of trade routes and accumulating wealth. Consequently, political centralisation led to warfare and population displacement (Derricourt & Evers 1973; Esterhuysen & Smith 2007; Delius *et al.* 2012).

By the 1830s, Dutch-speaking farmers started to migrate from modern-day Cape Town towards the interior regions of South Africa. Dutch-speaking migrants entering the region were confronted with existing tension between local groups due to the ongoing Mfecane, trade conflicts, and pressure from foreign merchants. Motivated to improve their own economic position within the area, more conflict between the Dutch, Sotho-Tswana and Nguni speaking communities started to take place (Giliomee & Mbenga 2007). Ultimately, Dutch-speaking farmers did settle in Mpumalanga and neighbouring provinces.

During the 1850s coalfields were already being exploited. Coal served a variety of purposes, as it still does today. From powering steam trains, ships, furnaces for smelting metals, it was also utilised within a domestic context, to heat up space and cook food. Since the discovery of diamonds and gold the industrial demand for coal increased significantly. Lucrative mining continued until the onset of the South African War of 1899 -1902 when the workforce joined the war effort, and, as usual during wartime, railways and infrastructure were destroyed. Following the end of the South African War, activities within the South African Union (formed in 1910) were aimed at stabilising the economy by focusing on agriculture and coal mining. However, post-war socio-economic and political crises, especially after World War I (1914-1918) had a profound economic and political impact on the South African coal industry and mine workers (Giliomee & Mbenga 2007). Due to the relative economic and political stability after World War II (1939-1945), mining towns were established and coal mining continued. Today coal is still an integral part of the South African economy, used for the generation of electricity, synthetic fuels, and petrochemical products (Mathu & Chinomona 2013).

The discovery of coal, gold and diamonds during the mid-19th century led to a variety of socio-economic changes within South Africa. Since the discovery of mineral wealth, the new wage-economy and migrant labour systems contributed to the demise of traditional homestead economies and social organisation. In addition, competition for resources led to conflict, political upheavals and ultimately warfare (e.g., Crush & Soutter 1999; Delius 2014).

The province of Mpumalanga has the most collieries and the largest coalfield. The study area is situated near the town of Secunda within the GMM. The town was established in 1976 by Sasol Limited, on the farm Goede Hoop (Schirmer 2007; Mathu & Chinomona 2013).

The site itself is an agricultural landscape and, as shown on the historical aerial photography in **Figure 7-49** and modern view in **Figure 7-50**, its overall character has not changed over the last 67 years . A few specific changes are noticeable, however:

— The cultivated lands have changed slightly with some no longer in use and some new ones;
— Some new farmsteads have been added in the area since 1953 (including some within the study area);
— The Secunda Sasol Refinery has been developed immediately north of the study area; and
— Various small farm dams have been added to the landscape.

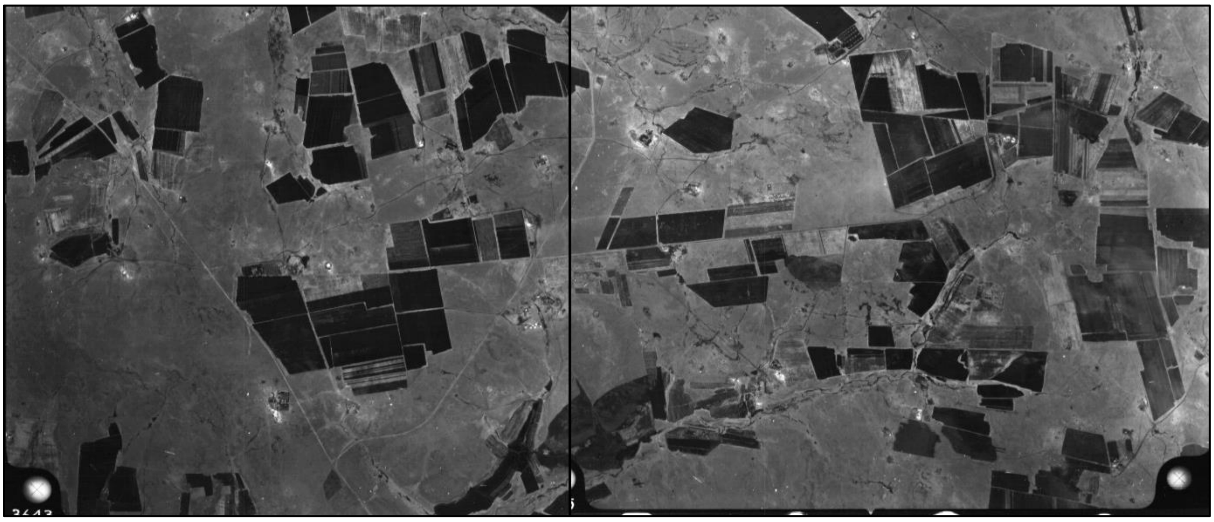


Figure 7-49: Aerial view from 1953 (326_004_03643 & 5) showing the landscape as a patchwork of arable lands and grassland

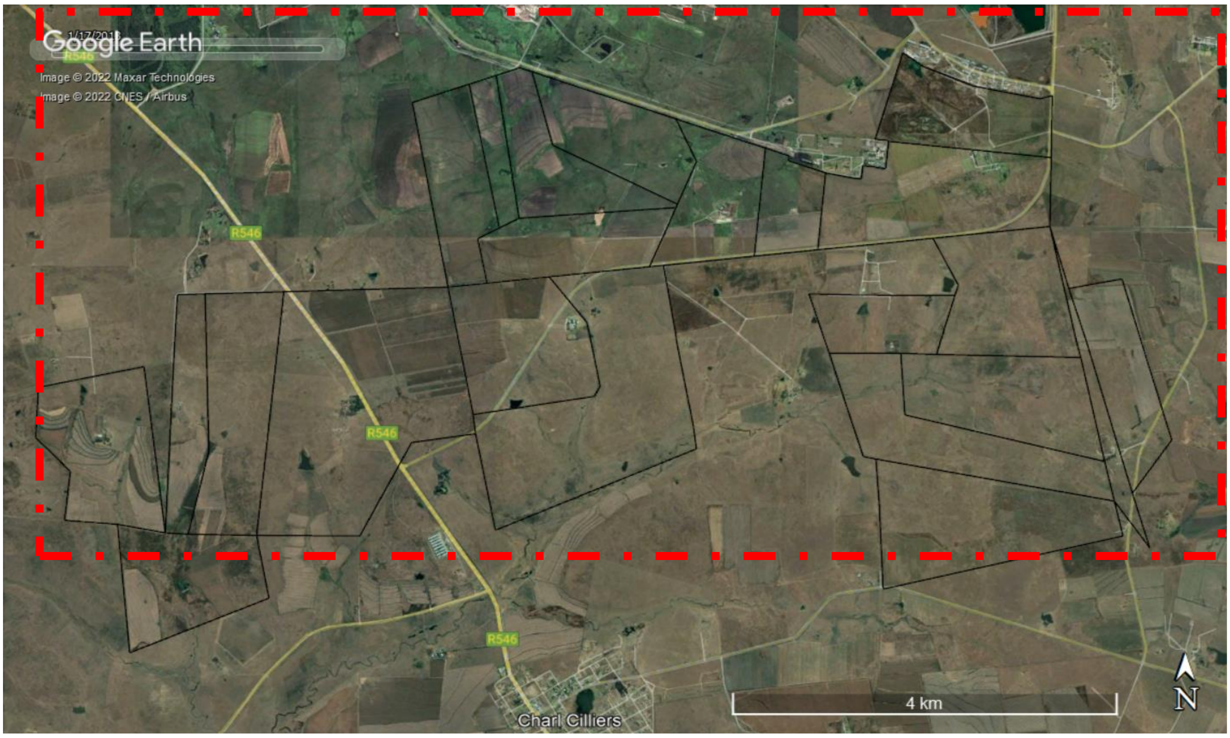


Figure 7-50: Modern aerial view (Google Earth) showing a similar patchwork of arable lands and grassland. The red box represents the area covered by Figure 7-49 above

It is evident from the historical archaeological finds that the agricultural landscape is historical, but many structures in the area seem to be relatively modern. No doubt a number of existing houses are older than 60 years but, because the survey focused on the then-proposed turbine locations, no houses were not visited. No buildings, historical or otherwise, will be directly impacted and no other historical sites are anticipated to occur in the study area.

CULTURAL LANDSCAPE

Cultural landscapes are the product of the interactions between humans and nature in a particular area. Sauer (1925) defined them thus: "The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape the result".

The historical landscape is an agricultural one characterised by grazing lands (grass) and arable lands (planted with crops). The landscape is extensive and is punctuated by towns and coal mines. It is not a particularly sensitive cultural landscape with most of its development having taken place during the 20th century. Locally, it is compromised by the very large Sasol facility located 5 km north of the study area, and several coal mines in the surrounding landscape.

There are no scenic routes in the area and the R546 that runs from northwest to southeast through the western part of the study area is a relatively minor road that is highly unlikely to be considered a scenic route.

STATEMENT OF SIGNIFICANCE AND PROVISIONAL GRADING

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The reasons that a place may have cultural significance are outlined in Section 3(3) of the NHRA (see Section 2 above).

The archaeological resources are deemed to have low to medium cultural significance at the local level for their scientific value and can be variably graded from GPA to GPC.

Graves are deemed to have high cultural significance at the local level for their social value. They are allocated a grade of IIIA. Possible graves are included here for precautionary reasons.

The cultural landscape is largely an agricultural landscape with low aesthetic value due to the visual intrusions from the nearby Sasol facility and coal mines which add an industrial layer. It is rated as having low cultural significance at the local level.

Figure 7-51 shows a grade map with all currently known heritage resources indicated with 50 m buffers.

Figure 7-51: Grade map of the study area showing the locations of all sites found. They are coloured as follows: Graded IIIA = dark red, GPA = orange, GPB = yellow and GPC = white

7.3.5 VISUAL CHARATER AND SENSITIVITY

The following is extracted from the Visual Impact Assessment compiled by SLR Consulting (Pty) Ltd and included as ***Appendix H-10****.*

The broader area surrounding the proposed Mukondeleli WEF is characterised by a mix of flat to undulating plains intersected by shallow river valleys. Areas of slightly higher elevation form a plateau in the central and eastern sections of the study area. Slopes across the study area are relatively gentle to low, with steeper slopes being largely associated with the more incised river valleys The main water course in the study area is the Boesmanspruit which occupies a shallow valley to the south-west of the Mukondeleli WEF project area.

The Mukondeleli WEF project area is largely located on a plateau where relatively flat to undulating terrain prevails with only gentle slopes in evidence across the site.

The nature of the topography and the position of the viewer within the landscape are strong factors influencing the types of vistas typically present. Wider vistas will typically be experienced from higher-lying areas or hilltops and as such the view will be directly dependent on whether the viewer is within a valley bottom or in an area of higher elevation. Importantly in the context of this study, the same is true of objects placed at different elevations and within different landscape settings. Objects placed on high-elevation slopes or ridge tops would be highly visible, while those placed in valleys or enclosed plateaus would be far less visible.

The position of the viewer within the landscape will influence the types of vistas typically present. Viewers located within a more incised valley for example would have limited vistas, whereas much wider vistas would be experienced by viewers on higher-lying ridge tops or slopes. Importantly in the context of this study, the same is true of objects placed at different elevations and within different landscape settings.

Bearing in mind that wind turbines are very large structures (potentially up to 300m in height including the rotor blades with a diameter of 200m), these could be visible from a considerable area around the site. Although localised topographic variations may limit views of wind turbines from some areas within the study area, there would be very little topographic shielding across the remainder of the study area to lessen the visual impact of the turbines from any locally occurring receptor locations.

The high degree of visibility was confirmed by way of a preliminary visibility analysis for the EIA phase turbine layout proposals as provided by Mukondeleli. A worst-case scenario was assumed when undertaking the analysis, in which the proposed turbines were assigned a maximum height 300 m (maximum height at blade tip). The resulting viewshed as shown in **Figure 7-52**, indicates that although there are some scattered pockets of land that are outside the viewshed for the WEF, blade tips of wind turbines positioned on the application site would be visible from most parts of the study area.

Detailed topographic data was not available for the broader study area and as such the visibility analysis does not consider any localised topographic variations which may constrain views. Additionally, the visibility analysis is based entirely on topography and does not consider any existing vegetation cover or built infrastructure which may screen views of the proposed development. This analysis should therefore be seen as a conceptual representation or a worst-case scenario.

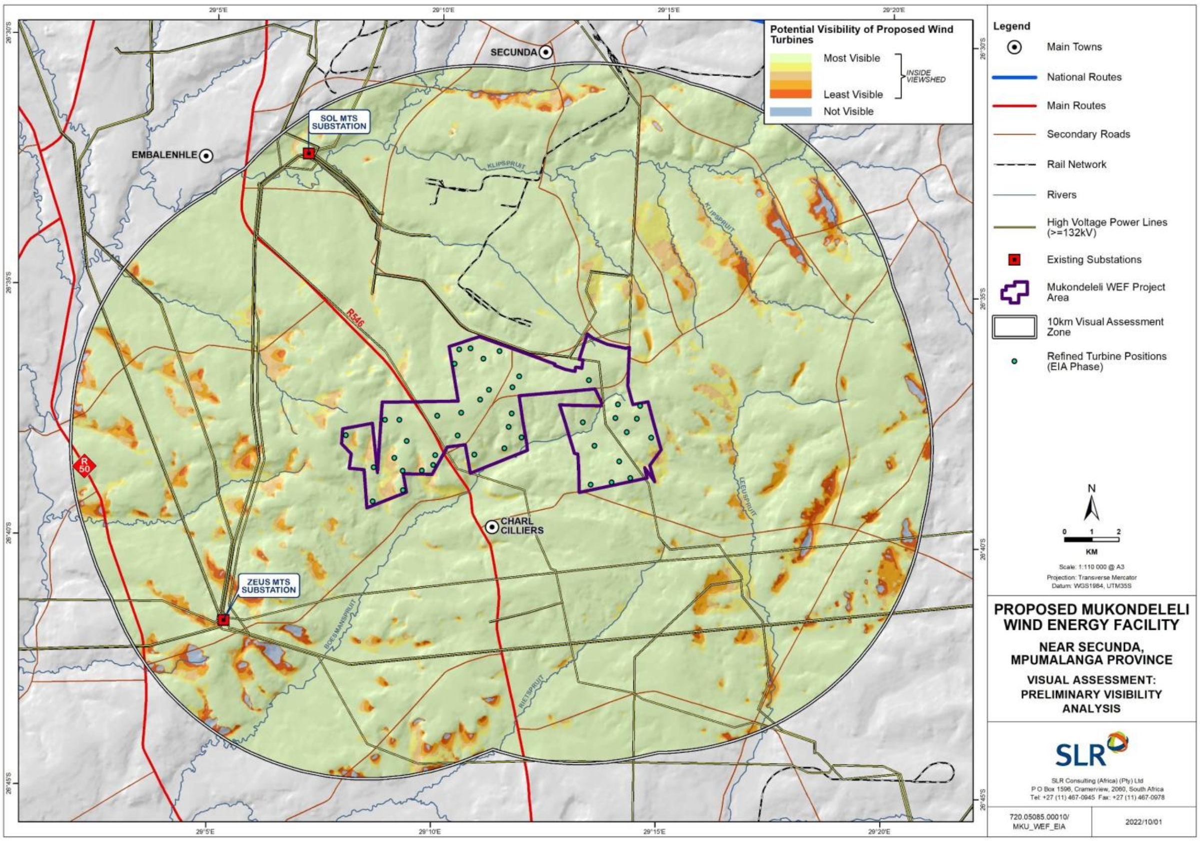


Figure 7-52: Potential Visibility of Wind Turbines

VISUAL CHARACTER AND CULTURAL VALUE

The physical and land use-related characteristics of the study area as described above contribute to its overall visual character. Visual character largely depends on the level of change or transformation from a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural, undisturbed landscape. Visual character is also influenced by the presence of built infrastructure including buildings, roads and other objects such as telephone or electrical infrastructure. The visual character of an area largely determines the sense of place relevant to the area. This is the unique quality or character of a place, whether natural, rural or urban which results in a uniqueness, distinctiveness or strong identity.

The predominant land use in the area (maize cultivation) has significantly transformed the natural landscape across much of the study area. In addition, the landscape becomes progressively more transformed towards the northern and north-western boundary of the study area where the towns of Embalenhle and Secunda, the Sasol Secunda fuel plant and mining activities have resulted in a high degree of visual degradation. The more industrial character of the landscape is an important factor in this context, as the introduction of the proposed WEF would result in less visual contrast where other anthropogenic elements are already present, especially where the scale of those elements is similar to that of the proposed development.

The scenic quality of the landscape is also an important factor that contributes to the visual character or inherent sense of place. Visual appeal is often associated with unique natural features or distinct variations in form. As such, the pastoral landscape and rolling hills in parts of the study area are important features that could increase the visual appeal and visual interest in the area.

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of 'cultural landscape' is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). In this instance, the rural / pastoral landscape represents how the environment has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction.

In light of this, it is important to assess whether the introduction of a WEF into the study area would be a degrading factor in the context of the prevailing character of the cultural landscape. Broadly speaking, visual impacts on the cultural landscape in the area around the proposed development would be reduced by the fact that the visual character in much of the area has been significantly transformed and degraded by mining, industrial, urban and infrastructural development.

SENSITIVE VISUAL RECEPTOR LOCATIONS

A sensitive visual receptor location is defined as a location from where receptors would potentially be impacted by a proposed development. Adverse impacts often arise where a new development is seen as an intrusion that alters the visual character of the area and affects the 'sense of place'. The degree of visual impact experienced will however vary from one receptor to another, depending on the viewer's perception.

A distinction must be made between a receptor location and a sensitive receptor location. A receptor location is a site from where the proposed development may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Less sensitive receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. More sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include tourism facilities, scenic sites and residential dwellings in natural settings.

The identification of sensitive receptors is typically based on a number of factors which include:

— the visual character of the area, especially taking into account visually scenic areas and areas of visual sensitivity;
— the presence of leisure-based (especially nature-based) tourism in an area;
— the presence of sites / routes that are valued for their scenic quality and sense of place;
— the presence of homesteads / farmsteads in a largely natural setting where the development may influence the typical character of their views; and
— feedback from I&APs, as raised during the public participation process conducted as part of the Environmental Assessment study.

As the visibility of the development would diminish exponentially over distance, receptors that are closer to the WEF would experience greater adverse visual impacts than those located further away. Visual impacts resulting from wind turbines would be greatest within a 1km to 2km radius, and although turbines may still be visible beyond 10km, the degree of visual impact would diminish considerably at this distance.

At this stage of the process, zones of visual impact for the proposed WEF have been delineated according to distance from the nearest turbine position as per the EIA Phase WEF layout provided by the proponent. Based on the height and scale of the WEF project, the distance intervals chosen for the zones of visual impact are as follows:

— ≤2km (high impact zone)
— 2.1km – 6km (moderate impact zone)
— 6.1km – 10 km (low impact zone

The degree of visual impact experienced will vary from one receptor location to another, as it is largely based on the viewer's perception. Factors influencing the degree of visual impact experienced by the viewer include the following:

— Value placed by the viewer on the natural scenic characteristics of the area;
— The viewer's sentiments toward the proposed development. These may be positive (a symbol of progression toward a less polluted future) or negative (foreign objects degrading the natural landscape); and
— Degree to which the viewer will accept a change in the typical character of the surrounding area.

Preliminary desktop assessment did not identify any formal protected areas in the study area for the proposed Mukondeleli WEF. The desktop assessment did however identify two receptors which are considered to be sensitive due to the fact that they are linked to leisure / tourism activities, these being Rhino Lodge Game Farm (SR1 and Zorgen Vrij Wedding Venue (SR2).

In addition, multiple farmsteads and residences were identified within the study area. While these homesteads and residences could be considered to be receptors, not all of them would be sensitive to the proposed development and given the number of farmsteads, it was not possible to confirm the presence of receptors at all the identified locations. Notwithstanding these limitations, all the identified receptor locations were assessed as part of the VIA as they are still regarded as being potentially sensitive to the visual impacts associated with the proposed development.

Although most of the receptor locations are believed to be farmsteads, they are regarded as potentially sensitive visual receptors as the proposed development could potentially alter natural or semi-natural vistas experienced from these locations. At this stage however, local sentiments towards the proposed development are not known.

It was noted that residential areas within the towns of Embalenhle, Charl Cilliers and Secunda are located within the Mukondeleli WEF study area and while these could be considered as receptors, they are not considered to be sensitive due to their location within built-up, transformed areas.

In many cases, roads along which people travel, are regarded as sensitive receptors. The primary thoroughfare in the study area is the R546 Main Road which traverses the study area, linking Standerton to the south with the N17 National Route and Kinross to the North. In addition, a small section of the R50 arterial route runs along the western boundary of the study area, providing a more direct route between Standerton and the N17. The sections of these roads traversing the study area are not considered part of designated scenic routes, although these routes are important links and are likely to be utilised, to some extent, by tourists exploring this part of Mpumalanga Province. As a result, they are considered to be potentially sensitive receptor roads – i.e., roads being used by motorists who may object to the potential visual intrusion of the proposed WEF and associated infrastructure.

Other minor thoroughfares in the study area are primarily used as local access roads and do not form part of any scenic tourist routes. These roads are not specifically valued or utilised for their scenic or tourism potential and are therefore not regarded as visually sensitive.

The potentially sensitive visual receptor locations identified within the study area for the Mukondeleli WEF are indicated in **Figure 7-53**.

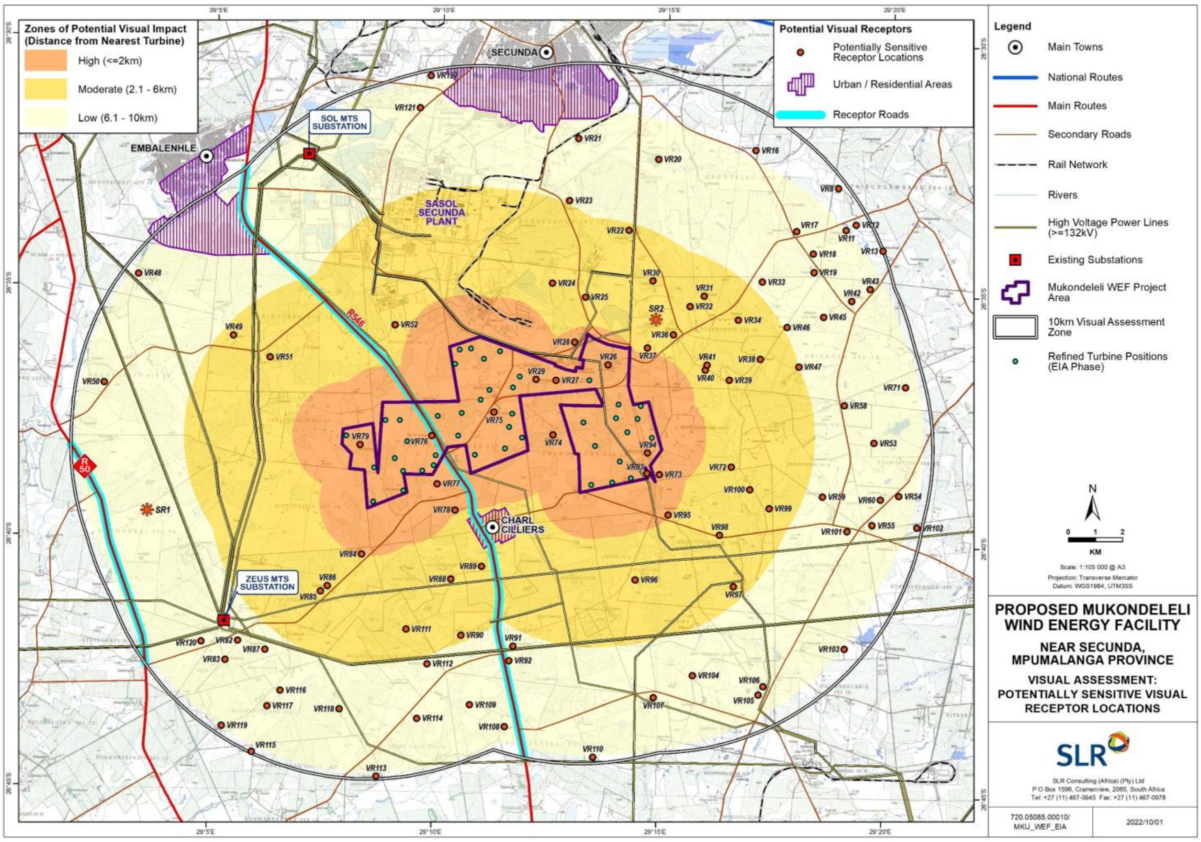


Figure 7-53: Potentially Sensitive Visual Receptor Locations

PHOTOMONTAGES

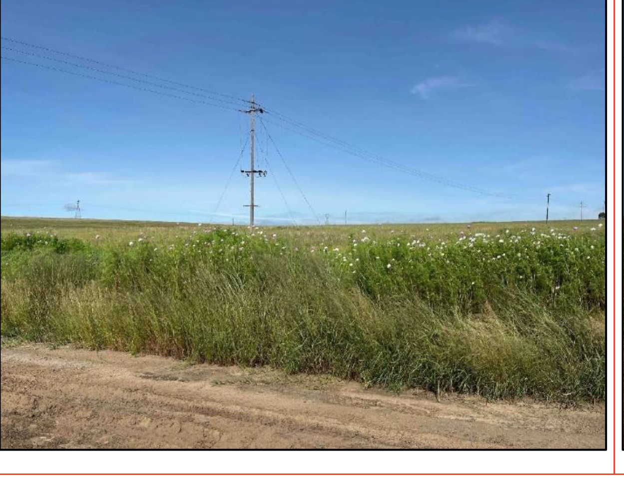
Photomontages (visual simulations) have been compiled to provide an indication of how the proposed Mukondeleli WEF development would appear from selected view points within the visual assessment area (**Table 7-29**). Photomontages for these locations were compiled by superimposing a 3 Dimensional model of the Mukondelei WEF turbine layout onto photographs taken during the site visit.

Limitations associated with this exercise are outlined below.

- Access to areas off the main roads was restricted and as such, only a limited number of suitable view points were photographed.
- Photomontages are specific to each location, and even sites in close proximity to one another may be affected in different ways by the proposed WEF development.
- The photomontages represent a visual environment that assumes that all vegetation cleared during construction will be restored to its current state after the construction phase. This is however an improbable scenario as some vegetation cover may be permanently removed which may reduce the accuracy of the models generated.
- Infrastructure associated with the WEF has not been included in the models.
- These photomontages have been provided merely as indicative illustrations and should not be seen as an accurate representation of the proposed Mukondeleli WEF turbine layout.

However, the resulting photomontages presented below are still considered relevant as they illustrate how views from each selected viewpoint could potentially be transformed by the proposed WEF development if the wind turbines are erected within the project area as proposed.

Table 7-29: Photomontages

VIEWPOINT	DESCRIPTION	PRE-CONSTRUCTION	POST CONSTRUCTION
MW1	This viewpoint is located on the R546 Main Road, in the Mukondeleli WEF project area approximately 1.5 km from the nearest turbine placement in the view and is thus in a zone of high visual impact		
MW2	This viewpoint is located on the south-eastern boundary of the Mukondeleli WEF project area approximately 1.2 km from the nearest turbine placement in the view and is thus in a zone of high visual impact		

VIEWPOINT	DESCRIPTION	PRE-CONSTRUCTION	POST CONSTRUCTION
MW3	This viewpoint is located on the District Road immediately south of the Mukondeleli WEF project area, approximately 1.1 km from the nearest turbine placement in the view and is thus in a zone of high visual impact		
MW4	This viewpoint is located on the District Road immediately south of the Mukondeleli WEF project area, approximately 3.2 km from the nearest turbine placement in the view and is thus in a zone of moderate visual impact		

7.3.6 SOCIO-ECONOMIC

*The following is extracted from the Social Impact Assessment compiled by Tony Barbour Environmental Consulting and included as **Appendix H-8***

SOCIAL OVERVIEW OF THE STUDY AREA

The study area is located approximately 8-10 south of the town of Secunda in the GMM. The town of Secunda has its origins in the 1973/74 international oil crisis when the then South African Government took the decision to establish a second coal liquefaction plant following the establishment of the first at Sasolburg in the 1950s. After the site for the Sasol complex had been identified, it had to be decided whether or not to combine the existing towns of Evander and Trichardt. The huge burden that extensions of this nature would have had on the financial and administrative resources of the established communities as well as the tempo at which such development should proceed was decisive and resulted in the decision to develop Trichardt and Secunda to be one town, named Secunda. Evander, located ~ 8km to the west of the current day Secunda, remained a separate town. Trichardt borders onto the northern part of Secunda.

The first town area was proclaimed in June 1976[15]. The name Secunda is derived from the from the Latin, secundi meaning second/following, and was given to the town as it was the second extraction refinery producing oil from coal, after Sasolburg, which is located approximately 140km west of Secunda. The town was located adjacent to the large coalfields in the area, including the Evander and Winkelhaak coal mines located to the north west of the town. The Secunda facility consists of Sasol Two (1980) and Sasol Three (1982) is the largest coal liquefaction plant in the world, and produces synthetic fuel, diesel, and related fuels and petrochemicals from coal gasification. The Secunda facility is located to the south of the town, approximately 3.5 km from the northern boundary of the WEF site **(Figure 7-54**). The town of Secunda is located approximately 90 km west of Benoni in Gauteng, and 23 km west of Bethal. The N17 which runs to the north of the town and the site connects the towns of Benoni and Bethal. The small settlement of Charl Cilliers is located ~ 2km to the south of the WEF site. The Brandspruit Mine is located ~ 1.5 km to the north of the northern boundary of the WEF site. The western section of the WEF site is bisected by the R 546.

The other land uses in the study area include coal mining and commercial agriculture. Commercial agriculture in the study area located to the south of the N17 and east of Secunda includes livestock and grain farming. Based on the Google Earth information there appear to be a limited number of farmsteads in the study area. The number of occupied farmsteads will be confirmed during the site visit undertaken during the assessment phase. The social environment can therefore be described is a working agricultural / industrial environment. There do not appear to be any tourist related activities located in the study area. Therefore, from a social perspective there appear to be a limited number of sensitive social receptors. This will be confirmed during the site visit undertaken during the Assessment Phase of the SIA.

15 https://www.primidi.com/secunda_mpumalanga/early_history

Figure 7-54: Secunda Sasol Facility

ADMINISTRATIVE CONTEXT

The study area is located within the GMM within the Mpumalanga Province. The GMM is one of the seven Local Municipalities that make up the Gert Sibande District Municipality. The town of Secunda is the administrative seat of the GMM (**Figure 7-55**).

Figure 7-55: Location of Govan Mbeki Municipality within the Gert Sibande District Municipality.

DEMOGRAPHIC OVERVIEW

POPULATION

The population of the GMM in 2016 was 340 091 (Community Household Survey 2016). Of this total, 32.5% were under the age of 18, 63.3% were between 18 and 64, and the remaining 4.2% were 65 and older. The GMM therefore had a high percentage of the population that fall within the economically active group of 18-65. The population of Ward 5 in 2011 was 9 219 (Census 2011). Of this total, 21.5% were under the age of 18, 72.1% were between 18 and 64, and the remaining 6.4% were 65 and older. Ward 5 like the GMM also had a high percentage of the population that fall within the economically active group of 18-65. The figures are higher than the figures for the GSDM and Mpumalanga (57.7% and 56.6% respectively). This is due to the employment opportunities associated with the industrial, mining and manufacturing activities in the MM.

The dependency ratio is the ratio of non-economically active dependents (usually people younger than 15 or older than 64) to the working age population group (15-64). The higher the dependency ratio the larger the percentage of the population dependent on the economically active age group. This in turn translates to reduced revenue for local authorities to meet the growing demand for services. The traditional approach is based people younger than 15 or older than 64. The information provided provides information for the age group under 18. The total number of people falling within this age group will therefore be higher than the 0-15 age group. However, most people between the age of 15 and 17 are not economically active (i.e., they are likely to be at school).

Using information on people under the age of 18 is therefore likely to represent a more accurate reflection of the dependency ratio. Based on these figures, the dependency ratios for the GMM, the GSDM and Mpumalanga in 2016 were 58%, 73.5% and 77% respectively. The dependency ratio for Ward 5 in 2011 was 38.6%. The lower dependency ratios in the GMM and Ward 5 reflect the employment and economic opportunities in and around Secunda linked to the towns petrochemical and industrial sector.

In terms of race groups, Black Africans made up 85.8% of the population on the GMM, followed by Whites, 12.1% and Coloureds (1.2%). The figures for Ward 5 in 2011 were Whites (72.6%), Black Africans (22.2%), Indian or Asian (2.7%) and Coloureds (2.3%). The main first language spoken in the GMM was isizulu, 60.5%, followed by Siswati, 7.3% and Afrikaans, 6.2%. In Ward 5 Afrikaans (64.6%) followed by English (11.1%) were the main languages spoken.

HOUSEHOLDS AND HOUSE TYPES

The total number of households in the GMM in 2016 was 108 892, which constituted approximately 33% of the total number of households in the GSDM. Of these 63% were formal houses, 20.4% were shacks, and 10.6% were flats in backyards. The figures for the GSDM were 67.2%, 13.4%, 6.7% and 8.3% respectively. While the majority of dwellings in the GMM are formal structures there are a high percentage of informal structures which reflects the migration of jobseekers to the area and the pressure this in turn places on housing. In Ward 5 82.5% of the dwellings were formal houses. There were no reported shacks.

In terms of ownership, 46% of the dwellings in the GMM were owned and fully paid off, while 10.6% were in the process of being paid off. 17.9% of the dwellings were rented from private individuals. In Ward 5, 15.2% were owned and fully paid off, 34.2% were in the process of being paid off, and 35% were rented. A relatively large percentage of the properties in the GMM (56.6%) were owned and or in the process of being paid off. This reflects a relatively stable and established community.

In terms of household heads, approximately 30.8% of the households in the GMM and 39.1% of the households in the GSDM were headed by women. These figures similar to the provincial figure of 39.71%. The figure for Ward 5 in 2011 was substantially lower at 15.5%. The high percentage of households headed by women in the GMM reflects the likelihood that the men have left the area in search of employment opportunities in Gauteng. This is despite the well-developed industrial sector in and around Secunda. Women headed households tend to be more vulnerable.

HOUSEHOLD INCOME

Based on the data from the 2011 Census, 16.6% of the population of the GMM had no formal income, 3.6% earned less than R 4 800, 5.5% earned between R 5 000 and R 10 000 per annum, 12.6% between R 10 000 and R 20 000 per annum and 16.4% between R 20 000 and 40 000 per annum (2016). The poverty gap indicator produced by the World Bank Development Research Group measures poverty using information from household per capita income/consumption. This indicator illustrates the average shortfall of the total population from the poverty line. This measurement is used to reflect the intensity of poverty, which is based on living on less than R3 200 per month for an average sized household (~ 40 000 per annum). Based on this measure, in the region of 54.7% of the households in the GMM and 65.2% in the GSDM live close to or below the poverty line. The figure for Ward 5 in 2011 was 16.9%.

The low-income levels in the GMM and GSDM reflect the limited formal employment opportunities outside in the urban areas. This is also reflected in the high unemployment rates. The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the GMM. This in turn impacts on the ability of the GMM to maintain and provide services.

Household income levels are likely to have been impacted by the COVID-19 pandemic. The number of households in the GMM and GSDM that live close to or below the poverty line is likely to have increased over the last 18 months. This, coupled with the high dependency ratio, is a major cause of concern for the area.

EMPLOYMENT

The official unemployment rate in the GMM in 2016 was 17.2%, while 48.5% were employed, and 31% were regarded as not economically active. The figures for Ward 5 in 2011 were 3.6%, 63.6% and 32.4% respectively. However, the COVID-19 pandemic is likely to have resulted in an increase in unemployment rates in both the GMM and Ward 5. Recent figures released by Stats South Africa also indicate that South Africa's unemployment rate is in the region of 36%, the highest formal unemployment rate in the world.

EDUCATION

In terms of education levels, the percentage of the population over 20 years of age in the GMM and GSDM with no schooling was 6.5% in 2016, compared to 10.8% and 11.3% for the GSDM and Mpumalanga Province respectively. The figure for Ward 5 in 201 was 1.8%. The percentage of the population over the age of 20 with matric in the GMM (2016) and Ward 5 (2011) was 39.4% and 39.2% respectively, compared to 34.3% and 36.1% for the GSDM and Mpumalanga. The education levels in the GMM and Ward 5 are therefore marginally higher than the DM and Provincial figures.

MUNICIPAL SERVICES

ELECTRICITY

Based on 2016 survey, 95.1% of households in the GMM had access to electricity, compared to 90% for the GSDM and 93% for Mpumalanga.

ACCESS TO WATER

Based on the 2016 survey information, 96.9% of households in the GMM were supplied by a service provider. This compares to 86.7% and 80.5% for the GSDM and Mpumalanga respectively. The figure for Ward 5 in 2011 was 91.4%.

SANITATION

94.9% of the households in the GMM had access to flush toilets (2016), while 3.4% relied on pit toilets. This compares to 65.3% and 42.1% for the GSDM and Mpumalanga respectively. The figure for Ward 5 in 2011 was 94.5%. Only 0.5% of the households in the GMM reported that they had no access to formal sanitation, compared to 2.6% and 2.8% for the GSDM and Mpumalanga respectively.

REFUSE COLLECTION

72.5% of the households in the GMM had access to regular refuse removal service, while for 13.9% the service was provided, but not on a regular basis. This compares to 52.2% for the GSDM (regular) and 5.2% (irregular). 89% of households in Ward 5 had their waste collected on a regular basis by a service provided.

7.4 HEALTH AND SAFETY

The following is extracted from the Safety Health and Environmental Risk Assessment *compiled by* ISHECON *and included as* ***Appendix H-12.***

7.4.1 SOLID STATE LITHIUM BATTERY CHEMICAL HAZARDS

HAZARD - THERMAL DECOMPOSITION

Upon heating of the contents of a battery due to shorting, contaminants, external heat or exposure to water and reaction heat, the lithium salts in batteries begin to break down exothermically to release either oxygen (oxidants) that enhances combustion, possibly leading to explosion, or fumes such as hydrogen fluoride or chlorine that are toxic.

These exothermic break down reactions are self-sustaining above a certain temperature (typically 70 deg C) and can lead to thermal run away. In this process the battery gets hotter and hotter, the decomposition reactions happen faster and faster and excessive hot fumes are generated in the battery. Eventually the pressure in the battery builds up to the point where those gases need to vented, usually via the weakest point in the system. These vented fumes can be flammable due to vaporization of the electrolyte and can ignite as a flash fire or fire ball (if large amounts) leading to the fire spreading to any surrounding combustible materials, e.g. plastic insulation on cables, the electrolyte, the electrodes and possibly even the plastic parts of the battery casing etc. If the vented flammable vapours do not ignite immediately, they can accumulate within the surrounding structures. If this flammable mixture is ignited later, e.g. due to a spark, this can lead to a violent explosion of the module, cabinet, room, container etc. In addition to being flammable the vented gases will contain toxic components. These could include:

- The products of combustion such as carbon dioxide/monoxide, hydrogen cyanide
- VOCs like benzene and ethylene,
- Decomposition products such as hydrogen fluoride, hydrogen chloride, phosphorous pentafluoride, phosphoryl fluoride and oxides of aluminium, cobalt, copper etc.

The temperature in the batteries and of these vented gases can be extremely high, e.g. > 600 deg C.

In the situation where oxygen is released internally as part of the decomposition (e.g. lithium perchlorate) the oxygen is available to react with the combustible electrolyte and if all this happens extremely fast in a self-sustaining manner within the confines of the device, an explosion of the device can result.

HAZARD - PROPAGATION

A BESS is composed of individual batteries which are combined into different size packs such as modules, racks. The very high temperature generated by one battery cell in thermal run away could lead to overheating of adjacent cells. This cell in turn then starts thermal decomposition and so the process propagates through the entire system. In order to prevent propagation, there are separation requirements between cells, modules etc. Separation could be with physical space or insulating materials etc.

HAZARD - ELECTROLYTE LEAKS

Although extremely unlikely due to the structure of the batteries, should electrolyte liquid leak out of the batteries, it can be potentially flammable as well as corrosive etc. If ignited as fire, or explosion, the smoke would contain toxic components. If unignited it can still be extremely harmful especially if its decomposition products include hydrofluoric acid.

7.4.2 VANADIUM REDOX FLOW BATTERY HAZARDS

HAZARD – TOXICITY AND CORROSIVITY

The electrolyte in the VRF system is corrosive. It is composed of a sulphuric acid-based solution similar to common automotive lead acid batteries. Unlike traditional lead-acid batteries, VRBs do not include lead.

Therefore, VRBs do not have the toxicity issues of lead that conventional car batteries have. The only potential source of human toxicity in a VRB is Vanadium.

Vanadium in various physio-chemical states can have a relatively high aquatic and human toxicity. Acute oral exposure to high doses can lead to hemorrhaging, while chronic exposure leads to adverse effects on the digestive system, kidneys and blood (diarrhea, cramps etc.).

Inhalation hazards lead to irritation of the respiratory tract, bronchospasm, pulmonary congestion. There is little evidence that vanadium compounds are reproductive toxics or teratogens. There is also no evidence that it is carcinogenic (Source USA EPA Risk Assessment Information Systems, Toxicity Profiles, Vanadium 1998).

In the electrolyte the concentration levels of Vanadium are so low that when it is mixed into liquid form in the final product and put into operation, the VRB is deemed non-toxic. In addition, VRBs have a lower concentration of sulfuric acid than traditional lead-acid batteries. Vanadium poses a hazard when it is in powder form, i.e. when making up the electrolyte solution. The Mukondeleli facilities will purchase electrolyte already made up and there will be no solid vanadium powder on site.

Toxicity or corrosion risks may be present from off-gassing produced by over-heating aqueous or vaporized electrolytes. In addition, flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes. Refer to sections on fire below for mitigation measures.

HAZARD – ELECTRICAL SHOCK/ARC

Electrical shock presents a risk to workers and emergency responders, if the energy storage system cannot be “turned off”. This is referred to as “stranded energy” and presents unique hazards. Arc flash or blast is possible for systems operating above 100 V. Li-ion systems operate from 48 - 1000 V, depending on the battery design.

In the area of shock hazard, a flow battery produces voltage only when electrolytes are in a cell stack. For most designs, if the motors are turned off and fluids drained from the cell stack, then the cell stacks have no measurable voltage at the terminals. This happens not only when the battery is forcible turned off but also in the standby mode as vanadium batteries do not include any metal plates to hold the chemical reactions / charges / voltages and can be fully drained when not in use.

If not fully drained, vanadium flow batteries are also unique in terms of short circuiting in that the internal dynamics of the battery are such that the energy discharge is limited to the fluid in the battery at any given time and the is typically less than 1% of the total stored energy. Therefore, together with the relatively low energy density of the vanadium electrolyte, the immediate release of energy, which occurs as a result of electrical shorting, is somewhat limited. The high heat capacity of the aqueous electrolyte is also beneficial in limiting the temperature rise.

Vanadium flow batteries have been tested under dead-short conditions resulting in normal operation with no danger to either equipment or personnel.

HAZARD – FIRE / DEFLAGRATION

Over 50% of the electrolyte solution is made up of water, which gives the electrolyte a non-flammable property. In the event of short circuiting, intense heat or high pressure, it is unlikely for the battery to catch fire. There is no “thermal runaway” risk when compared to other battery technologies.

Whilst some heat may be discharged from the battery, it will not be at a level that is deemed unsafe. Like all other RFBs, VRFs also have a battery management system. A battery management system ensures optimum and safe conditions for battery operation. Often a heat management system is integrated to avoid too high or too low temperatures.

HAZARD - HYDROGEN GENERATION

As with all other aqueous batteries, aqueous energy storage media from redox flow batteries are also subject to water limitations. In case of too high voltages or more precisely too high or too low half-cell potentials, the water is decomposed into its components, hydrogen and oxygen. The generation of hydrogen in particular is often present as a very small but undesirable side reaction and causes a charge carrier imbalance between positive and negative half-cells, which leads to a slow loss of capacity. It also presents a fire / explosion hazard.

With VRF, due to the flowability of the energy storage medium, the reaction products that would normally remain in the half-cell can be transported out of the cell and stored in separate tanks thus allowing the capability for a higher capacity than that attainable with conventional batteries. In addition, any deviations from safe operating parameter will trigger the shutdown of the system pumps ceasing to charge the electrolyte and thereby reducing the changes of accidental H2 generation. In addition, the thermal mass of the electrolyte tanks can provide an additional barrier to overcharging conditions by allowing ambient temperature during the discharge times to cool the VRF for the next charge cycle.

HAZARD – WASTE ELECTROLYTE

Unfortunately, pentavalent vanadium ions have a tendency to react with each other, which leads to the formation of larger molecules which precipitate as solids and can thus damage the system. The reaction depends on the temperature and the concentration of VO2+ (state of charge) but is also a function of the proton concentration. Temperature and concentrations therefore need to be controlled within specified ranges.

Should the concentration of undesirable components increase in the electrolyte, a part may need to be purged and replaced with fresh electrolyte.

HAZARD - ELECTROLYTE LEAKS

Leaks must be expected in any hazardous-fluid handling equipment. Secondary containment is typically designed into the system and standard corrosive PPE is required for handling liquid. Reliable leak detection, annunciation, and containment is paramount.

As with any chemicals plant a suitable design with detection, alarm and trip instrumentation that has been subject to thorough Hazop study should be in place, e.g. detection of dry running of pumps, detection of dead heading of pumps, prevention of reverse flow, detection of drop in tank levels etc.

7.4.3 OTHER CHEMICALS OR HAZARDS

The BESS is composed not only of the batteries. There are electrical connections, switches, power converters, cooling systems etc.

COOLING SYSTEMS

Due to the need to keep the batteries within a specified temperature range most of the containerized modular system have built-in air-conditioning systems while the VRF building systems may have cooling water systems. Some have only fans for air cooling with filters to remove dust prior to cooling. Others, particularly those in hot environments requiring more cooling, may have refrigerant-based systems. These would have a refrigerant circuit usually containing non-flammable non-toxic refrigerant such as R134a (simple asphyxiant) etc as well as a low hazard circulating medium such as an ethylene glycol-based coolant. At high temperatures above 250 deg C R134 may decompose and may generate hydrogen fluoride and other toxic gases. Ethylene glycol is really only harmful if swallowed. In the environment it breaks down quickly and at low concentrations that would typically occur from occasional small spills, it has no toxicity.

FIRE SUPPRESSION SYSTEMS

Although these are only effective for some fire scenarios, some of the solid-state containerized systems come fitted with “Clean agent” fire suppressant systems. These are pressurized containers of powder/gases that are released into the container to snuff a fire and do not leave a residue on the equipment.

Some containers have water sprinkler systems installed to quench thermal run-away reactions.

VRF batteries do not present a high fire risk. However, on any chemical plant there is always the risk of fires with electrical equipment and other materials used on site. Fire systems would typically consist of local strategically placed extinguishers as well as a fire water hose/hydrant system.

In general fire fighters may respond with water cannons/hydrants, foam systems etc. Such responses may generate large amount of contaminated and hazardous water runoff. A system to contain as much of this as possible should be in place.

GENERAL ELECTRICAL AND ELECTRONIC EQUIPMENT

Whatever the configuration of the battery containers/ buildings there will be electrical and electronic equipment in the battery compartment, the battery building as well as outside. In some installations the main electrical equipment such as the power conversion system is in a separate compartment separated by a fire wall. In others it can be in a separate container.

Wherever there is electrical equipment there is a possibility of shorting and overheating and fire.

8 IMPACT ASSESSMENT

The EIA phase of the S&EIR process has determined potential impacts associated with the proposed Mukondeleli WEF. The anticipated environmental and social impacts have been identified and assessed by the various specialists according to the phases of the project's development. For the purpose of this project, these phases have been generically defined below.

Construction Phase:

The construction phase includes the preparatory works/activities typically associated with the creation of surface infrastructure, access and electrical power. The activities most relevant to this phase include:

- Topsoil stripping;
- Cut and fill activities associated with site preparation (if required); and
- Construction of the surface infrastructure including turbine foundations, turbines, invertors, site substation and internal powerlines.

Operational Phase:

The operational phase includes the daily activities associated with the WEF.

Decommissioning Phase:

The decommissioning phase includes the activities associated with the removal/dismantling of machinery/equipment/infrastructure no longer necessary to the operation.

The impact assessment findings outlined in this section represent a summary of the detailed specialist findings/assessments contained in the relevant specialist reports (**Appendix H**).

The impacts below have been assessed according to environmental categories.

8.1 ACTIVITY MATRIX

The impacts below have been assessed according to environmental categories. **Table 8-1** provides an indication of how these environments are linked to the various NEMA listed activities outlined in **Section 2.**

Table 8-1: Activities Matrix (C – Construction; O – Operation; D – Decommissioning)

ACTIVITY DESCRIPTION	CLIMATE	AIR QUALITY	TOPOGRAPHY	GEOLOGY	SOIL AND AGRICULTURE POTENTIAL	SURFACE WATER	GROUNDWATER	REGIONAL VEGETATION	FAUNA	AVIFAUNA	SOCIAL	HERITAGE AND PALEONTOLOGY	VISUAL	TRAFFIC
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Activity 11(i)	C, D	C, D	O	C, D	C, D	C, D	C, D	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C
Activity 12(ii)(a)(c)	C, D	C	C, D	C, D	C, O, D	C, O, D	C, D	C, D	C, O, D	C, O, D	C, D	C, D	C, O, D	N/A
Activity 14	N/A	N/A	N/A	C	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	N/A
Activity 19	C, D	C, D	C, D	C, D	C, D	C, O, D	C, D	C, D	C, O, D	C, O, D	C, D	C, D	C, O, D	N/A
Activity 24(ii)	C, D	C, D	C, D	C	C, D	C, D	N/A	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, O, D
Activity 28(ii)	N/A	N/A	C, D	C, O, D	C, O, D	C, D	C, D	C, O, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, D
Activity 30	C, D	C, D	C, D	N/A	C, D	N/A	N/A	C, D	C, D	C, D	N/A	C, D	N/A	N/A
Activity 48(i)(a)(c)	C, D	C, D	C, D	C, D	C, D	C, D	N/A	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, O, D
Activity 56(ii)	C, D	C, D	C, D	C, D	C, D	C, D	N/A	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, O, D
GNR 984- Listing Notice 2														

ACTIVITY DESCRIPTION	CLIMATE	AIR QUALITY	TOPOGRAPHY	GEOLOGY	SOIL AND AGRICULTURE POTENTIAL	SURFACE WATER	GROUNDWATER	REGIONAL VEGETATION	FAUNA	AVIFAUNA	SOCIAL	HERITAGE AND PALEONTOLOGY	VISUAL	TRAFFIC
Activity 1	O	N/A	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, D
Activity 15	N/A	N/A	N/A	N/A	C	C	C	C,	C	C	N/A	C	C	N/A
GNR 985- Listing Notice 3														
Activity 4(f)(i)(aa)(bb)(cc)(ee)(gg)	N/A	N/A	C, D	C, D	C, D	C, D	N/A	C, D	C, O, D	C, O, D	C, O, D	C, D	C, O, D	C, O, D
Activity 12(f)(i)(ii)(iii)	C, D	C, D	N/A	N/A	C	C	C	C	C	C	N/A	C	C	N/A
Activity 14(ii)(a)(c)(f)(i)(aa)(bb)(dd)(ff)(hh)	N/A	N/A	C, D	C, D	C, O, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, O, D	C, D
Activity 15 (d)(ii)	C, D	C, D	N/A	N/A	C	C	C	C	C	C	C,O	C	C	N/A
Activity 18(f)(i)(aa)(bb)(cc)(ee)(gg)	N/A	N/A	C, D	C, D	C, D	C, D	C	C, D	C, O, D	C, D	C, O, D	C, D	C, O, D	C, O, D
Activity 23(ii)(a)(c)(f)(i)(aa)(bb)(cc)(ee)(gg)	N/A	N/A	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, D	C, O, D	C, D

8.2 AIR QUALITY

8.2.1 CONSTRUCTION PHASE

Emissions during construction are associated with land clearing, drilling, and blasting, ground excavation, cut and fill operations and the movement of heavy construction vehicles on temporary roads. Pollutants associated with construction activities are typically Total Suspended Particulates (TSP), PM10 and PM2.5 with lesser contributions of CO, NO_2, SO_2 and C_6H_6 from vehicle exhausts.

PM refers to solid or liquid particles suspended in the air. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Particles can be classified by their aerodynamic properties into coarse particles, PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) and fine particles, PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5 µm). In addition to reduced visibility, particulate air pollution poses health risks associated with the respiratory system.

Heavy construction activity is a source of dust emissions that can have a significant but transient impact on local air quality. The amount of dust emitted from construction operations depends on the area of land being worked, the proportion of land lying exposed at any time, the clearing and dozing equipment used, the number and type of vehicles on temporary roads, and the duration of the construction phase. The majority proportion of dust emissions result from heavy vehicle traffic movement on temporary gravel roads at the construction site.

Although the increased dust and emissions from construction activities may not significantly impact air quality, increased dust can be a nuisance to the nearby receptors and site workers. Considering the temporary nature of construction and the nature of the proposed activities, impact on air quality is not anticipated to be high. Furthermore, none of the sensitive receptors are within 200m of an area of activity causing dust. With the implementation of appropriate control measures, the impact on neighbouring sensitive receptors will be reduced further but is still assessed to be low.

The impact of the construction phase on the generation of dust and particulate matter (PM) is shown in **Table 8-2**.

Table 8-2: Construction Impact on Generation of Dust and PM

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Generation of Dust and PM									
Without Mitigation	2	2	1	2	5	**35**	**Moderate**	(-)	High
With Mitigation	1	1	1	2	5	**25**	**Low**	(-)	High
Mitigation and Management Measures	— Limit the duration of the construction phase to as short a timeframe as possible. — Where possible, minimise the area under construction. — Make use of wet suppression techniques to minimise dust entrainment along unpaved roads and during periods of high wind speeds. — Where possible, minimise speed limits, vehicle weights and the number of vehicles using unpaved roads. — Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and soil/material stockpiles especially. This includes wetting of exposed soft soil surfaces and not conducting activities during high wind periods which will increase the likelihood of dust being generated; — All stockpiles (if any) must be restricted to designated areas and may not exceed a height of two (2) metres; — Ensure that all vehicles, machines and equipment are adequately maintained to minimise emissions;								

	— It is recommended that the clearing of vegetation from the site should be selective, be kept to the minimum feasible area, and be undertaken just before construction so as to minimise erosion and dust potential; — All materials transported to, or from, site must be transported in such a manner that they do not fly or fall off the vehicle. This may necessitate covering or wetting friable materials. — No burning of waste, such as plastic bags, cement bags and litter is permitted; and — All issues/complaints must be recorded in the complaints register. — Once construction is complete, initiate rehabilitation (e.g. re-vegetation) procedures to reduce wind speed across exposed surfaces.

8.2.2 OPERATIONAL PHASE

Dust and emission generation applicable to the operational phase of Mukondeleli WEF is expected to occur as a result of maintenance vehicles along the gravel. However, this is expected to be intermittent trips and the impacts minimal. Operational phase dust and emissions impacts are not considered further.

8.2.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase.

8.3 NOISE AND VIBRATIONS

8.3.1 CONSTRUCTION PHASE

DAYTIME WTG CONSTRUCTION ACTIVITIES

Daytime ambient sound levels could range between less than 26 dBA to more than 65 dBA, averaging at 45 dBA. Ambient sound levels are typical of a rural noise district and introduced noises could be audible.

Various construction activities (development of access roads, laydown areas, the hard standing areas, excavation and concreting of foundations and the erection of the wind turbines, other infrastructure) taking place simultaneously during the day will increase ambient sound levels due to air-borne noises. The impact of the construction phase on noise and mitigation recommendations are indicated in **Table 8-3**.

Table 8-3: Construction Impact on Noise - Daytime

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Noise									
Without Mitigation	3	2	1	2	2	16	Low	(-)	High
With Mitigation	2	2	1	2	2	16	Low	(-)	High
Mitigation and Management Measures	— The significance of the noise impact is low for daytime construction activities and no additional mitigation is recommended.								

NIGHT-TIME WTG CONSTRUCTION ACTIVITIES

Night-time ambient sound levels could range between less than 23.6 dBA to more than 59 dBA, averaging at 39.5 dBA. Ambient sound levels are slightly elevated, and typical of a rural to suburban noise district. Introduced noises will be audible over 2,000 distances at night, especially during quiet periods.

Various construction activities (likely limited to the pouring of concrete as well as erection of WTG components) taking place simultaneously at night will increase ambient sound levels due to air-borne noise. The impact of the construction phase on noise and mitigation recommendations are indicated in **Table 8-4**. It should be noted that the "very high" magnitude mainly relates to the strict EIA criteria used by the author.

Table 8-4 Construction Impact on Noise – Night-time

Potential Impact Noise	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	5	3	1	2	5	55	Moderate	(-)	High
With Mitigation	3	3	1	2	2	18	Low	(-)	High
Mitigation and Management Measures	While night-time construction activities are generally not anticipated, weather, delays in the schedule or specific activities (such as the continuous pouring of concrete foundations) may require night-time construction activities. The medium significance may also relate to the worst-case scenario being investigated. It is recommended that the applicant: — notify the NSR when night-time activities will be taking place within 1,000m from any NSR; — minimise active night-time construction activities when operating within 1,000m from an NSR at night. Work should only take place at one WTG location to minimize potential night-time cumulative noises; and — plan the completion of noisiest activities (such a pile driving, rock breaking and excavation) during the daytime period.								

8.3.2 OPERATIONAL PHASE

DAYTIME OPERATION OF WTG

WTG will only operate during period with increased winds, periods when ambient sound levels are expected to be higher than periods with no or low winds. Ambient sound levels will likely be higher with this assessment assuming an ambient sound level of 42.5 dBA.

Numerous WTG of the Mukondeleli WEF operating simultaneously during the day will increase ambient sound levels due to air-borne noise from the WTG. The projected noise levels and the change in ambient sound levels is defined for these NSR are summarized in **Table 8-5** below.

Table 8-5: Operational Impact on Noise - Daytime

Potential Impact Noise	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	3	2	1	4	3	30	Low	(-)	High
With Mitigation	3	2	1	4	3	30	Low	(-)	High
Mitigation and Management Measures	— The significance of the noise impact is low and no additional mitigation is recommended.								

NIGHT-TIME OPERATION OF WTG

WTG will only operate during period with increased winds, when ambient sound levels are higher than periods with no or low winds. Ambient sound levels will likely be higher with this assessment assuming an ambient sound level of 42.5 dBA.

Numerous WTG of the Mukondeleli WEF operating simultaneously at night will increase ambient sound levels due to air-borne noise from the WTG.

The impact significance defined in **Table 8-6** however is based on the use of the mitigated WTG, as well as a change in the layout to move some WTG further from NSR.

Table 8-6: Operational Impact on Noise – Night-time

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Noise									
Without Mitigation	3	3	1	4	3	**44**	**Moderate**	(-)	High
With Mitigation	2	3	1	4	2	**20**	**Low**	(-)	High
Mitigation and Management Measures	The significance of the noise impact could be of a moderate significance for night-time operational activities. A number of options are recommended, and it is recommended that the applicant consider one or more of the following options to ensure that total noise levels are less than 45 dBA at all NSR, including: — the applicant can select to use a quieter WTG (with a SPL less than 106.0 dBA as per the IEC 61400-14 certificate) within 2,000m from all NSR where noise rating levels was modelled higher than 45 dBA; or, — the layout be changed, where the WTG located within 1,000m from certain NSR (from all NSR where noise rating levels was modelled higher than 45 dBA) be moved further from this NSR. The applicant should also consider the total number of WTG located within 2,000m from these NSR (to ensure that cumulative noise rating levels are acceptable); or, — the applicant can develop a noise abatement programme, that may require the operation of one or more WTG in a reduced noise mode (if the WTG allows such an operating mode) to ensure that the noise levels are less than 45 dBA at NSR (all NSR where noise rating levels was modelled higher than 45 dBA); or — that certain NSR be relocated (NSR where noise rating levels was modelled higher than 45 dBA); and, the applicant must get confirmation in writing that the structure(s) will not be used for residential purposes in the future.									

8.3.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase.

8.4 GELOLOGICAL ENVIRONMENT

8.4.1 CONSTRUCTION PHASE

SOIL EROSION

Soil erosion can be as a result of the following:

— Increased stormwater velocity.
— Increase in soil and wind erosion due to clearing of vegetation.
— Creation of drainage paths along access tracks.
— Sedimentation of non-perennial features and excessive dust.

The impacts of the construction phase as a result of soil erosion are outlined in **Table 8-7**.

Table 8-7: Construction Impact on Geology (Soil Erosion)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Increased stormwater velocity. — Increase in soil and wind erosion due to clearing of vegetation. — Creation of drainage paths along access tracks. — Sedimentation of non-perennial features and excessive dust.									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Rehabilitation of affected areas (such as revegetation). — Construction of temporary berms and drainage channels to divert surface water. — Minimize earthworks and fills. — Use existing road network and access tracks. — Correct engineering design and construction of gravel roads and water crossings. — Control stormwater flow.								

OIL SPILILAGE

Oil spillage can lead to the contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources. The impacts of the construction phase as a result of oil spillage are outlined in **Table 8-8**.

Table 8-8 Construction Impact on Geology (Oil Spillage)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources..									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	High
With Mitigation	2	2	1	1	2	**12**	**Very Low**	(-)	High

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources..									
Mitigation and Management Measures	— Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. — Frequent checks and conditional monitoring								

DISTURBANCE OF FAUNA AND FLORA

The disturbance of fauna and flora can lead to the displacement of natural earth material and overlying vegetation leading to erosion.

The impacts of the construction phase as a result of the disturbance of fauna and flora are outlined in **Table 8-9**.

Table 8-9 Construction Impact on Geology (Disturbance of Fauna and Flora)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— The displacement of natural earth material and overlying vegetation leading to erosion.									
Without Mitigation	3	1	3	3	3	**30**	**Low**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Limit and control excavations								

SLOPE STABILITY

Instability can result in damage to the infrastructure. The impacts of the construction phase as a result of slope instability are outlined in **Table 8-10**.

Table 8-10: Construction Impact on Geology (Slope Stability)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Slope instability around structures.									
Without Mitigation	2	1	3	3	2	**18**	**Low**	(-)	High
With Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	High
Mitigation and Management Measures	— Avoid steep slope areas. — Design cut slopes according to detailed geotechnical analysis.								

SEISMIC ACTIVITY

Seismic activity would result in damage to the infrastructure. The impacts of the construction phase as a result of seismic activity are outlined in **Table 8-11**.

Table 8-11: Construction Impact on Geology (Seismic Activity)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Damage of proposed development.									
Without Mitigation	4	1	3	4	1	**14**	**Very Low**	(-)	High
With Mitigation	2	1	3	3	1	**9**	**Very Low**	(-)	High

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Damage of proposed development.									
Mitigation and Management Measures	— Design according to expected peak ground acceleration.								

8.4.2 OPERATION PHASE

SOIL EROSION

Soil erosion can be as a result of the following:

- Increased stormwater velocity.
- Increase in soil and wind erosion due to clearing of vegetation.
- Creation of drainage paths along access tracks.
- Sedimentation of non-perennial features and excessive dust.

The impacts of the operation phase as a result of soil erosion are outlined in **Table 8-12**.

Table 8-12: Operation Impact on Geology (Soil Erosion)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Increase in soil and wind erosion due to clearance of structures. — Displacement of soil and damage to vegetation by vehicles									
Without Mitigation	2	1	3	2	2	16	Low	(-)	High
With Mitigation	1	1	1	1	1	4	Very Low	(-)	High
Mitigation and Management Measures	— Use existing road network and access tracks. — Use of temporary berms and drainage channels to divert surface water. — Minimize earthworks and demolish footprints. — Rehabilitation of affected areas (such as revegetation). — Reinstate channelized drainage features. — Strip, stockpile and re-spread topsoil								

POTENTIAL OIL SPILILAGE

Oil spillage can lead to the contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources. The impacts of the operation phase as a result of oil spillage are outlined in **Table 8-13** below.

Table 8-13 Operation Impact on Geology (Oil Spillage)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Potential oil spillages from service vehicles and heavy plant									
Without Mitigation	3	2	5	5	3	45	Moderate	(-)	High
With Mitigation	2	1	3	1	1	7	Very Low	(-)	High
Mitigation and Management Measures	— Vehicle repairs to be undertaken in designated areas.								

8.4.3 DECOMMISSIONING PHASE

SOIL EROSION

Soil erosion can be as a result of the following:

- Increased stormwater velocity.
- Increase in soil and wind erosion due to clearing of vegetation.
- Creation of drainage paths along access tracks.
- Sedimentation of non-perennial features and excessive dust.

The impacts of the decommissioning phase as a result of soil erosion are outlined in **Table 8-14**.

Table 8-14: Decommissioning Impact on Geology (Soil Erosion)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Increase in soil and wind erosion due to clearance of structures. — Displacement of soil and damage to vegetation by vehicles									
Without Mitigation	4	2	3	3	4	**48**	**Moderate**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Use existing road network and access tracks. — Use of temporary berms and drainage channels to divert surface water. — Minimize earthworks and demolish footprints. — Rehabilitation of affected areas (such as revegetation). — Reinstate channelized drainage features. — Strip, stockpile and re-spread topsoil								

OIL SPILILAGE

Oil spillage can lead to the contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources. The impacts of the decommisioning phase as a result of oil spillage are outlined in **Table 8-15** below.

Table 8-15 Decommissioning Impact on Geology (Oil Spillage)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Potential oil spillages due to clearance of structures.									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	High
With Mitigation	2	1	3	1	2	**14**	**Very Low**	(-)	High
Mitigation and Management Measures	— Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. — Frequent checks and conditional monitoring								

DISTURBANCE OF FAUNA AND FLORA

The disturbance of fauna and flora can lead to the displacement of natural earth material and overlying vegetation leading to erosion.

The impacts of the decommissioning phase as a result of the disturbance of fauna and flora are outlined in **Table 8-16**.

Table 8-16 Decommissioning Impact on Geology (Disturbance of Fauna and Flora)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— The displacement of natural earth material and overlying vegetation leading to erosion.									
Without Mitigation	3	1	3	3	3	**30**	**Low**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Limit excavations								

SLOPE STABILITY

Instability can result in damage to the infrastructure. The impacts of the construction phase as a result of slope instability are outlined in **Table 8-17**.

Table 8-17: Decommissioning Impact on Geology (Slope Stability)

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Slope instability around structures.									
Without Mitigation	2	1	3	3	2	**18**	**Low**	(-)	High
With Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	High
Mitigation and Management Measures	— Avoid steep slope areas. — Design cut slopes according to detailed geotechnical analysis.								

8.5 SOILS, LAND CAPABILITY AND AGRICULTURAL POTENTIAL

The purpose of the agricultural component in the Environmental Authorisation process is to ensure that South Africa balances the need for development against the need to ensure the conservation of the natural agricultural resources, including land, required for agricultural production and national food security.

When the agricultural impact of a development involves the permanent or long term non-agricultural use of potential agricultural land, as it does in this case, the focus and defining question of the agricultural impact assessment is to determine the importance, from an agricultural production point of view, of that land not being utilised for the development and kept solely for agriculture.

There is ultimately only ever a single agricultural impact of a development and that is a change to the future agricultural production potential of the land. This impact occurs by way of different mechanisms some of which lead to a decrease in production potential and some of which lead to an increase. It is the net sum of positive and negative effects that determines the overall agricultural impact.

Two direct impacts have been identified that lead to decreased agricultural potential by:

— **occupation of land** - Agricultural land directly occupied by the development infrastructure will become restricted for agricultural use, with consequent potential loss of agricultural productivity for the duration of the project lifetime. This is relevant only in the construction phase. No further occupation of agricultural land occurs in subsequent phases. As has been discussed above, the small and widely distributed nature of the agricultural footprint of the facility means that only an insignificant proportion of the available agricultural land is impacted in this way.

— **soil erosion and degradation** – Erosion can occur as a result of the alteration of the land surface run-off characteristics, predominantly through the establishment of hard surface areas including roads, and through the disturbance of existing contour bank systems that control erosion. Soil erosion is completely preventable. The storm water management that will be an inherent part of the road engineering on site and standard, best practice erosion control measures recommended and included in the EMPr, are likely to be effective in preventing soil erosion. Loss of topsoil can result from poor topsoil management during construction related excavations.

Three positive agricultural impacts have been identified, that are indirect impacts and lead to an increase in agricultural potential through:

— **increased financial security for farming operations -** Reliable and predictable income will be generated by the farming enterprises through the lease of the land to the energy facility. This is likely to increase their cash flow and financial security and could improve farming operations and productivity through increased investment into farming.
— **improved security against stock theft and other crime** due to the presence of security infrastructure and security personnel at the energy facility.
— **an improved road network**, with associated storm water handling system. The wind farm will construct turbine access roads of a higher standard than the existing farm roads which will give farming vehicles better access to farmlands. This will be especially relevant during wet periods when access to croplands for spraying etc is limited by the current farm roads.

Mitigation measures to prevent soil degradation are all inherent in the project design and / or are standard, best-practice for construction sites.

— A system of storm water management, which will prevent erosion, will be an inherent part of the road engineering on site. As part of this system, the integrity of the existing contour bank systems of erosion control on croplands, where they occur on steeper slopes, must be kept intact. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion from occurring there.
— Any excavations during the construction phase, in areas that will be rehabilitated to agricultural land at the end of the construction phase, must separate the upper 30 cm of topsoil from the rest of the excavation spoils and store it in a separate stockpile. When the excavation is back-filled, the topsoil must be back-filled last, so that it is at the surface. Topsoil should only be stripped in areas that are excavated. On areas that are only cleared, like construction lay down areas, it is much better to leave the topsoil in place.

8.5.1 CONSTRUCTION PHASE

AGRICULTURAL POTENTIAL LOSS BY LAND OCCUPATION

Agricultural potential loss by land occupation occurs only on the site and for the lifetime of the development. Its consequence is considered slight because so little land is excluded from agricultural use. For the same reason, the irreplaceability is considered low. The probability of this impact is very likely. Its reversibility is considered high, because after decommissioning the land can be returned to agricultural land use.

The construction phase impact on Agricultural Production Potential loss by land occupation are outlined in **Table 8-18**.

Table 8-18: Impact on Agricultural Production Potential loss by land occupation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential loss by land occupation									
Without Mitigation	2	1	1	4	4	**32**	**Moderate**	(-)	High
With Mitigation	2	1	1	4	4	**32**	**Moderate**	(-)	High
Mitigation and Management Measures	— None possible								

AGRICULTURAL POTENTIAL LOSS BY SOIL DEGRADATION

Agricultural potential loss by degradation occurs only on the site and only during the construction and decommissioning phases. Its consequence is considered slight because the soil is not particularly susceptible to degradation. Irreplaceability is considered low because of the limited land capability as well. The probability of this impact is unlikely because of the low susceptibility. Its reversibility is considered moderate, because if soil is degraded there is some potential for rehabilitation.

The construction phase impact on Agricultural Production Potential by land soil degradation are outlined in **Table 8-19**.

Table 8-19: Impact on Agricultural Production Potential loss by soil degradation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential loss by soil degradation									
Without Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High
With Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High
Mitigation and Management Measures	— Maintain vegetation and facilitate re-vegetation. — Strip, stockpile and re-spread topsoil.								

8.5.2 OPERATION PHASE

AGRICULTURAL POTENTIAL ENHANCEMENT THROUGH FINANCIAL SECURITY

Agricultural potential enhancement through increased financial security for farming operations occurs across the farming operation and during the operational phase. Its consequence is considered slight because increased farm investment is only likely to slightly increase farm productivity. Some financial improvement to farming operations is likely as a result of the additional revenue. Reversibility is considered high because the additional revenue will stop when the operation ceases. Irreplaceability is considered moderate because the additional revenue may not be easy to replace after the operation ceases, although once a renewable energy facility is established, it may well be recommissioned for continued operation.

The operational phase impaact on Agricultural Potential enhancement are outlined in **Table 8-20**.

Table 8-20: Impact on Agricultural Potential enhancement Through Financial Security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential enhancement through increased financial security for farming operations									
Without Mitigation	2	2	1	4	3	**27**	**Low**	(-)	High
With Mitigation	2	2	1	4	3	**27**	**Low**	(-)	High
Mitigation and Management Measures	— None possible								

8.5.3 DECOMMISSIONING PHASE

AGRICULTURAL POTENTIAL LOSS BY SOIL DEGRADATION

The decommissioning phase impact on Agricultural Production Potential by land soil degradation are outlined in **Table 8-21**.

Table 8-21: Impact on Agricultural Production Potential loss by soil degradation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential enhancement through increased financial security for farming operations									
Without Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Agricultural potential enhancement through increased financial security for farming operations									
With Mitigation	2	1	3	4	1	**10**	**Very Low**	(-)	High
Mitigation and Management Measures	— Maintain vegetation and facilitate re-vegetation. — Strip, stockpile and re-spread topsoil.								

8.6 AQUATIC IMPACT ASSESSMENT

Based on the findings of the Aquatic Impact Assessment, the current Mukondeleli WEF layout does infringe on the wetlands as well as their respective buffer areas. One of the largest mitigation measures will be to remedy the layout in the design phase of the project and exclude wetlands and their associated buffer zones from the WEF layout.

The area around the WEF is already altered, large sections of the layout of the WEF are situated in agricultural fields and previously disturbed areas.

8.6.1 CONSTRUCTION PHASE

CHANGES IN WATER FLOW REGIME

Changes in flow regime arises from the compaction of soil, the removal of vegetation and surface water redirection. Changes to hydrological function at a landscape level which can arise from changes to flood regimes (i.e. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes). The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary, seasonal, permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). Changes to base flows i.e. too little/too much water in terms of characteristics and requirements of system). Fragmentation (i.e. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal). The construction impact along with mitigation measures are outlined in **Table 8-22.**

Table 8-22: Construction Impact on water flow regime

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in water flow regime									
Without Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields, — A temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse. — Where development activities are located upslope from wetlands, effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP.									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in water flow regime									
	— Where development activities are located upslope from wetlands, high energy stormwater input into the watercourses should be prevented at all cost. — Ideally access roads should be avoided if possible								

CHANGES IN SEDIMENT ENTERING AND EXITING THE SYSTEM

Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the watercourse and increase the turbidity of the water. Possible sources of the impacts include:

- Earthwork activities during construction
- Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonies eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil.
- Disturbance of soil surface
- Disturbance of slopes through creation of roads and tracks adjacent to the watercourse
- Erosion (e.g. gully formation, bank collapse)

Changes in sediment regimes of the aquatic ecosystem and its sub -catchment by for example sand movement, meandering river mouth /estuary, changing flooding or sedimentation patterns. The construction impact along with mitigation measures are outlined in **Table 8-23**.

Table 8-23: Construction Impact on sediment entering and exiting the system

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	33	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development is located upslope from wetlands, a temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse. — Where development is located upslope from wetlands, effective stormwater management including sediment barriers should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area. — Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
	— Monitoring should be done to ensure that sediment pollution is timeously dressed								

INTRODUCTION AND SPREAD OF ALIEN VEGETATION

The moving of soil and vegetation resulting in opportunistic invasions after disturbance. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a watercourse, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system, alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plants can easily colonise and impact on downstream users. The construction impact along with mitigation measures are outlined in **Table 8-24**.

Table 8-24: Construction Impact on the Introduction and spread of alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	33	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development is located upslope from wetlands, a temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse. — Where development is located upslope from wetlands, effective stormwater management including sediment barriers should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area. — Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. — Monitoring should be done to ensure that sediment pollution is timeously dressed									

LOSS AND DISTURBANCE OF WATERCOURSE HABITAT AND FRINGE VEGETATION

Loss and disturbance of watercourse habitat and fringe vegetation due to direct development on the watercourse as well as changes in management, fire regime and habitat fragmentation. The construction impact along with mitigation measures are outlined in **Table 8-25**.

Table 8-25: Construction Impact on the loss and disturbance of watercourse habitat and fringe vegetation

Potential Impact Changes in sediment entering and exiting the system	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	4	3	36	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish. — Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. — Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas. — Operational activities should not impact on rehabilitated or naturally vegetated areas.								

CHANGES IN WATER QUALITY DUE TO POLLUTION

Changes in water quality due to input of foreign materials i.e. due to increased sediment load, contamination by chemical and /or organic effluent, and /or eutrophication. During the construction phase a large amount of waste will be produced including sewerage, domestic waste, wash-water, used oils and grease, diesel or lubricant spills, etc. Waste generally contains pollutants and present a potential risk to the water and surrounding environment if not managed effectively. Oil and diesel spillages may occur during the construction phase which can contaminate surface water. Other potential contaminants (i.e. from chemical toilets, domestic waste, storage facilities, workshop facilities, etc.) can reduce surface water quality or result in discharge that exceeds the maximum concentrations permitted by the National Water Act. Changes to the water quality could result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality deterioration often leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. The construction impact along with mitigation measures are outlined in **Table 8-26**.

Table 8-26: Construction Impact on water quality

Potential Impact Changes in sediment entering and exiting the system	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	3	3	33	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Provision of adequate sanitation facilities located outside of the watercourse or its associated buffer zone. — Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation and to prevent contaminated runoff into the watercourse. — The development footprint must be fenced off from the watercourses and no related impacts may be allowed into the								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
	watercourse i.e. water runoff from cleaning of equipment, vehicle access etc. — Maintenance of construction vehicles/equipment should not take place within the watercourse or watercourse buffer. — Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects. — Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse. — Regular independent water quality monitoring should form part of operational procedures in order to identify pollution. — Treatment of pollution identified should be prioritized according to best practice guidelines. — Develop norms and standards for the treatment of spills such as oil or hydraulic fluid. Ensure that the required equipment is available on hand to contain any spills. — Appoint a reliable contractor for the removal of refuse during the construction phase.								

LOSS OF AQUATIC BIOTA

Aquatic biota can be lost due to the disturbance of the habitat and direct impacts on the watercourse/ rivers/ streams. This can be attributed to Loss and disturbance of biota due to direct development on the watercourse as well as changes in habitat including water quality, the water column, increased sediment, increased alien vegetation fire regime and habitat fragmentation. The construction impact along with mitigation measures are outlined in **Table 8-27**.

Table 8-27: Construction Impact on aquatic biota

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— This impact is not easily mitigated. Further loss in diversity can be minimised by following the mitigation measures mentioned above — The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields								

8.6.2 OPERATIONAL PHASE

CHANGES IN WATER FLOW REGIME

The operation impact along with mitigation measures are outlined in **Table 8-28.**

Table 8-28: Operation Impact on water flow regime

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in water flow regime									
Without Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development activities are located upslope from wetlands, effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Effective culverts should be incorporated into the design of access roads.								

CHANGES IN SEDIMENT ENTERING AND EXITING THE SYSTEM

The operation impact along with mitigation measures are outlined in **Table 8-29**.

Table 8-29: Operation Impact on sediment entering and exiting the system

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields — Where development is located upslope from wetlands, effective stormwater management including sediment barriers should be a priority during both construction and operational phase. This should be monitored as part of the EMP. — Monitoring should be done to ensure that sediment pollution is timeously dressed								

INTRODUCTION AND SPREAD OF ALIEN VEGETATION

The operation impact along with mitigation measures are outlined in **Table 8-30**.

Table 8-30: Operation Impact on the Introduction and spread of alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	**33**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
	take immediate corrective action where invasive species are observed to establish. — Undertake an Alien Plant Control Plan which specifies actions and measurable targets — Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area and returning it where possible afterwards. — Long-term monitoring for the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish, as specified in the Alien Vegetation Management Plan.								

LOSS AND DISTURBANCE OF WATERCOURSE HABITAT AND FRINGE VEGETATION

The operation impact along with mitigation measures are outlined in **Table 8-31**.

Table 8-31: Operation Impact on the loss and disturbance of watercourse habitat and fringe vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	4	3	36	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Amend WEF designs to exclude wetlands as well as buffer areas. — Monitor the establishment of alien invasive species within the areas affected by the construction and take immediate corrective action where invasive species are observed to establish. — Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. — Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas. — Operational activities should not impact on rehabilitated or naturally vegetated areas.								

CHANGES IN WATER QUALITY DUE TO POLLUTION

The operation impact along with mitigation measures are outlined in **Table 8-32**.

Table 8-32: Operation Impact on water quality

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	33	Moderate	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Amend WEF designs to exclude wetlands as well as buffer areas. — Provision of adequate sanitation facilities located outside of the watercourse or its associated buffer zone. — Maintenance of construction vehicles/equipment should not take place within the watercourse or watercourse buffer. — Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects. — Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse. — Regular independent water quality monitoring should form part of operational procedures in order to identify pollution. — Treatment of pollution identified should be prioritized according to best practice guidelines. — Develop norms and practices for the treatment of spills such as oil or hydraulic fluid. Ensure that the required equipment is available on hand to contain any spills. — Appoint a reliable contractor for the removal of refuse during the operational phase.								

LOSS OF AQUATIC BIOTA

The operation impact along with mitigation measures are outlined in **Table 8-33**.

Table 8-33: Operation Impact on aquatic biota

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in sediment entering and exiting the system									
Without Mitigation	3	2	3	3	3	33	Moderate	(-)	Moderate
With Mitigation	2	2	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— This impact is not easily mitigated. Further loss in diversity can be minimised by following the mitigation measures mentioned above								

8.6.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

8.7 BIODIVERSITY

8.7.1 CONSTRUCTION PHASE

The main biodiversity impacts associated with construction of the proposed Mukondeleli WEF infrastructure include:

THE CLEARING OF NATURAL VEGETATION

Natural vegetation will be cleared for the turbines and crane pads, new access roads, upgrading of existing tracks, laydown site, construction site and batching plant and substation. The removal of indigenous vegetation may cause a loss of individuals of threatened, protected and/or endemic species and will also be accompanied by a loss of faunal habitat. However, no threatened or endemic plant species were found on site and all provincially protected plant species have a Least Concern status. None of the SCC listed by the Screening Tool, were recorded on site. Vegetation loss is generally also associated with increased water run-off and erosion.

Since the turbine footprint is relatively small and spread across the site, the loss of prime habitat within the Soweto Highveld Grassland vegetation type can be constrained by well-planned positioning of the turbines. Service roads generally have a larger impact on vegetation clearance, however since the roads will have a gravel surface animal movement should still be possible. Beyond the permanent infrastructure footprint, environmental functions and processes should however, not be altered.

The impact of construction activities on natural vegetation is outlined in **Table 8-34**.

Table 8-34: Construction Impact on natural vegetation

Potential Impact The clearing of natural vegetation	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	3	4	4	**44**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	3	3	**30**	**Low**	(-)	
Mitigation and Management Measures	— A preconstruction walk-through of the development footprint for the purpose of turbine and crane pad micrositing could ensure that no SCC are present at these sites. — Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. This includes awareness as to remaining within demarcated construction areas, no littering, handling of pollution and chemical spills, avoiding fire hazards and minimising wildlife interactions. — Ensure that all temporary use areas e.g. laydown areas and construction camp, are located in areas of low sensitivity. — Footprints of the turbines, crane pads, roads, construction and substation locations should be clearly demarcated. Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. — Watercourses, wetlands, rocky outcrops/sheets should be avoided (Habitats 1 & 7). — Observe buffer zones along drainage lines (see report of aquatic specialist). — All vehicles are to remain on demarcated roads and no driving through the veld should be allowed. — The ECO is to provide supervision on vegetation clearing activities and other activities that may cause damage to the environment, especially when construction commences and most vegetation clearing is taking place. — River/stream crossings should be placed in areas without extensive wetlands and preferably in areas where the risk of disruption and erosion is low. All river/stream crossings should be inspected by the aquatic specialist to ensure that optimal and acceptable locations have been chosen for river crossings. River/stream crossings should be specifically									

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The clearing of natural vegetation									
	designed not to impede or disrupt the direction and flow of the water. Specific guidelines of the aquatic specialist should be followed. — No plants may be translocated or otherwise uprooted or disturbed without express permission from the ECO.								

THE LOSS OF THREATENED, PROTECTED & ENDEMIC PLANT SPECIES

The loss of the vegetation for the turbines and crane pads, new access roads, upgrading of existing tracks, construction site and substation may cause a loss of individuals of threatened, protected or endemic plant species. The site visit did however, not reveal the presence of any plant species with an IUCN threatened status and no endemic species are listed for the Soweto Highveld Grassland. Twelve provincially protected plant species were encountered in the region during the site survey, although all have a Least Concern status, except *Gladiolus robertsoniae* which is Near Threatened. However, *Gladiolus robertsoniae* occurs in Habitat 1, which is not affected by the development and furthermore was not recorded on Mukondeleli. As the other protected plant species at the site are not threatened, the loss of a small number of individuals (if any) is not likely to threaten the local or regional populations of these species.

The loss of some individuals of protected species is unlikely to alter the patterns or processes of the natural system, in the sense that environmental functions and processes will temporarily or permanently cease. Nevertheless, permits need to be obtained for the destruction of provincially specially protected or protected species.

The impact of construction activities on threatened, protected & endemic plant species is outlined in **Table 8-35**.

Table 8-35: Construction Impact on threatened, protected & endemic plant species

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The loss of threatened protected & endemic plant species									
Without Mitigation	3	1	3	4	3	33	Moderate	(-)	Moderate
With Mitigation	2	1	3	4	1	30	Low	(-)	
Mitigation and Management Measures	— Placement of infrastructure should be done in such a way as to minimise the impact on protected species. — The construction crew should undergo environmental training (induction) to make them aware of the importance of protected species.								

LOSS OF FAUNAL HABITAT

The loss of the vegetation due to turbines and crane pads, new access roads, upgrading of existing tracks, construction site and substation will be accompanied by a loss of faunal habitat.

Rare species reported for the region by the landowners, include the Near Threatened serval Leptailurus serval and the Southern African hedgehog *Atelerix frontalis*. The screening report refers to *Crocidura maquassiensis* (Maquassie musk shrew) as the species of concern. The Maquassie musk shrew depends on wetlands as suitable habitat. It is very rare and for example has not been reported from Mpumalanga post-1999. It is patchily distributed and the nearest recording was at Loskop Dam to the north. It may tolerate a wide range of habitats, including urban and rural landscapes. However, there is a very low probability for it to occur on site. The Lepidopteran species are unlikely to occur on site because its host plant was not recorded on site.

The impact of construction activities on the loss of faunal habitat is outlined in **Table 8-36**.

Table 8-36: Construction Impact on faunal habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of faunal habitat									
Without Mitigation	3	1	3	3	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	1	3	3	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Placement of infrastructure should be done in such a way as to minimise the impact on protected species. — Vegetation clearance should be confined to the smallest possible footprint of the development and unnecessary clearance should be avoided. — Construction crew should undergo environmental training (induction) to increase their awareness of environmental concerns. — Speed limits should be set on all roads and strictly adhered to. — Development should avoid water courses, wetlands and rocky outcrops/sheets. — Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the sites. — Observe buffer zones along drainage lines.								

DIRECT FAUNAL MORTALITIES DUE TO CONSTRUCTION AND INCREASED TRAFFIC

Faunal mortalities may be caused by construction at the footprint of the infrastructure, construction vehicles or other operational activities and by electrical fences, should they be erected around the construction site and substation. In particular slow-moving species such as tortoises, might be prone to these mortalities. When animals ingest waste material or become ensnared in wires, fatalities might also occur.

Larger more mobile fauna such as antelope and larger predators will most likely move away from areas of high activity during the construction phase. Smaller and less-mobile animals are not as capable of moving away and may seek shelter down burrows and other shelter sites. None of the SCC listed in the screening tool were encountered on site and generally these species occur at a low density and thus it is unlikely that they would be directly encountered by people at the WEF.

The impact of construction activities on faunal mortalities due to construction and increased traffic is outlined in **Table 8-37**.

Table 8-37: Construction Impact on faunal mortalities due to construction and increased traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct faunal mortalities due to construction and increased traffic									
Without Mitigation	2	1	3	2	3	**24**	**Low**	(-)	Moderate
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns in order to reduce the number of kills during construction and on roads. The crew should also be made aware of not harming or collecting species such as snakes, tortoises and owls.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct faunal mortalities due to construction and increased traffic									
	— Proper waste management procedures should be in place to avoid litter, food or other foreign material from lying around and to remove all waste material from the site. — No activity, including night driving, should be allowed at the site after sunset. — Speed limits should be set on all roads on site and strictly adhered to. — Personnel should not be allowed to roam into the veld. — Ensure that cabling and electrical infrastructure at the site are buried sufficiently deeply to avoid being excavated by fauna and that where such infrastructure emerges above-ground that it is sufficiently protected from gnawing animals. — Any dangerous fauna (e.g. snakes, scorpions) that are encountered during construction should not be handled or molested by construction staff and the ECO (or other suitably qualified person) should be contacted to remove the animals to safety. — Holes and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days, should have an escape ramp to allow any fauna that fall in to escape. — If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals. — Should electrical fences be erected it must be done according to the norms and standards of the Nature Conservation Authorities in Mpumalanga. — Access to the site should be regulated to reduce the opportunities for poaching.								

INCREASED DUST DEPOSITION

Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing. The increased dust levels will however be temporary (**Table 8-38**).

Table 8-38: Construction Impact on dust deposition

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased dust deposition									
Without Mitigation	3	1	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— Excessive dust can be reduced by spraying water onto the exposed soil surface.								

INCREASED HUMAN ACTIVITY, NOISE AND LIGHT LEVELS

Construction activities will increase human presence, noise and light levels at the site. These activities may affect animal behaviour. However, increased noise and light levels associated with the construction phase are temporary (**Table 8-39**).

Table 8-39: Construction Impact on human activity, noise and light levels

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased human activity, noise and light levels									
Without Mitigation	5	1	3	2	3	33	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	3	27	Low	(-)	
Mitigation and Management Measures	— The SANS standards should be adhered to in terms of noise levels. — No construction should be done at night. — If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals.								

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the clearance of indigenous vegetation and resulting degradation, alien species might invade the area. Twelve declared alien invasive plant species were recorded on the three Enertrag sites and 35 naturalised species. Another four naturalised alien species were listed by NewPosa for the region.

Six declared invasive species were noted on the Mukondeleli site and increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation. Bare areas that are not actively rehabilitated and areas receiving runoff are particularly vulnerable to alien infestation (**Table 8-40**).

Table 8-40: Construction Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	3	2	3	4	3	36	Moderate	(-)	Moderate
With Mitigation	2	1	3	4	1	10	Very Low	(-)	
Mitigation and Management Measures	— Implement a monitoring program for the early detection of alien invasive plant species. — A control program should be employed to combat declared alien invasive plant species in the most environmentally friendly manner that does not result in undesirable secondary impacts. — Herbicides for the control of alien species should be applied according to the relevant instructions and by appropriately trained personnel. — No alien species should be used in rehabilitation or landscaping. — Use only plants and seed collected on-site for revegetation. — Cleared areas may need to be fenced-off during rehabilitation to exclude livestock and wildlife.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
	— Material brought onto site e.g. building sand should be regularly checked for the germination of alien species.								

INCREASED WATER RUN-OFF AND EROSION

Increased water run-off and erosion will be caused by the clearing of the indigenous vegetation and compaction of soil on the crane pads. The roads traversing hill slopes will be the main source of erosion if not properly constructed and provided with structures to deflect water run-off. In addition, the hardened surfaces created by the roads, crane pads and other infrastructure will increase run-off, which will pose an erosion risk in the areas receiving the water, even if these areas have not been disturbed. Increased run-off and erosion could affect hydrological processes in the area and change water and silt discharge into the streams.

The site lies within the summer rainfall region and can experience intense thundershowers, which will increase the potential for erosion. On slopes, active rehabilitation and mitigation measures to prevent erosion will be required (**Table 8-41**).

Table 8-41: Construction Impact on water run-off and erosion

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased water run-off and erosion									
Without Mitigation	4	3	3	4	3	42	Moderate	(-)	Moderate
With Mitigation	2	1	3	4	3	30	Low	(-)	
Mitigation and Management Measures	— Clearing of vegetation, compaction and leveling should be restricted to the footprint of the proposed development. — All roads should have structures to deflect water run-off to disperse the water into the receiving area. — A rehabilitation and revegetation plan should be developed as part of the EMP. — Regular monitoring of the site during construction for erosion problems. — Silt traps should be used where there is a danger of topsoil eroding and entering streams and other sensitive areas. — If applicable, topsoil should be removed and stockpiled, then reapplied as soon as possible in order to facilitate regeneration of the natural vegetation on cleared areas. — Reduce activity on site after large rainfall events when the soils are wet. No driving off hardened roads until soils have dried out and the risk of bogging down has decreased. — A suitably qualified person should plan, design and supervise the proper construction of roads to minimise the impact on the environment.								

CHANGES IN ANIMAL BEHAVIOUR

The increased human presence and/or construction operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels and loss of animal habitat may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Species with small territories may be negatively affected as well as species that live in the soil.

Research elsewhere showed that the response of animals to wind energy facilities was highly species-specific and could range from avoidance to a positive reaction. The response was apparently also depended on the level of predation, with no impact noted where predation pressure was low. Wind farms affect large terrestrial mammals mainly through an increase in human activity within the wind farm area. During the construction phase, the mobile large-mammal carnivores and ungulates may temporarily avoid the site, but when construction ceases and human presence decreases, these animals generally acclimate to the wind energy infrastructure. The impact on burrowing fauna may be higher, since these animals are usually sensitive to soil tremors and disturbances, and consequently they will likely move away from construction areas. It is anticipated that the impact of the Mukondeleli site on the fauna would mostly be temporary, i.e. during the construction phase (**Table 8-42**).

Table 8-42: Construction Impact on animal behaviour

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Changes in animal behaviour									
Without Mitigation	3	1	3	4	3	33	Moderate	(-)	Moderate
With Mitigation	3	1	3	3	3	30	Low	(-)	
Mitigation and Management Measures	— Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns. — Development should avoid wetlands and rocky sheets. — Soil compaction should be kept to a minimum by restricting driving to designated roads. — Appropriate lighting should be installed to minimise negative effects on nocturnal animals. — No activity should be allowed at the site between sunset and sunrise. — The mitigation measures as indicated by the noise specialist must be adhered to.								

8.7.2 OPERATIONAL PHASE

DIRECT FAUNAL MORTALITIES

Faunal mortalities may be caused by maintenance vehicles or other maintenance activities, electric fences and ingestion of waste material. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals become ensnared in wires or in electric fences. Bird and bat collisions with the wind turbine blades will be addressed by the avifaunal and bat specialists.

Although activity at the site is likely to be relatively low during operation, some impact on fauna may still occur as a result of personnel present on site as well as the operation of maintenance vehicles. Direct interactions between the turbines and terrestrial fauna (excluding avifauna and bats) are likely to be low. Major risk factors during operation are likely to be from vehicle collisions with fauna (**Table 8-43**).

Table 8-43: Operation Impact on faunal mortalities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct faunal mortalities									
Without Mitigation	2	1	3	4	3	30	Low	(-)	Moderate
With Mitigation	1	1	3	4	1	9	Very Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Direct faunal mortalities									
Mitigation and Management Measures	— Maintenance crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns. — Access to the site should be strictly controlled. — All excess wires, cables and waste material should be removed from the site. — All vehicles at the site should adhere to a low speed limit and slow-moving fauna such as tortoises on roads should be moved off the road. — No activity should be allowed at the site between sunset and sunrise. — Electrical fences should be erected according to the norms and standards of the Nature Conservation Authorities in Mpumalanga.								

INCREASED LIGHT AND NOISE LEVELS AND CHANGES IN ANIMAL BEHAVIOUR

The loss of vegetation cover, compacting of soils, increased noise levels and the increased human presence will alter animal behavioural patterns by making certain areas unavailable and making roads more difficult to traverse. Some animal species will be more affected than others. These species might undergo a reduction in their population size.

According to Todd & Skowno (2014) small mammals, reptiles and amphibians are not likely to move away from the turbines on account of the noise as these animals do not rely on sound to forage and rely largely on plant cover and other avoidance measures to avoid predators. Although frogs communicate with their calls, the pitch of the noise generated by the turbines is not likely to be similar to that of the frogs and a significant impact is unlikely. Fauna which rely heavily on hearing for foraging or predator avoidance are potentially worst affected by the noise. This would include species such as hares which rely on hearing for predator avoidance. However, it is difficult to predict the impact on these species without entering into a high degree of speculation as there has been little research on this topic and hence there is no baseline in terms of known impacts due to turbine noise on fauna, especially within the South African context. However, noise due to turbines at the site will be variable and related to wind direction and operating conditions among other factors. As most fauna are adaptable with regards to noise, it is likely that any affected fauna would adapt to the local conditions and it is not likely that there would be any ecosystem-level or trophic impacts due to turbine noise (**Table 8-44**).

According to Todd & Skowno (2014) the possibility that predators such as jackal and caracal would prey more heavily on livestock or wildlife as a result of turbine noise, is not a likely scenario.

Table 8-44: Operation Impact on light and noise levels and changes in animal behaviour

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased light and noise levels and changes in animal behaviour									
Without Mitigation	2	1	3	4	3	30	Low	(-)	Moderate
With Mitigation	1	1	3	4	1	9	Very Low	(-)	
Mitigation and Management Measures	— The mitigation measures as indicated by the noise specialist must be adhered to. — Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased light and noise levels and changes in animal behaviour									
	— Soil compaction should be kept to a minimum by restricting driving to designated roads. — Appropriate lighting should be installed to minimise negative effects on nocturnal animals. — No activity should be allowed at the site between sunset and sunrise.								

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the loss of indigenous vegetation and resulting degradation, primarily during the construction phase, alien species might invade the area. Alien invasive species are generally more common in along roads than the adjacent undisturbed farmland. The invasion by alien species will continue unless controlled. Increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may eventually cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation (**Table 8-45**).

Table 8-45: Operation Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	2	1	3	4	3	**30**	**Low**	(-)	
With Mitigation	1	1	3	4	1	**9**	**Very Low**	(-)	Moderate
Mitigation and Management Measures	— Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed. — No alien species should be used for landscaping, rehabilitation or any other purpose. — Clearing of alien species should be done on a regular basis								

INCREASED WATER RUN-OFF AND EROSION

Disturbance created during construction will take several years to fully stabilise and the increase in compacted areas as a result of roads may increase run-off which will pose an erosion risk. Particular areas of concern would be roads traversing slopes as well as any infrastructure on gentle slopes with erodible soils. Consequently, erosion risk during operation is likely to be centred on areas disturbed during construction and on areas receiving run-off from roads and similar hardened surfaces. Increased run-off and erosion could affect hydrological processes in the area and may change water discharge into the streams and increase silt load (**Table 8-46**).

Table 8-46: Operation Impact on water run-off and erosion

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased water run-off and erosion									
Without Mitigation	3	2	3	4	3	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Proper road maintenance procedures should be in place. — Regular monitoring of the site during operation for erosion problems.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased water run-off and erosion									
	— Should new sections of the road be needed, a suitably qualified person should plan, design and supervise the proper construction of roads. — Reduced activity at the site after large rainfall events when the soils are wet.								

8.7.3 DECOMMISSIONING PHASE

FAUNAL MORTALITIES

Faunal mortalities may be caused by vehicles or other decommissioning activities and waste. In particular slow-moving species such as tortoises, might be prone to road mortalities. When animals ingest waste material or become ensnared in it fatalities might also occur.

Table 8-47: Decommissioning Impact on faunal mortalities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Faunal mortalities									
Without Mitigation	2	1	3	2	3	**24**	**Low**	(-)	Moderate
With Mitigation	2	1	3	2	1	**8**	**Very Low**	(-)	
Mitigation and Management Measures	— Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns. — Speed limits should be adhered to. — Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.								

INCREASED DUST DEPOSITION

Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing the dust covered vegetation. The increased dust levels will be temporary.

Table 8-48: Decommissioning Impact on dust deposition

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased dust deposition									
Without Mitigation	3	1	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	1	1	3	2	1	**7**	**Very Low**	(-)	
Mitigation and Management Measures	— Excessive dust can be reduced by spraying water onto the soil.								

ESTABLISHMENT OF ALIEN VEGETATION

As a result of the decommissioning activities, areas will be disturbed and alien species might invade. Increased vehicle traffic may facilitate the introduction of seeds of alien species.

Table 8-49: Decommissioning Impact on alien vegetation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Establishment of alien vegetation									
Without Mitigation	3	1	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	1	1	3	2	1	**7**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement a monitoring program for at least three years after decommissioning to document vegetation recovery and alien infestation across the site. — A control program to combat declared alien invasive plant species should be employed. — Areas where infrastructure is removed, must be revegetated with indigenous plant species. — No alien species should be used for rehabilitation/revegetation or any other purpose.								

INCREASED WATER RUN-OFF AND EROSION

Some of the existing roads might have to be upgraded and increased erosion and water run-off will thus be caused by the clearing of the indigenous vegetation and soil disturbance. Decommissioning would involve the removal of the infrastructure of the facility and the rehabilitation of the roads and other hard infrastructure of the facility. If the rehabilitation is not successful, this would leave the site vulnerable to erosion. Without management, increased run-off and erosion could affect hydrological processes in the area and may change water discharge into the streams and increase silt load.

Table 8-50: Decommissioning Impact on water run-off and erosion

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased water run-off and erosion									
Without Mitigation	3	1	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	1	1	3	2	1	**7**	**Very Low**	(-)	
Mitigation and Management Measures	— No new roads should be built. — Proper road maintenance procedures should be in place. — Removal of all infrastructure components from the site. — Rehabilitation of all cleared and disturbed areas with local species. — Off-site disposal of all facility components. — Monitoring programme for at least three years after decommissioning to document vegetation recovery on site.								

8.8 AVIFAUNA

8.8.1 CONSTRUCTION PHASE

DISPLACEMENT OF PRIORITY AVIFAUNA DUE TO DISTURBANCE ASSOCIATED WITH THE CONSTRUCTION OF THE WIND TURBINES AND ASSOCIATED INFRASTRUCTURE

The displacement of birds away from areas in and around wind farms due to visual intrusion and airspace disturbance can be considered functional habitat loss. This disturbances can be detrimental to migratory bird population if wind farms disrupt migration routes (Marques et al., 2020, 2021), or if impact the breeding productivity and population sizes of species which undergo macro-avoidance of wind farms. Displacement may occur during both the construction and operation phases of wind farms, manifesting from turbines themselves through visual, noise and vibration impacts, as well as vehicle and personnel movements related to site construction and maintenance (Campedelli et al., 2014; May, 2015). Disturbance magnitude varies across sites and species, necessitating assessments on a site-by-site basis (Dohm et al., 2019; Drewitt & Langston, 2006). A recent meta-analysis study found that of long-term studies into avian displacement around wind farms found that half ~50% of studies reported limited displacement from wind turbines, 46% reported a decrease in some bird populations, and 7.7% found an increased abundance of certain species around wind farms (Marques et al., 2021). Unfortunately, few studies provide comprehensive before- and-after and control-impact (BACI) assessments, limiting current inferential power.

The operational phase is thought to impose the greatest displacement threat to bird populations, although these impacts may in temporary (Dohm et al., 2019; Pearce-Higgins et al., 2012). Local raptor populations around wind farms may rebound within 7-8 years post-construction (Dohm et al., 2019). Bustards may retain high affinity for historic lek sites (courtship display areas) on wind farms, as has been document in Great Bustard in Spain (A. Camiña, personal communications, 17 November 2012) and Denham's Bustard in South Africa (Ralston-Paton et al., 2017). It should be noted that Great Bustard elsewhere in Europe can be displaced by 0.6km [Wurm & Kollar (2000), as quoated by Raab et al. (2009)] to 1km (Langgemach, 2008) of an operational wind farm, although Denham's Bustards populations do not appear to be displaced by wind farms in South Africa (Ralston-Paton et al., 2017). It should be noted that for raptors and large terrestrial species, site-fidelity and species longevity may mask short- and medium-term impacts that wind farms may have on these species, and that the true impact severity may only manifest in the long-term – such as through diminishing recruitment of new individuals over the course of multiple generations (Ferrer et al., 2012; Santos et al., 2020).

The limited research into shorter-lived bird species around wind farms may offer insights into the long-term response of birds more generally. Leddy et al., (1999) reported increased densities of breeding grassland passerines with increased distance (>80m) from wind turbines, and review study by (Hötker et al. (2006) found that the minimum avoidance distances of eleven breeding passerines species ranged 14–93m of wind turbines. However, Hale et al. (2014) and Stevens et al. (2013) found limited evidence for permanent displacement of grassland passerines in North America. Passerine resilience to wind farms is further observed in the United Kingdoms in species such Skylark (despite some evidence of turbine avoidance) (Pearce-Higgins et al., 2012), and Thekla Lark populations in Southern Spain (Farfán et al., 2009). Across nine wind farms in Scotland, seven out of twelve birds species across a range of taxa exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with demonstrable turbine avoidance behaviour in a further two species (Pearce-Higgins et al., 2009). No species preferentially occurred close to the turbines, and breeding pair densities decreased 15-53% within 500m of wind turbines for several species. Follow-up monitoring reported breeding densities of certain species (such as Red Grouse) recovered post-construction, whereas others (such as Snipe and Curlew) did not. Conversely, breeding densities of certain species (such as Skylark and Stonechat) increased on wind farms during construction.

Species response to wind farm construction and operation appears highly idiosyncratic, and although the local populations of many bird species may recover, the long-term impacts of wind farms on bird populations remains to be better elucidated.

It is inevitable that a measure of displacement will take place at the WEF for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species in the remaining high-quality grassland, wetlands and wetland fringes the most, as *this could temporarily disrupt their reproductive cycle. Some species might be able to recolonise the area after the completion of the construction phase, but for some species, this might only be partially the case, resulting in lower densities than before once the WEFs are operational, due to the disturbance factor of the operational turbines, and the habitat fragmentation*

The construction impact on priority avifauna due to disturbance during construction of the wind farm is outlined in **Table 8-51**.

Table 8-51: Construction impact on priority avifauna due to disturbance during construction of the wind farm

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority avifauna due to disturbance during construction of the wind farm									
Without Mitigation	4	1	1	2	5	40	Moderate	(-)	Moderate
With Mitigation	3	1	1	2	4	28	Low	(-)	
Mitigation and Management Measures	— Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed. — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned). — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum — Measures to control noise and dust should be applied according to current best practice in the industry. — Bird flight diverters should be installed on all overhead medium voltage power lines (according to the relevant Eskom Engineering Instruction). These devices must be installed as soon as the conductors are strung.									

DISPLACEMENT OF PRIORITY SPECIES DUE TO HABITAT TRANSFORMATION AS A RESULT OF THE CONSTRUCTION OF THE WIND TURBINES AND ASSOCIATED INFRASTRUCTURE

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general, it is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development site [Fox et al. (2006) as cited by Drewitt & Langston (2006)], with a further 3-14% of airspace altered by turbines (Marques et al., 2020) (see Section 8.2). The effects of habitat loss could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat transformation following the development of the Altamont Pass Wind Farm in California led to increased mammal prey availability for some species of raptor, such as higher abundance of Pocket Gophers Thomomys bottae burrows around turbine bases), although this may also have increased collision risk ([Thelander et al., (2003) as cited by Drewitt & Langston (2006)].

Despite overall habitat loss resulting from wind farm development may be limited, the associated infrastructure such as roads and powerlines fragment previously continuous tracts of habitat. Beyond the increased mortality risks to local bird populations posed by such infrastructure, the resulting habitat fragmentation can degrade adjacent habitats, potentially changing the way birds interact with the immediate environment (Fletcher et al., 2018). It remains disputed whether habitat fragmentation is always an environmental detriment (Fahrig et al., 2019), yet the effects of this landscape change have been observed in bird species vulnerable to wind farms. Lane et al. (2001) noted that Great Bustard flocks in Spain were significantly larger further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard in South Africa generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes in South Africa select nesting sites away from roads.

Marques et al. (2021) reviewed 71 peer-reviewed studies on displacement and compiled: (1) information on the geographical areas, type of wind farm, study design and bird groups studied; and (2) the evidence of displacement effects on different bird groups. They found that most studies have been conducted in Europe and North America, particularly in agricultural areas. About half of the studies did not find any effects, for wind farms both on land and at sea, while many studies (40.6%) found displacement effects, and a small proportion (7.7%) detected attraction, i.e., an increased abundance of birds around the wind farms. Relevant to this project, they found that waterfowl and raptors were significantly affected.

The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab et al., 2011). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Allan et al., 1997).

The existing network of roads at the WEF has already resulted in significant habitat fragmentation. This, together with the disturbance factor of the operating turbines, could influence the density of several species, particularly larger terrestrial species and owls which would utilise the remaining high-quality grassland, wetlands, and wetland fringes as breeding habitat. Given the conceptual turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the development site, but densities may be reduced.

The construction impact on priority avifauna d due to habitat change and loss at the wind farm is outlined in **Table 8-52**.

Table 8-52: Construction impact on priority avifauna d due to habitat change and loss at the wind farm

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority avifauna due to habitat change and loss at the wind farm									
Without Mitigation	3	1	3	2	4	**36**	**Moderate**	(-)	Moderate
With Mitigation	2	1	1	2	4	**24**	**Low**	(-)	
Mitigation and Management Measures	— Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed. — Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned). — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum — Measures to control noise and dust should be applied according to current best practice in the industry. — Bird flight diverters should be installed on all overhead medium voltage power lines (according to the relevant Eskom Engineering Instruction). These devices must be installed as soon as the conductors are strung.								

8.8.2 OPERATIONAL PHASE

COLLISION MORTALITY OF PRIORITY SPECIES CAUSED BY THE WIND TURBINES IN THE OPERATIONAL PHASE.

This impact relates to the bird mortalities because of potential collisions with the wind turbines. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur et al., 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a major ecological drawback to wind energy (Drewitt & Langston, 2006).

Collisions with wind turbines kill fewer birds than collisions with other man-made infrastructure, such as power lines, buildings or even traffic (Erickson et al., 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0-40 deaths per turbine per year (Sovacool, 2013). Bird mortality rates vary across sites, as do the number of sensitive bird species impacted (Hull et al., 2013; May, 2015). Estimated mortalities are likely lower than true number of bird deaths from wind farm infrastructure, given that studies may fail to account for detection biases caused by scavenging, search efficiency and search radius (Bernardino et al., 2013; Erickson et al., 2005; Huso et al., 2015, 2021). Additionally, even for low mortality rates, collisions with wind turbines may disproportionately affect certain species. For long-lived species with low reproductivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (Carrete et al., 2009; De Lucas et al., 2008; Drewitt & Langston, 2006). The situation is even more critical for species of conservation concern and those with restricted distributions, which sometimes are most at risk (Osborn et al., 1998).

High bird mortality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles (Aquila chrysaetos), Tarifa in Southern Spain for Griffon vultures (Gyps fulvus), Smøla in Norway for White-tailed eagles (Haliaatus albicilla), and the port of Zeebrugge in Belgium for gulls (Larus spp.) and terns (Sterna spp.) (Barrios & Rodríguez, 2004; Drewitt & Langston, 2006; Huso et al., 2015; Stienen et al., 2008; Thelander et al., 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for many fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull et al., 2013; Marques et al., 2014) An understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures. In southern Africa, vultures – followed by larger eagle species – are highlighted as being especially susceptible to collisions with wind turbines (McClure et al., 2021).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and very likely probability, which will render the impact significance as high without the implementation of mitigation measures.

The operation impact on mortality of priority avifauna due to collisions with the wind turbines is outlined in **Table 8-53**.

Table 8-53: Operation impact on mortality of priority avifauna due to collisions with the wind turbines

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Mortality of priority avifauna due to collisions with the wind turbines									
Without Mitigation	5	2	3	4	5	**70**	**High**	(-)	Moderate
With Mitigation	3	2	3	4	4	**48**	**Moderate**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Mortality of priority avifauna due to collisions with the wind turbines									
Mitigation and Management Measures	— The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas. — Live-bird monitoring and carcass searches to be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al., 2015) to compare the abundance of avifauna during the pre-construction monitoring with the abundance post-construction. Operational monitoring and carcass searches to be implemented for a minimum of two years, and then again in Year 5 and every fifth year after that. — If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).								

ELECTROCUTION MORTALITY CAUSED BY THE MEDIUM VOLTAGE RETICULATION LINES

Electrocution refers to instances where birds perch, or attempt to perch, upon electrical structure in a manner that physically bridges the air gap between live components and/or live and earthed components, causing a fatal electrical short circuit through the birds (Bevanger, 1994; van Rooyen, 2000). The electrocution risk is largely determined by the design of the electrical hardware, with medium voltage electricity poles posing a potential electrocution risk to raptors (Cole & Dahl, 2013; Haas et al., 2006; Loss et al., 2014).

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various priority species, particularly large terrestrial species and waterbirds

The operation impact on mortality of priority avifauna due to electrocution on the medium voltage overhead lines is outlined in **Table 8-54**.

Table 8-54: Operation impact on mortality of priority avifauna due to electrocution on the medium voltage overhead lines

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Mortality of priority avifauna due to electrocution on the medium voltage overhead lines									
Without Mitigation	5	2	3	4	4	56	High	(-)	Moderate
With Mitigation	1	2	3	4	1	10	Very Low	(-)	
Mitigation and Management Measures	— The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas. — Live-bird monitoring and carcass searches to be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al., 2015) to compare the abundance of avifauna during the pre-construction monitoring with the abundance post-construction. Operational monitoring and carcass searches to be implemented for a								

Potential Impact Mortality of priority avifauna due to electrocution on the medium voltage overhead lines	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
	minimum of two years, and then again in Year 5 and every fifth year after that. — If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).							

COLLISION MORTALITY CAUSED BY THE MEDIUM VOLTAGE RETICULATION LINES

Transmission line collisions arguably pose the greatest threat to birds in southern Africa (van Rooyen, 2004), including in the Overberg near the PAOI (Shaw et al., 2010). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and to a lesser extent, vultures (Shaw et al., 2010; van Rooyen, 2004). These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (van Rooyen, 2004).

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 12).

Power line collisions are generally accepted as a key threat to bustards (Barrientos et al., 2012; Jenkins et al., 2010; Raab et al., 2009, 2011; Shaw, 2013). In one study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw, 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards Ardeotis kori also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw, 2013).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo (Shaw et al., 2018). Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw et al., 2018).

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various priority species, particularly large terrestrial species and waterbirds.

The operation impact on priority avifauna due to collisions with the medium voltage overhead lines is outlined in **Table 8-55**.

Table 8-55: Operation impact on mortality of priority avifauna due to collisions with the medium voltage overhead lines

Potential Impact Mortality of priority avifauna due to collisions with the medium voltage overhead lines	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	2	3	4	4	56	High	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Mortality of priority avifauna due to collisions with the medium voltage overhead lines									
With Mitigation	1	2	3	4	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas. — Live-bird monitoring and carcass searches to be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al., 2015) to compare the abundance of avifauna during the pre-construction monitoring with the abundance post-construction. Operational monitoring and carcass searches to be implemented for a minimum of two years, and then again in Year 5 and every fifth year after that. — If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).								

8.8.3 DECOMMISSIONING PHASE

DISPLACEMENT OF PRIORITY AVIFAUNA DUE TO DISTURBANCE ASSOCIATED WITH THE DISMANTLING OF THE WIND TURBINES AND ASSOCIATED INFRASTRUCTURE.

The decommissioning impact on mortality of priority avifauna due to collisions with the medium voltage overhead lines is outlined in **Table 8-54**.

Table 8-56: Decommissioning impact on mortality of priority avifauna due to collisions with the medium voltage overhead lines

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Displacement of priority avifauna due to disturbance during dismantling of the wind									
Without Mitigation	4	1	1	2	5	**40**	**Moderate**	(-)	Moderate
With Mitigation	3	1	1	2	4	**28**	**Low**	(-)	
Mitigation and Management Measures	— Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. — Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. — Measures to control noise and dust should be applied according to current best practice in the industry. — Maximum used should be made of existing access roads.								

8.9 BATS

8.9.1 CONSTRUCTION PHASE

The following impacts on Bats, during the construction phase of the proposed Mukondeleli WEF, were identified:

LOSS OF FORAGING HABITAT BY CLEARING OF VEGETATION

Foraging habitat supporting bat insect prey will be lost by construction of turbines, crane pads, as well as temporary and long-term construction yards. This construction impact as well as possible mitigation measures are outlined in **Table 8-57.**

Table 8-57: Construction Impact on bat foraging habitat

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of foraging habitat by clearing of vegetation.									
Without Mitigation	1	1	3	2	4	**28**	**Low**	(-)	Easy
With Mitigation	1	1	3	2	3	**21**	**Low**	(-)	
Mitigation and Management Measures	— Adhere to the bat sensitivity map criteria. — Rehabilitate cleared vegetation where possible at areas such as laydown yards.								

ROOST DESTRUCTION DURING EARTHWORKS

Construction activities may possibly disturb or destroy bat roosts underground, and roosts in tall trees. Forcing bats to find alternative roosts. This construction impact as well as possible mitigation measures are outlined in **Table 8-58.**

Table 8-58: Construction Impact on bat roosts

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Roost destruction during earthworks.									
Without Mitigation	4	1	3	2	2	**20**	**Low**	(-)	Easy
With Mitigation	4	1	3	2	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Adhere to the bat sensitivity map criteria.								

8.9.2 OPERATIONAL PHASE

The following impacts on Bats, during the operational phase of the proposed Mukondeleli WEF, were identified:

BAT MORTALITIES DURING FORAGING

Foraging bats can be killed by colliding with turbine blades, or by suffering barotrauma during foraging activities. This operational impact as well as possible mitigation measures are outlined in **Table 8-59**.

Table 8-59: Operational Impact on bat mortalities during foraging

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Bat mortalities during foraging.									
Without Mitigation	4	2	3	4	5	65	High	(-)	Hard
With Mitigation	4	2	3	4	3	39	Moderate	(-)	
Mitigation and Management Measures	— Turbine layout adjustments to adhere to the sensitivity map (already implemented), and where needed, reducing blade movement at selected turbines during high-risk bat activity times/weather conditions. — Acoustic deterrents are developed well enough to be trialled. The WEF should measure its bat mortality impact during operation and ensure that the WEF impact remain within sustainable levels								

BAT MORTALITIES DURING MIGRATION

Migrating bats influence several ecosystems since they are cave dwelling species, also over a larger area due to the distances that may be travelled. If turbines are placed within a migration path, a larger area and higher diversity of ecosystems may be impacted. This operational impact as well as possible mitigation measures are outlined in **Table 8-60**.

Table 8-60: Operational Impact on bat mortalities during migration

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Bat mortalities during migration.									
Without Mitigation	4	3	3	4	4	56	Moderate	(-)	Hard
With Mitigation	4	3	3	4	2	28	Low	(-)	
Mitigation and Management Measures	— Reducing blade movement at selected turbines if a migration route is discovered. — Acoustic deterrents are developed well enough to be trialled.								

INCREASED BAT MORTALITIES DUE TO LIGHT ATTRACTION AND HABITAT CREATION

Floodlights and other lights at turbine bases or nearby buildings, will attract bats preying on insects and therefore significantly increase the likelihood of these bats being impacted on by moving turbine blades. Habitat creation in the roofs of nearby buildings can cause a similar increased risk factor. This operational impact as well as possible mitigation measures are outlined in **Table 8-61**.

Table 8-61: Operational Impact on bat mortalities due to light attraction

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased bat mortalities due to light attraction and habitat creation.									
Without Mitigation	4	2	3	2	5	65	High	(-)	Easy
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby while still adhering to safety and security requirements, to prevent the creation of regular insect gathering pools. This will be at turbine bases (if applicable, and other infrastructure buildings). — For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Increased bat mortalities due to light attraction and habitat creation.								
	— The stormwater management plan should prevent the creation of any artificial wetlands and open water sources within 300m of any turbine bases.							

8.9.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase.

8.10 Visual and Landscapes

8.10.1 CONSTRUCTION PHASE

Large construction vehicles, equipment and construction material stockpiles will alter the natural character of the study area and expose visual receptors to impacts associated with construction. Construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Temporary stockpiling of soil during construction may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact.

Dust emissions and dust plumes from increased traffic on the gravel roads serving the construction site may evoke negative sentiments from surrounding viewers.

Surface clearance for cable trenches, access roads, laydown areas and other on-site infrastructure may result in the increased visual prominence of these features, thus increasing the level of contrast with the surrounding landscape. Potential visual pollution could also result from littering on the construction site.

The construction visual impact as well as mitigation measures are indicated in **Table 8-62**.

Table 8-62: Construction Impact on the visual receptors of the Mukondeleli WEF

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact due to construction									
Without Mitigation	3	2	3	4	3	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Carefully plan to minimise the construction period and avoid construction delays. — Where possible, restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting. — Inform receptors within 1km of the WEF development area of the construction programme and schedules. — Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. — Maintain a neat construction site by removing rubble, litter and waste materials regularly. — Position storage / stockpile areas in unobtrusive positions in the landscape, where possible. — Make use of existing gravel access roads where possible. — Limit the number of vehicles and trucks travelling to and from the construction site, where possible. — Ensure that dust suppression techniques are implemented: — on all access roads;								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Visual impact due to construction								
	— in all areas where vegetation clearing has taken place; — on all soil stockpiles.							

8.10.2 OPERATIONAL PHASE

The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. The proposed WEF and associated infrastructure will alter the visual character of the surrounding area and expose potentially sensitive visual receptor locations to visual impacts. Shadow flicker may impact nearby receptors.

Dust emissions and dust plumes from maintenance vehicles accessing the site via gravel roads may evoke negative sentiments from surrounding viewers. The night time visual environment will be altered as a result of operational and security lighting at the proposed WEF.The impact assessment for the above-mentioned impacts is outlined in **Table 8-63**.

Table 8-63: Operational Impact on the visual receptors of the Mukondeleli WEF

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact of wind turbines and associated infrastructure									
Without Mitigation	3	3	3	4	4	52	Moderate	(-)	Moderate
With Mitigation	3	3	3	4	4	52	Moderate	(-)	
Mitigation and Management Measures	— Turbine colours should adhere to CAA requirements. Bright colours and logos on the turbines should be kept to a minimum. — Inoperative turbines should be repaired promptly, as they are considered more visually appealing when the blades are rotating (or at work) (Vissering, 2011). — If turbines need to be replaced for any reason, they should be replaced with turbines of similar height and scale to lessen the visual impact. — As far as possible, limit the number of maintenance vehicles which are allowed to access the site. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on site (whilst adhering to relevant safety standards). — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to relevant safety standards. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If possible, make use of motion detectors on security lighting. — Where possible, the operation and maintenance buildings should be consolidated to reduce visual clutter. — Non-reflective surfaces should be used where possible.								

8.10.3 DECOMMISSIONING PHASE

Vehicles and equipment required for decommissioning will alter the natural character of the study area and expose visual receptors to visual impacts. Decommissioning activities may be perceived as an unwelcome visual intrusion. Dust emissions and dust plumes from increased traffic on the gravel roads serving the decommissioning site may evoke negative sentiments from surrounding viewers. Surface disturbance during construction would expose bare soil resulting in visual scarring of the landscape and increasing the level of visual contrast with the surrounding environment. Temporary stockpiling of soil during decommissioning may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact. Decommissioned infrastructure left on the site may be visually intrusive.

The impact assessment for the above-mentioned decommissioning impacts is outlined in **Table 8-64**.

Table 8-64: Decommissioning Impact on the visual receptors

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impact due to decommissioning									
Without Mitigation	3	2	3	4	3	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— All infrastructure that is not required for post-decommissioning use should be removed. — Carefully plan to minimize the decommissioning period and avoid delays. — Maintain a neat decommissioning site by removing rubble and waste materials regularly. — Position storage / stockpile areas in unobtrusive positions in the landscape, where possible. — Ensure that dust suppression procedures are maintained on all gravel access roads throughout the decommissioning phase. — All cleared areas should be rehabilitated as soon as possible.								

8.11 HERITAGE AND CULTURAL RESOURCES

8.11.1 CONSTRUCTION PHASE

IMPACTS TO ARCHAEOLOGICAL RESOURCES

Direct impacts to archaeological resources would occur during the construction phase when grubbing and construction commence. Culturally significant archaeological sites do not occur close to the turbine locations but, significantly, the locations of roads, laydown areas and other infrastructure is not yet known. For precautionary reasons it is thus assumed that some impacts might occur and the impact significance calculates to **moderate negative**. With mitigation, the significance reduces to **very low negative**. There are no fatal flaws in terms of construction phase impacts to archaeology.

The construction impacts as well as the mitigation measures are outlined in **Table 8-65**.

Table 8-65: Construction Impact on archaeological resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
Without Mitigation	3	1	5	5	3	**42**	**Moderate**	(-)	High
With Mitigation	1	1	5	5	1	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Surveying the as yet unsurveyed areas (but arable lands need not be covered)								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
	— Micrositing of infrastructure as required to avoid any impacts as well as reporting any further sites discovered during construction								

IMPACTS TO GRAVES

Several graves or possible graves have been recorded in the overall study area but with one possible exception, none occur close to the turbine locations provided. The exception is a likely graveyard that was identified from aerial photography and lies within 10 m of turbine MK-24 and is thus certain to be impacted by the hardstand area. It is assumed here that the site is a graveyard and that it would be impacted. Because of the very high cultural significance of graves the magnitude of impacts to graves is rated high. Because most of the layout remains unsurveyed there is still a chance of impacts occurring elsewhere as well. The resulting impact significance is **high negative**.. With mitigation the significance would reduce to **very low negative**. The calculated ratings are considered one level too low but have been conditioned by the very small extent of the impacts. Ratings of **very high negative** and **low negative** before and after mitigation might actually be more appropriate.

Impacts to graves would be considered a fatal flaw but if mitigation results in MD015 being avoided then there are no fatal flaws in terms of construction phase impacts to graves.

The construction impacts as well as the mitigation measures are outlined in**Table 8-66**.

Table 8-66: Construction Impact on graves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of graves									
Without Mitigation	5	1	5	5	5	80	High	(-)	High
With Mitigation	1	1	5	5	1	12	Very Low	(-)	
Mitigation and Management Measures	— Avoid all graves and potential graves — Report any chance finds of unmarked graves during construction — A pre-construction survey should also be undertaken to determine whether any graves are visible in the final footprint.								

IMPACTS TO THE CULTURAL LANDSCAPE

The local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the construction equipment and solar panels is considered to be of low magnitude. Due to the certainty of an impact occurring, the significance calculates to moderate negative. A rating of low negative, however, is considered a better fit considering the existing impacts to the landscape. There are no fatal flaws in terms of construction phase impacts to the cultural landscape

The construction impacts as well as the mitigation measures are outlined in **Table 8-67**.

Table 8-67: Construction Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	2	2	3	2	5	46	Moderate	(-)	High
With Mitigation	1	2	3	2	6	40	Moderate	(-)	
Mitigation and Management Measures	— Minimising the construction duration								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
	— Minimising landscape disturbance in general and ensuring rehabilitation of areas not needed during operation								

8.11.2 OPERATIONAL PHASE

IMPACTS TO THE CULTURAL LANDSCAPE

As before, the local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the solar panels and related infrastructure is considered to be of only low magnitude. Due to the certainty of an impact occurring, the significance calculates to **moderate negative**. Post-mitigation significance would remain at the **moderate negative** level. A rating of **low negative**, however, is considered a better fit considering the existing impacts to the landscape. There are no fatal flaws in terms of operation phase impacts to the cultural landscape.

The construction impacts as well as the mitigation measures are outlined in **Table 8-87**.

Table 8-68: Operation Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	2	2	3	4	5	55	Moderate	(-)	High
With Mitigation	1	2	3	4	5	50	Moderate	(-)	
Mitigation and Management Measures	— There are no specific mitigation measures that can be applied during operation other than the best practice measure of ensuring that all maintenance work occurs within designated areas								

8.11.3 DECOMMISSIONING PHASE

Once again, because the local landscape is compromised by the Sasol facility and coal mines, the intrusion into this landscape of the equipment needed for decommissioning is considered to be of low magnitude. The significance calculates to moderate negative. A rating of low negative, however, is considered a better fit considering the existing impacts to the landscape. There are no fatal flaws in terms of operation phase impacts to the cultural landscape.

The construction impacts as well as the mitigation measures are outlined in **Table 8-69.**

Table 8-69: Decommissioning Impact on cultural landscapes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual intrusion into and change of character of the cultural landscape									
Without Mitigation	2	2	3	2	5	45	Moderate	(-)	High
With Mitigation	1	2	3	2	5	40	Moderate	(-)	
Mitigation and Management Measures	— Minimising the decommissioning duration — Ensuring full rehabilitation post-closure will not result in a change to the calculated significance which remains moderate negative								

8.12 PALAEONTOLOGY

8.12.1 CONSTRUCTION PHASE

The proposed Mukondeleli WEF site lies predominantly on non-fossiliferous Jurassic dolerite with several small sections on potentially fossiliferous sediments of the Vryheid Formation (Ecca Group, Karoo Supergroup. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations for poles or foundations have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised. The construction impacts as well as the mitigation measures are outlined in **Table 8-70**.

Table 8-70: Construction Impact on palaeontological resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Damage to or destruction of archaeological resources									
Without Mitigation	1	1	5	5	1	**12**	**Very Low**	(-)	High
With Mitigation	1	1	5	5	1	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Implementation of a chance finds procedure on site.								

8.12.2 OPERATIONAL PHASE

The operational phase will not impact the palaeontology.

8.12.3 DECOMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase.

8.13 TRANSPORT

The potential impacts to the surrounding environment expected to be generated form the development traffic is traffic congestion and associated noise, dust, and exhaust pollution. This will be true for the construction, operation, and decommissioning phase. It must be noted that significance of the impact is expected to be higher during the construction and decommissioning phase because these phases generate the highest development traffic.

It must be noted that:

- The significance of the traffic impacts is expected to be higher during the construction and decommissioning phase because these phases generate the highest development traffic.
- Traffic impacts are typically assessed for the operational stage as the long-term road infrastructure impact. The construction and decommissioning phase are expected to produce high development traffic volume and a traffic management plan document is often compiled and managed throughout these phases to help manage traffic during these phases.

8.13.1 CONSTRUCTION PHASE

NOISE AND DUST POLLUTION ASSOCIATED POTENTIAL TRAFFIC

This phase includes the transportation of people, construction materials and equipment to the site. This phase also includes the construction of the WEF, including construction of footings, roads, excavations, trenching, and ancillary construction works. This phase will temporarily generate the most development traffic.

The nature of the impact expected to be generated at this stage would be traffic congestion and delays on the surrounding road network as well as the associated noise, dust, and exhaust pollution due to the increase in traffic (**Table 8-71**).

Table 8-71: Construction Impact of noise and dust pollution associated potential traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust & exhaust pollution due to additional trips on the national and district roads.									
Without Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	Easy
With Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	
Mitigation and Management Measures	Noise, dust, and exhaust pollution during the construction phase cannot be completely mitigated. Where possible, the following mitigation measures will significantly reduce the impact: — The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods. — Dust suppression of gravel roads during the construction phase, as required. — The use of mobile batch plants and quarries near the site would decrease the traffic impact on the surrounding road networks. — Accommodation of secure material storage on site to allow for staggered delivery of materials. — Staff and general trips should occur outside of peak traffic periods as far as possible. — The use of busses and taxis to transport staff can also limit construction phase trips. — The preferred abnormal load travel routes should be surveyed to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification). — Design and maintenance of internal roads. Any internal gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional. All vehicles that travel on-site must not be overloaded, and abnormal vehicles must comply to relevant legislation for overweight loads, to ensure lowest possible road surface damage.								

8.13.2 OPERATIONAL PHASE

NOISE AND DUST POLLUTION ASSOCIATED POTENTIAL TRAFFIC

This phase includes the operation and maintenance of the WEF throughout its life span. The nature of the impact expected to be generated at this stage would be traffic congestion and delays on the surrounding road network, and the associated noise, dust, and exhaust pollution due to the operational traffic trips (**Table 8-72**).

Table 8-72: Operational Impact of noise and dust pollution associated potential traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust & exhaust pollution due to additional trips on the national and district roads.									
Without Mitigation	2	1	3	4	2	**20**	**Low**	(-)	Easy
With Mitigation	2	1	3	4	2	**20**	**Low**	(-)	
Mitigation and Management Measures	Noise, dust, and exhaust pollution cannot be completely mitigated. Where possible, the following mitigation measures will significantly reduce the impact: — Encouraging workers to travel outside peak hour periods. — Dust suppression as well as maintenance of internal roads.								

8.13.3 DECOMMISSIONING PHASE

The decommissioning phase will generate construction related traffic including transportation of people, construction materials, water, and equipment (abnormal trucks transporting turbine components). It is therefore expected that the decommissioning phase will generate the same impact as that of the construction phase due to the similarity in nature of the traffic demand expected for both phases. Based on the impact rating, a medium significance rating can be expected during the construction and decommissioning stage.

8.14 SOCIAL

8.14.1 CONSTRUCTION PHASE

CREATION OF LOCAL EMPLOYMENT, TRAINING, AND BUSINESS OPPORTUNITIES

The construction phase of the WEF will extend over a period of approximately 36 months and create in the region of 220 employment opportunities (43% skilled, 45% semi-skilled and 36% low-skilled). Members from the local communities in the area, specifically Secunda, would be in a position to qualify for most of the low skilled and semi-skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. Based on information from similar projects the total wage bill will be in the region of R 50 million (2022 Rand values). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area.

Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. The capital expenditure associated with the construction phase will be approximately R 2.5-3 billion (2022 Rand value). Due the lack of diversification in the local economy the potential for local companies is likely to be limited. The majority of benefits are therefore likely to accrue to contractors and engineering companies based outside the GMM. The local service sector will also benefit from the construction phase. The potential opportunities would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site.

The hospitality industry in the area will also benefit from the provision of accommodation and meals for professionals (engineers, quantity surveyors, project managers, product representatives etc.) and other (non-construction) personnel involved on the project. Experience from other construction projects indicates that the potential opportunities are not limited to on-site construction workers but also to consultants and product representatives associated with the project. The construction impact of employment, training and business creation opportunities is outlined in **Table 8-73.**

Table 8-73: Construction Impact of employment, skills development, and business creation opportunities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Creation of employment and business opportunities									
Without Mitigation	3	2	N/A	2	3	21	Low	(+)	Easy
With Mitigation	3	3	N/A	2	4	32	Moderate	(+)	
Mitigation and Management Measures	**Employment** — Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area. — Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. — Before the construction phase commences the proponent should meet with representatives from the MM to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. — The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project. — Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. — The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. **Business** — The proponent should liaise with the MM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work.								

IMPACT OF CONSTRUCTION WORKERS ON LOCAL COMMUNITIES

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

— An increase in alcohol and drug use.

— An increase in crime levels.

— The loss of girlfriends and/or wives to construction workers.

— An increase in teenage and unwanted pregnancies.

— An increase in prostitution.
— An increase in sexually transmitted diseases (STDs), including HIV.

The objective will be to source as many of the low and semi-skilled workers locally. These workers will be from the local community and form part of the local family and social networks. This will reduce the risk and mitigate the potential impacts on the local community. The potential impact on the local community will therefore be negligible. The balance of semi-skilled and skilled workers will be accommodated in the nearby town of Secunda. The construction impact on local communities due to construction workers in the area is outlined in **Table 8-74**.

Table 8-74: Construction Impact of the presence of construction workers in the area on local communities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impacts on family structures and social networks associated with the presence of construction workers									
Without Mitigation	3	2	3	2	3	**30**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The SEP and CHSSP should include a Grievance Mechanism that enables stakeholders to report resolve incidents. — Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories. — The proponent should consider the option of establishing a Monitoring Committee (MC) for the construction phase that representatives from local landowners, farming associations, and the local municipality. This MC should be established prior to commencement of the construction phase and form part of the SEP. — The proponent and the contractor should implement an HIV/AIDS, COVID-19 and Tuberculosis (TB) awareness programme for all construction workers at the outset of the construction phase. The programmes should form part of the CHSSP. — The contractor should provide transport for workers to and from the site on a daily basis. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site. — The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end. — No construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.									

INFLUX OF JOB SEEKERS

Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. While the proposed project on its own does not constitute a large construction project, the establishment of a number of renewable energy projects in the area may attract job seekers to the area. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the way in which they conduct themselves can impact on the local community. The main areas of concern associated with the influx of job seekers include:

- Impacts on existing social networks and community structures.
- Competition for housing, specifically low-cost housing.
- Competition for scarce jobs.
- Increase in incidences of crime.

These issues are similar to the concerns associated with the presence of construction workers and are discussed above. Based on experience from the construction of other renewable energy facilities the potential for economically motivated in-migration and subsequent labour stranding is likely to limited. This is due to the relatively limited number of employment opportunities and short duration of the construction phase. The construction impact of job seekers on local communities is outlined in **Table 8-75.**

Table 8-75: Construction Impact of job seekers on local communities

Potential Impact: Influx of job seekers into local community	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	2	3	27	Low	(-)	Moderate
With Mitigation	2	1	3	2	3	24	Low	(-)	
Mitigation and Management Measures	It is impossible to stop people from coming to the area in search of employment. However, as indicated above, the proponent should ensure that the employment criteria favour residents from the area. In addition: — Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The proponent, in consultation with the LM, should investigate the option of establishing a MC to monitor and identify potential problems that may arise due to the influx of job seekers to the area. The MC should also include the other proponents of solar energy projects in the area. — The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities. — The proponent should implement a policy that no employment will be available at the gate.									

RISK TO SAFETY, LIVESTOCK, AND FARM INFRASTRUCTURE

The presence on and movement of construction workers on and off the site poses a potential safety threat to local famers and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged, or stock theft linked either directly or indirectly to the presence of construction workers on the site. The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction workers and construction related activities during the construction phase. The construction impact if risk to safety, livestock, and damage to farm infrastructure is outlined in **Table 8-76**.

Table 8-76: Construction Impact of risk to safety, livestock and damage to farm infrastructure

Potential Impact: Risk to safety, livestock and damage to farm infrastructure	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	2	4	40	Moderate	(-)	Easy
With Mitigation	2	1	3	2	3	24	Low	(-)	

Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences. — All farm gates must be closed after passing through. — Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. — The proponent should establish a MC and CoC for workers (see above). — The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors, and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below). — The proponent should implement a Grievance Mechanism that provides local farmers with an effective and efficient mechanism to address issues related to report issues related to damage to farm infrastructure, stock theft and poaching etc. — The Environmental Management Plan (EMP) must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested. — Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms. — Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the CoC. All dismissals must be in accordance with South African labour legislation. — It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

INCREASED RISK OF GRASS FIRE

The presence of construction workers and construction-related activities on the site poses an increased risk of grass fires that could, in turn pose, a threat to livestock, crops, wildlife and farm infrastructure. The potential risk of grass fires will be higher during the dry, windy winter months from May to October. The impacts will be largely local and can be effectively mitigated. The construction impact of veld fires to livestock, farm infrastructure and grazing is outlined in **Table 8-77**.

Table 8-77: Construction Impact of risk posed by veld fires

Potential Impact **Loss of livestock and grazing and damage to farm infrastructure associated with increased incidence of grass fires**	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	1	2	3	**21**	**Low**	(-)	Easy
With Mitigation	2	1	1	2	2	**12**	**Low**	(-)	

Mitigation and Management Measures	— Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc., during the construction phase will be compensated for. The agreement should be signed before the construction phase commences. — Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas. — Smoking on site should be confined to designated areas. — Contractor should ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months. — Contractor should provide adequate fire-fighting equipment on-site, including a fire fighting vehicle. — Contractor should provide fire-fighting training to selected construction staff. As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire-fighting costs borne by farmers and local authorities. — No construction staff, with the exception of security staff, to be accommodated on site overnight.

NUISANCE IMPACTS ASSOCIATED WITH CONSTRUCTION RELATED ACTIVITIES

Construction related activities, including the movement of heavy construction vehicles of and on the site, has the potential to create dust, noise and safety impacts and damage to local roads. The impacts will be largely local and can be effectively mitigated. The assessment of the nuisance impacts associated with construction related activities is outlined in **Table 8-78.**

Table 8-78: Construction Impact of noise, dust and safety

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust and safety impacts associated with movement of construction related activities and movement of traffic to and from the site									
Without Mitigation	3	2	3	2	3	30	Moderate	(-)	Easy
With Mitigation	2	1	3	2	2	16	Low	(-)	
Mitigation and Management Measures	— Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. — Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. — Timing of construction activities should be planned to avoid / minimise impact on key farming activities, including planting and harvesting operations. — The proponent should establish a MC to monitor the construction phase and the implementation of the recommended mitigation measures. The MC should be established before the construction phase commences, and should include key stakeholders, including representatives from local farmers and the								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust and safety impacts associated with movement of construction related activities and movement of traffic to and from the site									
	contractor(s). The MF should also address issues associated with damage to roads and other construction related impacts. — Ongoing communication with land owners and road users during construction period. This should be outlined in the SEP. — The proponent should implement a Grievance Mechanism that provides local farmers and other road users with an effective and efficient mechanism to address issues related to construction related impacts, including damage to local gravel farm roads. — Implementation of a road maintenance programme throughout the construction phase to ensure that the affected roads maintained in a good condition and repaired once the construction phase is completed. — Repair of all affected road portions at the end of construction period where required. — Dust suppression measures must be implemented on un-surfaced roads, such as wetting on a regular basis and ensuring that vehicles used to transport building materials are fitted with tarpaulins or covers. — All vehicles must be roadworthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.								

IMPACTS ASSOCIATED WITH LOSS OF FARMLAND

The activities associated with the construction phase and establishment of the proposed project and associated infrastructure will result in the disturbance and loss of land available for grazing. The impact on farmland associated with the construction phase can be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. In addition, the landowner will be compensated for the loss of land.

Based on feedback from the affected land owners, turbine footprint issues relate to impacts on cropped areas. Messrs Serfontein (321/5), Steyn (317/1), Joubert (291/14, 291/9, 291/10, 291/2), and Te Water (313/9) indicated that a number of proposed turbine locations are located within cropped areas. However, the landowners all indicated that mitigation was possible by repositioning the relevant turbines to adjacent headlands (‘wenakkers’)(See Figure 3.6). This would reduce the impact on productive land.

In terms of substation, Substation Alternative 2 was regarded as due its proximity to the residential cluster on Van Tondershoek (317/12). Alternative 1 is acceptable, as deemed sufficiently distant, and not impacting on cropping land (Joubert, pers. comm).

The affected landowners also indicated that they should be provided with information on timing of construction activities in order to plan cropping and stocking activities. Harvests are typically marketed in advance of activities, i.e., farmers are committed to deliver contracted yields. This requires annual planning, determining how much land needs to be cultivated that season within the operation. The construction impact on farmlands is outlined in **Table 8-79**.

Table 8-79: Construction Impact on farmlands

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impact on productive farmland									
Without Mitigation	3	2	3	2	4	**40**	**Moderate**	(-)	Easy
With Mitigation	2	1	3	2	3	**24**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Impact on productive farmland								
Mitigation and Management Measures	— The loss of high-quality agricultural land should be avoided and or minimised by careful planning of the final layout of the proposed WEF turbines. The recommendations of the agricultural / soil assessment should be implemented. — Affected landowners should be consulted about the timing of construction related activities in advance. — The footprint associated with the construction related activities (access roads, construction platforms, workshop etc.) should be minimised. — An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase. — All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. — The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be drawn up by the Environmental Consultants appointed to manage the EIA. — The implementation of the Rehabilitation Programme should be monitored by the ECO.							

8.14.2 OPERATIONAL PHASE

GENERATE RENEWABLE ENERGY TO PRODUCE GREEN HYDROGEN AND AMMONIA

The aim of the project is to generate renewable energy to produce commercially usable green hydrogen and ammonia that can be used as a fuel for transport in hydrogen fuel cells and or in different industrial uses. The ammonia will be primarily used for the production of ammonium nitrate (fertiliser) and manufacture of plastics, explosives, textiles, pesticides, and other chemicals. Ammonia can also be used as a stable 'carrier' of hydrogen, allowing hydrogen to be readily stored and transported. The proposed project will therefore create opportunities to improve energy security in South Africa by generating alternative energy sources and reduce the carbon footprint associated with current energy generation. The project will also produce green ammonium nitrate for the South African farming and industrial sector and support the transmission of South Africa's fossil fuel-based economy to renewable energy. The operational impact of the development of infrastructure to generate renewable energy to produce green hydrogen and ammonia is outlined in **Table 8-80**.

Table 8-80: Operational Impact of development of infrastructure to improve energy security and support the renewable sector

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generate renewable energy to produce green hydrogen and ammonia									
Without Mitigation	4	4	N/A	4	4	48	Moderate	(-)	Easy
With Mitigation	4	4	N/A	4	5	60	Moderate	(+)	
Mitigation and Management Measures	— As a policy level, government should be encouraged to develop and implement economic incentives to support investment in and the development of green hydrogen and ammonia initiatives. — Maximise opportunities for local content and procurement. — Maximise employment opportunities for local community members.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generate renewable energy to produce green hydrogen and ammonia									
	— Implement training and skills development programs for members from the local community.								

CREATION OF EMPLOYMENT AND BUSINESS OPPORTUNITIES

The proposed development will create in the region of 20 full time employment opportunities during the operational phase, of which 20% will be low-skilled, semi-skilled 30%, and 50% skilled. Based on similar projects the annual operating budget will be in the region of R 24 million (2022 Rand values), including wages. The operational impact of employment, skills development and business creation opportunities is outlined in **Table 8-81**.

Table 8-81: Operational Impact of employment, skills development and business opportunities

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Creation of employment, skills development and business opportunities									
Without Mitigation	2	1	N/A	4	2	14	Low	(+)	Easy
With Mitigation	3	2	N/A	4	4	36	Moderate	(+)	
Mitigation and Management Measures	— As a policy level, government should be encouraged to develop and implement economic incentives to support investment in and the development of green hydrogen and ammonia initiatives. — Maximise opportunities for local content and procurement. — Maximise employment opportunities for local community members. — Implement training and skills development programs for members from the local community. — The proponent should investigate providing training and skills development to enable locally based service providers to provide the required services for the operational phase								

GENERATE INCOME FOR AFFECTED LANDOWNERS

The proponent will enter into rental agreements with the affected landowners for the use of the land for the establishment of the proposed WEF. In terms of the rental agreement the affected landowner will be paid an annual amount dependent upon the area affected. The additional income will reduce the risk to his livelihoods posed by droughts and fluctuating market prices for farm outputs and farming inputs, such as fuel, feed etc. The additional income represents a significant benefit for the affected landowner. The operational impact of benefits associated with income generated for affected farmers is outlined in **Table 8-82**.

Table 8-82: Operational Impact of benefits associated with income generated for affected farmers

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generation of additional income for affected farmers									
Without Mitigation	2	1	N/A	4	3	21	Low	(+)	Easy
With Mitigation	3	2	N/A	4	5	45	Moderate	(+)	
Mitigation and Management Measures	— Implement agreements with affected landowners. — The loss of high-quality agricultural land should be avoided and or minimised by careful planning in the final layout of the proposed WEF facilities, where possible.								

VISUAL IMPACT AND IMPACT ON SENSE OF PLACE

The proposed WEF has the potential to impact on the areas existing rural sense of place. However, given the location of the site next to the existing, large Secunda petrochemical facility and associated coal mines the potential impact on the areas sense of place is likely to be limited. This was confirmed during the site visit. None of affected landowners or adjacent owners interviewed raised concerns regarding the potential impact on the areas sense of place. The visual impact and impact on sense of place associated with the proposed facility and associated infrastructure is outlined in **Table 8-83**.

Table 8-83: Visual impact and impact on sense of place during the operational phase

Potential Impact Visual impact and impact on the areas rural sense of place	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	4	2	**26**	**Low**	(-)	Easy
With Mitigation	2	2	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— The recommendations contained in the Visual Impact Assessment should also be implemented.								

POTENTIAL IMPACT ON PROPERTY VALUES

The potential visual impacts associated with the proposed WEF have the potential to impact on property values. Based on the results of a literature review undertaken for wind farms the potential impact on property values in rural areas is likely to be limited. In this regard a study undertaken in Australia in 2016 (Urbis Pty Ltd) found that:

— Appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values.

— There is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas.

Based on the findings of the literature review the impact of the proposed WEF on property values is therefore likely to be low, specifically given the location of the site next to the existing, large Secunda petrochemical facility and associated coal mines.

As indicated below, the only potentially significant tourism receptor in the study area, Rhino Lodge, is located adjacent to the west of the site. Based on the comments from the owner the WEF will not impact on current activities and as such the value of the property. The proposed WEF is therefore unlikely to impact on adjacent property values.. The operational impact on property values is outlined in **Table 8-84**.

Table 8-84: Operational impact on property values

Potential Impact Visual impact and impact on property values	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	N/A	4	2	**16**	**Low**	(-)	Easy
With Mitigation	2	1	N/A	4	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— The recommendations contained in the Visual Impact Assessment should be implemented.								

POTENTIAL IMPACT ON TOURISM

The potential visual impacts associated with the proposed WEF have the potential to impact on tourism facilities and tourism in the area. Based on the findings of the literature review there is limited evidence to suggest that the proposed WEF would impact on the tourism in the GMM and or GSDM.

The only potentially significant tourism receptor in the study area, Rhino Lodge, is located adjacent to the west of the site. The owner indicated that, apart from potential restrictions on hunting activities on the portion of Rhino Lodge immediately adjacent to Tweefontein, no sense of place, visual, etc impacts are anticipated (van Coller, pers. comm). A wedding venue (Zorgen Vrij) located approximately 2 km NNE of the site, has recently closed down (Botha, pers. comm). Ukhozi Lodge, located 5 km to the north of the site, forms part of SASOL's Rian Rademan Training Centre. The proposed WEF will therefore not impact on local tourism operations. The operational impact on tourism is outlined in **Table 8-85**.

Table 8-85: Operational Impact on tourism

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Impact of the WEF on local tourism operations and activities									
Without Mitigation	1	2	N/A	4	2	**14**	**Very Low**	(-)	Easy
With Mitigation	1	2	N/A	4	2	**14**	**Very Low**	(-)	
Mitigation and Management Measures	— The recommendations contained in the Visual Impact Assessment should be implemented.								

8.14.3 DECOMMISSIONING PHASE

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 years post commissioning. The decommissioning phase is therefore likely to create additional, construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

Given the relatively small number of people employed during the operational phase (~ 20), the social impacts at a community level associated with decommissioning will be limited. In addition, potential impacts associated with the decommissioning phase can be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be Low (negative). Decommissioning will also create temporary employment opportunities, which would represent a positive temporary impact. The significance would be Low with enhancement due to limited opportunities and short duration. The decommissioning impact on social impacts is outlined in **Table 8-85.**

Table 8-86: Social impacts associated with decommissioning

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Social impacts associated with decommissioning									
Without Mitigation	2	2	N/A	3	3	**18**	**Low**	(-)	Easy
With Mitigation	1	2	N/A	3	3	**15**	**Low**	(-)	
Mitigation and Management Measures	— The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned. — All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning.								

8.15 CLIMATE CHANGE

Climate change is regarded as the greatest environmental threat facing the world and keeping our planet's temperature at sustainable levels has become one of the major concerns of policy makers. The energy sector is considered the largest single source of emissions; accounting for approximately 40% of Carbon dioxide emissions and approximately 25% of overall emissions. Wind energy does not emit any climate inducing carbon dioxide or any other air pollutants. According to the Department of Energy[16], within 3 to 6 months of operation, a wind turbine has offset all emissions caused by its construction, to run virtually carbon free for the remainder of its approximate 20 year life.

8.15.1 CONSTRUCTION PHASE

Climate change associated impacts during construction relate to emissions of air pollutants. Air emissions impacts associated with the construction phase are expected to be the same as those discussed in **Section 8.2.1.**

8.15.2 OPERATIONAL PHASE

Carbon dioxide is one of the major greenhouse gases (GHGs) under the UN Framework Convention on Climate Change, and a priority GHG in terms of the National Environmental Management: Air Quality Act - Declaration of Greenhouse Gases as Priority Air Pollutants (GN. R710, 2017). Carbon dioxide is emitted from the combustion of fossil fuels. There will be no GHG emissions directly associated with power generation from the facility in the operational phase due to the nature of the technology.

Furthermore, the project may be regarded as having a positive impact in terms of GHG emissions associated with the development of power generation capacity in South Africa i.e. less GHG emissions per unit of power contributed when compared to conventional fossil fuel derived power.. The operational impact on climate change is outlined in **Table 8-87**.

Table 8-87: Operational Impact on combating climate change and contributing cleaner energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Reduced GHGs and contribution of cleaner energy to the National grid									
Without Mitigation	4	5	3	4	4	64	High	(+)	Easy
With Mitigation	4	5	3	4	4	64	High	(+)	
Mitigation and Management Measures	— The implementation of the project can be regarded as having a mitigatory effect in terms of contributing to the curbing of South African's CO2 emission increases.								

8.15.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase will be the same as that of the construction phase**.**

8.16 HAZARDOUS SUBSTANCES AND POLLUTANTS

8.16.1 CONSTRUCTION PHASE

Potential exists for soil, groundwater and surface water contamination associated with potential releases of small quantities of environmental contaminants and hazardous substances. Sources of pollutants and release mechanisms include:

[16] http://www.energy.gov.za/files/windEnergyCampaign/ImpactofwindenergyFactSheet2.pdf

— Leakages of hydrocarbons (diesel and oil) from construction vehicles and heavy machinery (e.g. excavators and bulldozers).

— Loss of containment and accidental spillage associated with storage and handling of hydrocarbons, chemicals, and concrete.

Runoff creates a preferential pathway and exposure of the above contaminants into the subsurface and water resources leading to a deterioration in water quality and secondary health impacts on aquatic ecosystems and water users.

The construction impact assessment for the abovementioned impact is included in **Table 8-88**.

Table 8-88: Construction Impact of contaminants on soil, groundwater and surface water

Potential Impact Soil, groundwater and surface water contamination	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	2	3	**30**	**Low**	(-)	Easy
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Avoid identified sensitive areas (watercourses and associated buffers) as far as possible. — Chemicals, hydrocarbon materials and hazardous substances maintained onsite must be managed in accordance with the Hazardous Substances Act (No. 15 of 1973) and its relevant regulations. — All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site or in appropriately bunded areas. — Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and — equipment when not in use. — All contaminated soil shall be treated in situ or removed and be placed in containers. — Provide secure storage for fuel, oil, chemicals and other waste materials to prevent contamination of stormwater runoff. — Spill kits must be available at all locations where hazardous substances are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol applicable to the material.									

8.16.2 OPERATIONAL PHASE

The anticipated contamination impacts during the operational phase of the project include spillage of oils, fuel, grease (from site operational and maintenance vehicles) and permanent onsite sewage systems. The operational impact of potential land contamination from hazardous substances is outlined in **Table 8-89.**

Table 8-89: Operational Impact due to hazardous substances

Potential Impact Soil, groundwater and surface water contamination	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	4	2	**22**	**Low**	(-)	Easy
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Soil, groundwater and surface water contamination								
Mitigation and Management Measures	— Chemicals, hydrocarbon materials and hazardous substances maintained onsite must be managed in accordance with the Hazardous Substances Act (No. 15 of 1973) and its relevant regulations. — The proper handling and storage of hazardous materials, the use of hardstanding in storage areas of hazardous substances and where spillages are possible. The use of bunding around storage of hazardous materials and proper upkeep of machinery and vehicles. A complete spill kit must be onsite at all times. — Implement site inspections on the effectiveness and integrity of the stormwater management systems.							

8.16.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

8.17 WASTE MANAGEMENT

8.17.1 CONSTRUCTION PHASE

GENERATION OF GENERAL AND HAZARDOUS WASTE

The table below provides a summary of the typical general and hazardous waste types that are likely to be generated on site during construction. The presence of construction workers has the potential to increase litter on site in the absence of adequate waste receptacles. This results in an unsightly working environment and possible entry into surrounding environment. Furthermore, waste materials may attract pest species / vectors into working areas leading to potential health implications for construction staff and community members.

Spoil material unsuitable for reuse as backfill and bedding material has the potential to disrupt land use and habitats if inappropriately manage or disposed illegally.

Waste generation (domestic waste, mixed industrial and metal waste) and a lack of appropriate separation, temporary storage and recycling (i.e. not aligned with the Waste Hierarchy) has the potential to result in unnecessary waste material to landfill.

Hazardous waste generation and inappropriate management and disposal has the potential to lead to contamination of soil, groundwater and surface water.

WASTE CATEGORY	WASTE TYPE	TYPICAL CONSTITUENTS
General Waste	Domestic Waste	Paper and cardboard packaging, empty plastic and metal containers (non-hazardous original contents) etc.
	Organic Waste	Canteen, food and cooking waste
	Mixed Industrial	Wood, plastic, packaging etc.
	Metal Waste	Ferrous and non-ferrous scrap and stainless steel, metal cuttings, electrode stubs from welding.

	Spoil Material	Excavations, trenching and terracing will result in the generation of spoil material
	Building rubble	Wasted flooring material, paint containers, wall tiles, timber, piping etc.
	Biomass	Cleared vegetation
Hazardous Waste	Oily Waste	Used lubricant and hydraulic oils and hydrocarbon-based solvents
	Oil Contaminated Waste	Solid material (rags etc.) that has come into contact with and contains traces of oil or grease
	Hazardous Chemical Containers	From temporary storage and use of chemicals on site
	Sanitary Waste	Sewerage / faecal matter generated at the contractor's camp

The construction impact of waste generation is outlined in **Table 8-90**.

Table 8-90: Construction Impact of waste generation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generation of general and hazardous waste									
Without Mitigation	3	3	3	2	3	**33**	**Moderate**	(-)	Easy
With Mitigation	2	2	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— Despite the modest volumes of waste anticipated to be generated by the Project, recycling opportunities should be sought in order to reduce the volume of waste to landfill and harness commercial benefits for both the project team and local community. — General waste (i.e. construction waste, building rubble, plastic, metal, excavated material, packaging material, paper and domestic waste etc.) generated during the construction phase should be stored in a designated area within suitable waste collection bins and skips (or similar). — Provisions of suitable waste receptacles for temporary storage of hazardous waste (in compliance with Material Safety Data Sheets). — Collection and disposal of hazardous waste at appropriately licences landfills and proof of disposal to be retained by contractors and facility operators. — Bins/skips must be emptied regularly and collected by a licensed contractor for disposal at an appropriate, licensed facility. Bins/skips must not be allowed to overflow. — Solid waste must be managed to avoid risk to local fauna and to avoid attracting animals to the site and to ensure containment and regular collection for disposal at a licenced landfill site. — Maintain good housekeeping on site and minimise the generation of waste.								

SANITATION WASTE

Sanitation services are required to accommodate workers on site, contractor's yard and at site camps. Temporary ablution facilities (chemical toilets) are proposed to appropriately contain and treat waste for offsite disposal. The incorrect siting of chemical toilets (i.e. within 100m of a watercourse or stream) and loss of containment could lead to pollution of the receiving environment (soil, groundwater and surface water), leading to secondary health impact to ecosystems and communities (ground and surface water users).

Sanitary waste, if not correctly contained, has the potential to enter surface water via runoff and increase organic matter loading in water systems.

The construction impact associate with sanitation waste generation is outlined in **Table 8-91**.

Table 8-91: Construction Impact associated with sanitation waste

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Generation of sanitation waste									
Without Mitigation	3	3	3	2	3	**33**	**Moderate**	(-)	Easy
With Mitigation	2	2	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— Chemical toilet facilities are to be supplied and serviced by an approved contractor. — Ablution facilities must be located in a specific area agreed to by the ECO prior to placement and must be located away from sensitive environments. — Spillages must be prevented during cleaning or servicing. — Ablution facilities must be effectively secured to prevent toppling or being wind-blown — Ablution facilities must be maintained in a hygienic state and serviced regularly								

8.17.2 OPERATIONAL PHASE

It is noted that only small volumes of waste are anticipated to be generated by the facility during operations. The Operational phase waste generation impact was therefore not assessed.

8.17.3 DECOMMISSIONING PHASE

The impacts associated with the decommissioning phase are expected to be the same as the construction phase.

8.18 HEALTH, SAFETY AND RISK

A high-level Safety Health and Environmental Risk Assessment was undertaken for the proposed development of Battery Energy Storage Systems (BESS) associated with the proposed Mukondeleli WEF, Secunda, Mpumalanga

8.18.1 CONSTRUCTION PHASE

SOLID STATE LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Exposure to materials such as cement, paints, solvents, welding fumes, truck fumes etc. during construction can result in employee / contractor illness. The construction impact associated with chronic exposure to toxic chemical or biological agents is outlined in Table 8-92**.**

Table 8-92: Construction Impact on Human Health chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	4	4	**44**	**Moderate**	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
With Mitigation	1	1	3	4	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy and procedure must be compiled and implemented. — A detailed construction risk assessment must be undertaken prior to construction work. — The necessary Personal Protective Equipment (PPE) must be provided and worn at the required working areas. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — All necessary health controls/ practices must be in place, e.g. ventilation of welding and painting areas. — SHE monitoring and reporting programs must be in place and implemented. — An emergency response plan must be compiled prior to construction, which must include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.								

HUMAN HEALTH - EXPOSURE TO NOISE

Exposure to drilling, piling, generators, air compressors during construction could lead to an adverse impact on hearing of workers as well as a possible nuisance factor in near-by areas. The construction impact associated with exposure to noise is outlined in **Table 8-93**.

Table 8-93: Construction Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	3	1	5	5	4	**56**	**Moderate**	(-)	Easy
With Mitigation	2	1	5	5	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— A health risk assessment must be undertaken to determine if equipment continuous noise exceeds 85dB at workstation and 61dB at the boundary of the site. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

During construction workers will be exposed to heat during the day and cold in winter. This could result in heat stroke or Hypothermia. The construction impact associated with exposure to temperature extremes and/or humidity is outlined in in Table 8-94.

Table 8-94: Construction Impact on human health - exposure to temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	3	2	3	1	2	**18**	**Low**	(-)	Easy
With Mitigation	2	2	3	1	1	**8**	**Very low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Mitigation and Management Measures	— Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Adequate potable water to be provided for employees during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the BESS installation staff during all phases of the project.								

HUMAN HEALTH - CHRONIC EXPOSURE TO PSYCHOLOGICAL STRESS

The construction of large projects brings many contractor workers into a small, isolated community. This may lead to a lack of sufficient accommodation, entertainment etc, resulting in an increase in alcohol abuse and violence. The construction impact associated with psychological stress is outlined in Table 8-95**.**

Table 8-95: Construction Impact on human health – exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	2	3	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Refer to Social Impact Assessment for this project (**Section 8.16**).								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting of heavy equipment and movement at awkward angles during construction may result in back and other injuries. The construction impact associated with ergonomic stress is outlined in Table 8-96**.**

Table 8-96: Construction impact on human health – exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	4	1	3	2	3	30	Low	(-)	Moderate
With Mitigation	4	1	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Ensure that despite the isolated location, all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. The necessary equipment must be available prior to the commencement of the project. — Isolated location, maintenance of construction equipment to ensure safe operation is critical. Ensure this is in place prior to project beginning. — Consider supporting the development of local service providers when sourcing and maintaining equipment. — First aid provision on site.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The construction phase could result in activities that pose a fire risk. This includes fire involving fuels used in construction vehicles or vehicles themselves (e.g. tyre fire), fire due to uncontrolled welding or other hot-work. This will result in injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as not highly flammable nor massive fire. The construction impact associated with exposure to fire radiation is outlined in Table 8-97.

Table 8-97: Construction impact on human and equipment safety – exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	4	2	3	5	4	56	Moderate	(-)	Complex
With Mitigation	4	2	3	5	2	28	Low	(-)	

Mitigation and Management Measures	— Fuels stored on site must be situated in dedicated, demarcated and bunded areas.
	— Suitable fire-fighting equipment must be available on site near source of fuel, e.g. diesel tank, generators, mess, living quarters, workshops etc
	— The company responsible for the facility at this stage is to have:
	  — An emergency plan must be in place prior to commencement of construction.
	  — Fuel spill containment procedures and equipment must be provided for and in place.
	  — Hot-work permit and management system must be in place.								

Solid state battery containers damaged on route e.g. dropped in port (drops do happen about 1/2000 containers) and importing of possibly approximately 100 containers for the site. With this it is possible, although unlikely, that one will be dropped, or a traffic accident may occur on-route. This includes involvement in an external fire e.g. at the port or on route. Data indicates installed facility events are 0.001/year. Transport of 100 units per installation is assumed to take 4 weeks each so f= 0.008 once in 125 years, so the likelihood is very low. A consequence of this could be injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as it is not highly flammable nor massive. The construction impact on human and equipment safety - exposure to fire radiation is outlined in Table 8-98.

Table 8-98: Construction Impact on human and equipment safety - exposure to fire radiation for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	2	34	Moderate	(-)	Complex
With Mitigation	5	2	5	5	1	17	Low	(-)	

Mitigation and Management Measures	— Solid state battery design must include abuse tests such as drop test, impact, rapid discharge etc. Propagation tests for systems, e.g. heat insulating materials between cells/modules must be conducted. Factory acceptance test prior to leaving manufacture must be conducted. Batteries are usually stored at 50% charge to prolong life but may be shipped fully discharged. This level of detail should be understood so as to assess the risk during transport and storage.
	— The appointed contractor should ensure suitably competent transport companies are appointed. The company responsible for transportation should ensure:
	  — Compliance with National Road Traffic Act Regulation 8 – dangerous goods.
	  — Port Authorities should be alerted to the overall project and the hazardous nature of the contents of battery containers being imported. Note. If, as per one of the typical suppliers (Tesla) indications, the containers are classified as IMDG Class 9 – the containers will not receive any special care in								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
	the ports and may be stored next to flammables. Port emergency response in particular need training on mitigating battery hazards. — Prior to bringing any containers into the country a full Emergency response plan should be in place for the full route from the ship to the site. Drivers must be trained in the hazards of containerized batteries. The emergency plan to determine and address: — What gases would be released in a fire and are there inhalation hazards. — Extinguishing has two important elements, put out fire and to provide cooling. Different approaches may be needed for small fire – e.g. put out, and for large fires e.g. cool with copious quantities of water. Note inert gases and foam may put out the initial fire but fail to control thermal runaway or to cool the batteries resulting in reignition. — What initial fire extinguishing medium should be used? — Are there any secondary gases or residues from use of extinguishers? — If water is appropriate, may need outside connections to inside sprinklers. — First responders need to know what media to use, especially if water totally unsuitable and if there are no connection points for water etc. — PPE to be specified including possible exposure to chemicals and fumes as well as radiate heat. — Containment of residues/water/damaged equipment. — Compile and implement a disposal plan that manages the handling of partially and/or fully charged damaged units, contaminated surfaces (e.g. HF residues) and other associated dangerously charged components.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

With solid state lithium containers, flammable gases generated by thermal run away reach explosive limits. The consequence of this is potential fatalities amongst first responders; damage to container, transport truck or other nearby items, e.g. other containers in the port. The construction impact on human and equipment safety - exposure to explosion over pressures is outlined in Table 8-99.

Table 8-99: Construction Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	4	5	5	3	**57**	**Moderate**	(-)	N/A
With Mitigation	5	4	5	5	1	**19**	**Low**	(-)	
Mitigation and Management Measures	— Develop and implement an emergency response plan that deals with all emergency responses applicable to the BESS, including during transportation. — For simplicity one transport route would be preferable. The route needs to be assessed in terms of responding local services, rest places for drivers, refuelling if required, break down services available etc.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
	— Once an import route has been chosen, e.g. Richards Bay or Durban and along N2/N3/N11 etc, then the appointed transport company should ensure key emergency services on route could be given awareness training in battery fire/accident response. — Emergency response planning and training referred to above may be important for key locations such as the mountain passes / tunnels.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in Table 8-100**.**

Table 8-100: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Complex
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged solid-state batteries release fumes, leak electrolyte, are completely broken exposing hazardous chemicals and thermal runaway and hazardous fumes released can cause mild skin irritation from exposure to small leaks to serious corrosive burns or lung damage. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in Table 8-101.

Table 8-101: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	3	3	5	3	**45**	**Moderate**	(-)	Complex
With Mitigation	4	3	3	5	2	**30**	**Low**	(-)	
Mitigation and Management Measures	— Appointed transport company to ensure transport in accordance with Regulation 8 of the National Road Traffic Act 93 of 1996, Dangerous Goods. The transportation of prescribed goods in manner that is not consistent with the prescriptions, e.g. consignor								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
	and consignee responsibilities is not permitted. Prescription are found in SANS 10228/29 and international codes for battery transport etc. — SSL BESS must be transported in sealed packages that are kept upright, protected from movement damage etc. — These must be packaged to ensure no short-circuiting during transport. — Consideration must be taken to prevent excessive vibration as battery internal may be damaged leading to thermal run-away during commissioning. — Pre-assembled containers will most likely be supplied. These will be fitted with the necessary protective measures by the supplier considering marine and road transport as well as lifting, setting down etc. — Route selection to consider possible incidents along the way and suitable response, e.g. satellite tracking, mobile communication, 24/7 helpline response. — Standard dangerous goods requirements for Hazmat labels must be adhered to, Transport Emergency Card (Trem cards) must be carried/held, and the driver/s must be trained on the hazards of the load.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Exposure to construction moving equipment, heavy loads, elevated loads, and working at heights can cause injury or possibly fatality, as well as damage to equipment, delays in starting the project and financial losses. The construction impact on human and equipment safety **-** exposure to violent release of kinetic or potential energy is outlined in **Table 8-102**.

Table 8-102: Construction Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	4	64	High	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy must be compiled and implemented. — Develop a detailed construction risk assessment prior to construction work. — A SHE procedure must be developed and implemented. — The necessary PPE to be worn must specified. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — SHE monitoring and reporting programs must be developed and implemented. — Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc must be developed and adhered to.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
	— Civil works and building structures must adhere to the National Building Regulations and building Standards Act 103 of 1977 SANS 10400 and other relevant codes. — Other constructions such as roads, sewers etc must also adhere to relevant SANS standards. — All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc must be developed before construction begins. — An emergency response plan must be compiled before construction begins.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

Construction activities will include the use of electrical machines, generators etc. Hot dry area static generation is highly likely as well as lightning strikes. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The construction impact on exposure to electromagnetic waves is outlined in **Table 8-103**.

Table 8-103: Construction Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Implement standard maintenance of condition of electrical equipment and adhere to safe operating instructions. — Consideration should be given, where required, for remote isolation devices or switching measures on equipment, plant and machinery to ensure the ability to shut off power to systems in use on site. — If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, installations to be suitably designed and maintained. — Lightning strike rate in the study area is very high. Outside work must be stopped during thunderstorms. — Lighting conductors may be required for the final installation, to be confirmed during design phase.								

ENVIRONMENT - EMISSIONS TO AIR

Dust from construction and generally hot dry area may cause adverse impact on employee health. The construction impact of emissions to air is indicated in Table 8-104.

Table 8-104: Construction Impact on the environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	2	1	1	4	**28**	**Low**	(-)	Easy
With Mitigation	2	2	1	1	2	**12**	**Very Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance	Character	Ease of mitigation
Environment – emissions to air								
Mitigation and Management Measures	— Implement dust control measures such as dampening of roads etc., particularly during dry or windy weather conditions, as per normal construction practices. — Construction workers to make use of necessary PPE (dust masks) when required.							

ENVIRONMENT - EMISSIONS TO WATER

The construction phase will make use of diesel for equipment, paints and solvents. There is also a possibility of Transformer oil spills and Sewage and kitchen/mess area wastewater generation. This could lead to environmental damage, particularly to the surface and underground water in the area if not managed correctly. The construction impact on environment due to emissions to water is outlined in Table 8-105.

Table 8-105: Construction impact on the environment - emissions to water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	27	Low	(-)	Moderate
With Mitigation	2	2	3	2	2	18	Low	(-)	
Mitigation and Management Measures	— Normal construction site practices for preventing and containing fuels/paint/oil etc spills must be adhered to. — Appropriate bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important and must be provided for. — Spill clean-up procedures to be in place before commencing construction. — Sewage and any kitchen liquids must have containment and suitable treatment/disposal must be followed.								

ENVIRONMENT - EMISSIONS TO EARTH

The construction phase will generate solid waste. Improper management of this waste will result in environmental pollution. The construction impact on waste generation is outlined in **Table 8-106**.

Table 8-106: Construction impact on the environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
Without Mitigation	2	2	3	3	3	30	Low	(-)	Easy
With Mitigation	1	2	3	3	2	18	Low	(-)	
Mitigation and Management Measures	— Solid waste, including packaging materials, must be collected and stored within designated areas on site and thereafter removed for disposal at a licensed waste disposal facility on a regular basis, as well as after regular maintenance. — Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The construction phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Furthermore, battery containers may be damaged during handling and/or transportation and may lead to construction delays. The construction impact of waste of resources e.g. water, power etc., is outlined in Table 8-107.

Table 8-107: Construction impact on the environment – waste of resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — End of Life plan needs to be in place before any battery containers enter the country as there may be damaged battery unit from day 1. — Develop and implement a water management plan and spill containment plan.								

PUBLIC - AESTHETHICS

The construction site will likely have bright surfaces reflecting light and tall structures in a flat area. This is likely to cause irritation/annoyance to the public. The construction impact on public aesthetics is outlined in **Table 8-108**.

Table 8-108: Construction impact on public - aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Moderate
With Mitigation	1	2	3	4	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Refer to visual impact assessment (**Section 8.12**).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays could result in financial loss for investors. The construction impact on investors – financial is outlined in **Table 8-109**.

Table 8-109: Construction impact on Investors - Financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management to include deviation monitoring systems.								

EMPLOYEES AND INVESTORS – SECURITY

During the construction phase there is a potential for hi-jacking of valuable but hazardous load while en-route to site. Theft of construction equipment and battery installation facilities is also a possibility on site. Civil unrest or violent strike by employees can also arise. The construction impact of security is outlined in Table 8-110.

Table 8-110: Construction impact on employees and investors - security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	1	3	2	4	**40**	**Moderate**	(-)	Complex
With Mitigation	4	1	3	2	4	**27**	**Low**	(-)	
Mitigation and Management Measures	— Fencing around the electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

EMERGENCIES

During the construction phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The construction impact of emergencies is outlined in Table 8-111**.**

Table 8-111: Construction impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	5	4	**56**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	5	2	**28**	**Low**	(-)	
Mitigation and Management Measures	— All safety measures listed in **Appendix H-12** must be implemented. — Emergency procedures need to be practiced prior to commencement of construction. — BESS units should not be stored any closer to each other than they would be in the final installation so that propagation is prevented, i.e. laydown area needs to be considered. — The company in charge of the containers at each stage in the transport process needs to be very clear so that responsibility for the integrity of the load and protection of the persons involved in transfer and coordination of emergency response on-route. E.g. if purchased from Tesla where does hand over occur to the South African contractor / owner, at the factory door in USA, at the port in RSA, at the site fence. For example, who will be accountable if there's thermal runway event on a truck with a container that stops in a small town for driver refreshments.								

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This could result in unknown hazards manifest due to using "cheaper supplier or less developed technology". The construction impact of battery technology on investors is outlined in Table 8-112**.**

Table 8-112: Construction impact on investors - legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	2	1	3	3	2	**18**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used and not old technologies prone to fires/explosions etc..								

VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Exposure to materials such as cement, paints, solvents, welding fumes, truck fumes etc. during construction can result in employee / contractor illness. The construction impact associated with chronic exposure to toxic chemical or biological agents is outlined in Table 8-113.

Table 8-113: Construction Impact on human health – exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	4	4	44	Moderate	(-)	Moderate
With Mitigation	1	1	3	4	2	18	Low	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy and procedure must be compiled and implemented. — A detailed construction risk assessment must be undertaken prior to construction work. — The necessary Personal Protective Equipment (PPE) must be provided and worn at the required working areas. — Ensure that relevant SHE appointees are in place. — Contractor's safety files must be in place and kept up to date. — All necessary health controls/ practices must be in place, e.g. ventilation of welding and painting areas. — SHE monitoring and reporting programs must be in place and implemented. — An emergency response plan must be compiled prior to construction, which must include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.								

HUMAN HEALTH - EXPOSURE TO NOISE

Exposure to drilling, piling, generators, air compressors during construction could lead to an adverse impact on hearing of workers as well as a possible nuisance factor in near-by areas. The construction impact associated with exposure to noise is outlined in **Table 8-114**.

Table 8-114: Construction Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	3	1	5	5	4	56	Moderate	(-)	Easy
With Mitigation	2	1	5	5	2	26	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Mitigation and Management Measures	— A health risk assessment must be undertaken to determine if equipment continuous noise exceeds 85dB at workstation and 61dB at the boundary of the site. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

During construction workers will be exposed to heat during the day and cold in winter. This could result in Heat stroke or Hypothermia. The construction impact associated with exposure to temperature extremes and/or humidity is outlined in in Table 8-115**.**

Table 8-115: Construction Impact on human health - exposure to temperature extremes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	3	2	3	1	2	**18**	**Low**	(-)	Easy
With Mitigation	2	2	3	1	1	**8**	**Very low**	(-)	
Mitigation and Management Measures	— Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Adequate potable water to be provided for employees during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the BESS installation staff during all phases of the project.								

HUMAN HEALTH - CHRONIC EXPOSURE TO PSYCHOLOGICAL STRESS

The construction of large projects brings many contractor workers into a small, isolated community. This may lead to a lack of sufficient accommodation, entertainment etc, resulting in an increase in alcohol abuse and violence. The construction impact associated with psychological stress is outlined in **Table 8-116**.

Table 8-116: Construction Impact on human health – exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	**20**	**Low**	(-)	Easy
With Mitigation	2	3	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Refer to Social Impact Assessment for this project (**Section 8.16**).								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting of heavy equipment and movement into awkward angles during construction may result in back and other injuries. The construction impact associated with ergonomic stress is outlined in Table 8-117**.**

Table 8-117: Construction impact on human health – exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
With Mitigation	4	1	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Ensure that despite the isolated location, all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. — Isolated location, maintenance of construction equipment to ensure safe operation is critical. Ensure this is in place prior to project beginning. — Ensure First aid provision on site.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The construction phase could result in activities that pose a fire risk. This includes fire involving fuels used in construction vehicles or vehicles themselves (e.g. tyre fire), fire due to uncontrolled welding or other hot-work. This will result in injuries due to radiation especially amongst first responders and bystanders. Fatalities are unlikely from the heat radiation as not highly flammable nor massive fire. The construction impact associated with exposure to fire radiation is outlined in **Table 8-118**.

Table 8-118: Construction impact on human and equipment safety – exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	4	2	3	5	4	**56**	**Moderate**	(-)	Complex
With Mitigation	4	2	3	5	2	**28**	**Low**	(-)	

Mitigation and Management Measures	— Fuels stored on site must be situated in dedicated, demarcated and bunded areas.
	— Suitable fire-fighting equipment must be available on site near source of fuel, e.g. diesel tank, generators, mess, living quarters, workshops etc
	— The company responsible for the facility at this stage is to have:
	  — An emergency plan must be in place prior to commencement of construction.
	  — Fuel spill containment procedures and equipment must be provided for and in place.
	  — Hot-work permit and management system must be in place.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The construction impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 8-119**.

Table 8-119: Construction Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	2	3	2	3	**33**	**Moderate**	(-)	Complex
With Mitigation	3	2	3	2	2	**20**	**Low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Exposure to construction moving equipment, heavy loads, elevated loads, and working at heights can cause injury or possibly fatality, as well as damage to equipment, delays in starting the project and financial losses. The construction impact on human and equipment safety **-** exposure to violent release of kinetic or potential energy is outlined in Table 8-120.

Table 8-120: Construction Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	4	64	High	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— The construction phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. — A SHEQ policy must be compiled and implemented. — Develop a detailed construction risk assessment prior to construction work. — A SHE procedure must be developed and implemented. — The necessary PPE to be worn must specified. — Ensure that relevant SHE appointees are in place. — Contractor’s safety files must be in place and kept up to date. — SHE monitoring and reporting programs must be developed and implemented. — Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc must be developed and adhered to. — Civil works and building structures must adhere to the National Building Regulations and building Standards Act 103 of 1977 SANS 10400 and other relevant codes. — Other constructions such as roads, sewers etc must also adhere to relevant SANS standards. — All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc must be developed before construction begins.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
	— An emergency response plan must be compiled before construction begins.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

Construction activities will include the use of electrical machines, generators etc. Hot dry area static generation is highly likely as well as lightning strikes. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The construction impact on exposure to electromagnetic waves is outlined in **Table 8-121**.

Table 8-121: Construction Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Complex
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Implement standard maintenance of condition of electrical equipment and adhere to safe operating instructions. — Consideration should be given, where required, for remote isolation devices or switching measures on equipment, plant and machinery to ensure the ability to shut off power to systems in use on site. — If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, installations to be suitably designed and maintained. — Lightning strike rate in the study area is very high. Outside work must be stopped during thunderstorms. — Lighting conductors may be required for the final installation, to be confirmed during design phase.								

ENVIRONMENT - EMISSIONS TO AIR

Dust from construction and generally hot dry area may cause adverse impact on employee health. The construction impact of emissions to air is indicated in Table 8-122.

Table 8-122: Construction Impact on the environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	2	1	1	4	**28**	**Low**	(-)	Easy
With Mitigation	2	2	1	1	2	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement dust control measures such as dampening of roads etc., particularly during dry or windy weather conditions, as per normal construction practices. — Construction workers to make use of necessary PPE (dust masks) when required.								

ENVIRONMENT - EMISSIONS TO WATER

The construction phase will make use of diesel for equipment, paints and solvents. There is also a possibility of Transformer oil spills and Sewage and kitchen/mess area wastewater generation. This could lead to environmental damage, particularly to the surface and underground water in the area if not managed correctly. The construction impact on environment due to emissions to water is outlined in **Table 8-123**.

Table 8-123: Construction impact on the environment - emissions to water

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Normal construction site practices for preventing and containing fuels/paint/oil etc spills must be adhered to. — Appropriate bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area is particularly important and must be provided for. — Spill clean-up procedures to be in place before commencing construction. — Sewage and any kitchen liquids must have containment and suitable treatment/disposal must be followed.								

ENVIRONMENT - EMISSIONS TO EARTH

The construction phase will generate solid waste. Improper management of this waste will result in environmental pollution. The construction impact on waste generation is outlined in Table 8-124.

Table 8-124: Construction impact on the environment - emissions to earth

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – waste generation									
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	1	2	3	3	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Solid waste, including packaging materials, must be collected and stored within designated areas on site and thereafter removed for disposal at a licensed waste disposal facility on a regular basis, as well as after regular maintenance. — Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The construction phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Furthermore, battery containers may be damaged during handling and/or transportation and may lead to construction delays. The construction impact of waste of resources e.g. water, power etc., is outlined in Table 8-125.

Table 8-125: Construction impact on the environment – waste of resources

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	**20**	**Low**	(-)	Easy
With Mitigation	1	1	1	2	2	**10**	**Very low**	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — Develop and implement a water management plan and spill containment plan.								

PUBLIC - AESTHETICS

The construction site will likely have bright surfaces reflecting light and tall structures in a flat area. This is likely to cause irritation/annoyance to the public. The construction impact on public aesthetics is outlined in Table 8-126**.**

Table 8-126: Construction impact on public - aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	3	2	3	4	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	1	2	3	4	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Visual impact assessment to include BESS installation when design details become available. Confirm height limitations for VRFB BESS building (if utility scale).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays could result in financial loss for investors. The construction impact on investors – financial is outlined in Table 8-127**.**

Table 8-127: Construction impact on Investors - Financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management to include deviation monitoring systems.								

EMPLOYEES AND INVESTORS – SECURITY

During the construction phase there is a potential for hi-jacking of valuable but hazardous loads while en-route to site. Theft of construction equipment and battery installation facilities is also a possibility on site. Civil unrest or violent strike by employees can also arise. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The construction impact of security is outlined in Table 8-128**.**

Table 8-128: Construction impact on employees and investors - security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	1	3	2	4	**40**	**Moderate**	(-)	Complex

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
With Mitigation	4	1	3	2	4	27	Low	(-)	
Mitigation and Management Measures	— Fencing around the electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

EMERGENCIES

During the construction phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The construction impact of emergencies is outlined in Table 8-129**.**

Table 8-129: Construction impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— Emergency procedures need to be practiced prior to commencement of construction.								

INVESTORS - LEGAL

The Battery sector is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This could result in unknown hazards manifest due to using “cheaper supplier or less developed technology”. The construction impact of battery technology on investors is outlined in Table 8-130**.**

Table 8-130: Construction impact on investors - legal matters

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	2	1	3	3	2	18	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable technology suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art technology systems are used and not old technologies prone to fires/explosions etc..								

8.18.2 OPERATIONAL PHASE (INCLUDING COMMISSIONING)

SOLID STATE LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Operation and maintenance materials such as spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc., may cause occupational illness. The operational impact on human health - chronic exposure to toxic chemical or biological agents is outlined in Table 8-131**.**

Table 8-131: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	4	5	50	Moderate	(-)	Easy
With Mitigation	1	1	3	4	2	18	Low	(-)	

Mitigation and Management Measures	— The operation and maintenance phase must be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993.
	— A SHEQ policy must be in place prior to commissioning.
	— A detailed risk assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning.
	— A SHE procedure must be in place prior to commissioning, and must include, but not limited to, PPE requirements, management of change, integrity monitoring.
	— Ensure that relevant SHE appointees are in place.
	— Training of staff on general hazards on site must be conducted.
	— All necessary health controls/ practices to be in place, e.g. ventilation of confined areas, occupational health monitoring if required and reporting programs must be in place and implemented.
	— An emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as:
	  — appointment of emergency controller,
	  — emergency isolation systems for electricity,
	  — emergency isolation and containment systems for electrolyte,
	  — provision of PPE for hazardous materials response,
	  — provision of emergency facilities for staff at the main office building,
	  — provision of first aid facilities,
	  — first responder contact numbers etc.									

Compromised battery compartment vapours accumulate in the containers, as well as release solids/liquids on surfaces. Maintenance of battery components can cause corrosive and mildly toxic liquid on surfaces. This can result in dermatitis, and skin /eye/lung irritation. The operational impact on human health - chronic exposure to toxic chemical or biological agents is outlined in **Table 8-132**.

Table 8-132: Operational Impact on human health - chronic exposure to toxic chemical or biological agents for SSL BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	3	1	3	5	4	48	Moderate	(-)	Complex
With Mitigation	1	1	3	5	2	20	Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
Mitigation and Management Measures	— Maintenance procedures must be in place should equipment need to be opened, e.g. pumps drained and decontaminated prior to repair in workshop etc. — Ensure PPE for handling battery parts and other equipment on site is specified and worn when required. — Training of staff on general hazards on site must be conducted. — Install a leak detection system with local alarms if regulated occupational exposure limits are exceeded etc prior to entry for inspection of battery containers. — Provide signage or labels on all equipment. — Confined space entry procedures must be developed and adhered to when entering tanks and possibly battery containers. — There needs to be careful thought given to procedures to be adopted before entering into the BESS or a container under normal circumstances (confined space) but particularly after a BMS shut down where there may be flammable or toxic gases present, a fire etc. Any situation could await those entering. — Safety Data Sheets (SDSs) must be available on site. — Operating manuals must be provided including start-up, shut-down, steady state, monitoring requirements. — Maintenance manuals with make safe, decontamination and repair procedures must also be in place. — A maintenance schedule must be developed and implemented to include the required daily, weekly, monthly, annual etc maintenance. — Provided portable equipment for calibration and for testing/verification of defective equipment, e.g. volt/current meters, infrared camera.								

HUMAN HEALTH - EXPOSURE TO NOISE

Moving parts inside containers, buildings, pumps, compressors, cooling systems etc., can cause adverse impact on hearing of workers, or may be a nuisance factor at near -by residences or other activities. The operational impact on human health - exposure to noise is outlined in Table 8-133.

Table 8-133: Operational Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	2	1	5	5	4	52	Moderate	(-)	Easy
With Mitigation	2	1	5	5	2	26	Low	(-)	
Mitigation and Management Measures	— Design the system to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g. emergency generator, air compressor etc. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

Workers may be exposed to extreme temperatures and/or humidity such as heat during the day and cold weather in winter. Batteries can also generate heat within enclosed buildings / containers, and night work requires lighting which can generate heat. This could result in heat stroke or hypothermia. The operational impact on human health - exposure to temperature extremes and/or humidity is outlined in Table 8-134.

Table 8-134: Operational Impact on human health - exposure to temperature extremes and/or humidity

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	4	2	3	1	2	20	Low	(-)	Easy
With Mitigation	3	2	3	1	1	9	Very Low	(-)	
Mitigation and Management Measures	— Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Ensure containers are temperature controlled as required to remain within the optimal battery operating temperature range. — Lighting to be provided inside any buildings, inside the containers, possibly linked to the door opening and outdoors where necessary. — Adequate potable water to be provided during all phases of the project. — Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. — PPE for operations and maintenance staff to be suitable for the weather conditions.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

Isolated workstation and monotonous repetitive work can cause low performance, and system productivity suffers. The operational impact on human health - exposure to psychological stress is outlined in Table 8-135.

Table 8-135: Operational Impact on human health - exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	1	3	3	2	1	9	Very Low	(-)	
Mitigation and Management Measures	— Implement staff rotation to other activities within the site where necessary. — Performance monitoring of inspections / maintenance tasks in particular must be undertaken.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting heavy equipment and movement at awkward angles during maintenance, stretching to reach high level and bending to low level, including working at heights if equipment is located on top of roofs or elevated electrical equipment (e.g. pylons), can result in back and other injuries. The operational impact on human health - exposure to ergonomic stress is outlined in Table 8-136.

Table 8-136: Operational Impact on human health - exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	5	1	3	2	3	33	Moderate	(-)	Easy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
With Mitigation	4	1	3	2	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Working at heights training must be provided. — If equipment is at height, ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. — A working at height procedure needs to be in place.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

During the operation of the facility there are chances of involvements in an external fire e.g. veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to batteries leading to shorting and heating can also be an issue along with high humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads and/or surges. Operator abuse, Battery management System (BMS) failure or software failure. Incorrect extinguishing mediums can escalate the fire. Consequences include contaminated run off. Radiation burns unlikely to be severe as no highly flammable materials on site. Damaged equipment. Fire spreads to other units or offsite if grass/vegetation not controlled. The operational impact on human and equipment safety - exposure to fire radiation is outlined in **Table 8-137**.

Table 8-137: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	1	5	5	3	**48**	**Moderate**	(-)	Complex
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Grass cutting and fire breaks must be maintained around the BESS installations to prevent veld fires. No combustible materials to be stored in or near the batteries or electrical infrastructure. Ensure separation of site diesel tank, transformers from BESS and vice versa. — The Facility to comply with prescribed design standards such as the BESS design codes from the USA and standards of practice that (e.g. UL9540, NFPA 855 and DNV GL RP 43). — A detailed Failure Modes and Effects Analysis (FMEA) / (Hazard and Operability Analysis (HAZOP) / Bowtie methodology must be developed during design at the component level and system levels. — Conduct safety integrity level rating of equipment (failure probably) with suitable redundancy if required. — Conduct Site Acceptance Testing as part of commissioning of each unit and the overall system. — Abuse tests to be conducted by supplier. — Ensure an effective Battery Management System (BMS) is included in the design. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. — Diagnostics must be easily accessible. Diagnostics are able to distinguish cell from stack or cell from module faults. Protective systems are only as good as their reliability and functionality testing is important, e.g. testing that all battery trips actually work.								

Potential Impact **Human and Equipment Safety - exposure to fire radiation**	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
	— Fire resistant barrier between the batteries and the PCS side if in the same container, or separate containers must form part of the design. — Suitable ingress protection level to be provided for electrical equipment, e.g. IP55 - 66. If air cooling into container, suitable dust filters to be provided. — Install smoke detectors linked to BMS & alerts in control room. — Effects of battery aging to be considered. Solid state battery life starts to be impacted above 40 deg C and significant impacts above 50 deg C with thermal run away starting at 65-70 deg C. BMS trips system at 50 deg C. Temperature monitoring to be in place. Regular infrared scanning. Data needs to be stored for trend analysis. — An Emergency plan, from transport and construction phase, must be extended to operational phase. The plan must include the hazards of the electrically live system. This Plan must include procedures to address solid state container fires - extinguishing, ventilating, entering as appropriate or not. — PPE for container firefighting must include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. — A planned fire response to prevent escalation to an explosion or an environmental event must be developed. — Suitable supply of fire extinguishing medium and cooling medium must be provided. Consider fire water for cooling adjacent equipment for BESS units. Fogging nozzles can be used to direct smoke. — Ensure procedures in place for clean up after event Lingering HF and other toxic residues in the soil and on adjacent structures..								

A Power Conversion System's (PCS – DC to AC) cooling failure can result in electrical fire. The consequence of this is that a fire can start in PCS or another section or room and spread to the battery area. The operational impact on human and equipment safety - exposure to fire radiation is outlined in Table 8-138.

Table 8-138: Operational Impact on human and equipment safety - exposure to fire radiation for SSL BESS

Potential Impact **Human and Equipment Safety - exposure to fire radiation**	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Moderate
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Consider modern lithium container design - put the PCS in another part of the container with a fire rated wall separating it from the battery. Alternately the PCS is another container altogether.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

Transformer shorting / overheating / explosion or flammable gases generated by thermal run away reach explosive limits. Ignition on hot surfaces can cause static. Lithium Cobalt Oxide generates O2 during decomposition which can cause escalation. This can result in potential fatalities amongst first responders, or damage to container or other nearby items, e.g. other container. The operational impact on human and equipment safety - exposure to explosion over pressures is outlined in **Table 8-139**.

Table 8-139: Operational Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures[17]									
Without Mitigation	5	1	5	5	2	32	Moderate	(-)	Moderate
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Electrical equipment will be specified to suit application. — An Emergency response plan must be in place as referred to above and employee training on the plan must be provided. — Undertake a hazardous area classification of the inside of the container to confirm the rating of electrical equipment. Might be zone 2 due to possible leaks of electrolyte or generation of flammable gases under thermal run away. — Suitable training of selected emergency responders who may be called out to the facility must be undertaken.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in Table 8-140**.**

Table 8-140: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	1	3	2	3	30	Low	(-)	Moderate
With Mitigation	3	1	2	2	2	16	Low	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged battery components, leakage of electrolyte, or if the components are completely broken exposing hazardous chemicals, and thermal runaway and hazardous fumes are released, this can cause mild skin irritation from exposure to small leaks to serious corrosive burns for large exposure. The operational impact on human and equipment safety **-** exposure to acute toxic chemical and biological agents is outlined in **Table 8-141**.

[17] Refer to Appendix A of the SHE Risk Assessment (**Appendix H-12**) for an initial approximation of worst-case possible explosion impact zones

Table 8-141: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS

Potential Impact Human and Equipment Safety - exposure to acute toxic chemical and biological agents[18]	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	4	3	3	5	3	45	Moderate	(-)	Moderate
With Mitigation	3	3	3	5	2	28	Low	(-)	
Mitigation and Management Measures	— Acid resistant PPE (e.g. overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. — PPE to be increased (e.g. full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g. sampling, maintenance. — All operators/maintenance staff to be trained in the hazards of chemicals on site. — Refer to fire above as all the protective measures apply to prevent toxic smoke. — Refer to fire above as all the measures apply to mitigate toxic smoke. — Ensure a 24/7 helpline response. — Adhere to standard dangerous goods requirements for Hazmat labels. — All operators/maintenance staff to be trained in the hazards.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights, traffic accidents and earthquake/tremors can cause injury or possibly fatality in unlikely worst case, damage to equipment, spills, and environment pollution. The operational impact on human and equipment safety **-** exposure to violent release of kinetic or potential energy is outlined in Table 8-142**.**

Table 8-142: Operational Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	1	5	5	3	48	Moderate	(-)	Moderate
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Maintenance equipment to be serviced and personnel suitably trained in the use thereof. — Traffic signs, rules etc to be in place on site. — All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc procedures to be in place. — An emergency response plan must be in place. — Civil design to take seismic activity into account.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The operational phase will include the use of electrical machines, generators etc. In hot dry areas, static generation is highly likely, as well as lightning strike. This may cause electrocution, ignition, burns, injury and death, as well

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[18] Refer to Appendix A of the SHE Risk Assessment (Appendix H-12) for an initial approximation of worst-case possible noxious smoke impact zones

as damage to electrical equipment. The operational impact on human and equipment safety - exposure to electromagnetic waves is outlined in **Table 8-143**.

Table 8-143: Operational Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	51	Moderate	(-)	Complex
With Mitigation	5	2	5	5	1	17	Low	(-)	
Mitigation and Management Measures	— Adhere to codes and guidelines for electrical insulation. — Provide suitable PPE. — Low voltage equipment (e.g. batteries) to be separated from high voltage (e.g. transmission to grid). — Personnel to be trained in line with IEE 1657 – 2018 (Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries). — Adhere to Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. — Software also need to be kept as update to date as reasonably practicable. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — PPE to consider static accumulation for entering the facility, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. — The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. — All outside work must be stopped during thunder storms. — Lighting conductors may be required for the installation, to be confirmed during design									

ENVIRONMENT - EMISSIONS TO AIR

Refrigerant may be an asphyxiant if accidentally released indoors it can accumulate and displace oxygen. It is however noted that this is not expected on a normal basis. The operational impact on environment - emissions to air is outlined in Table 8-144.

Table 8-144: Operational Impact on environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	1	1	1	3	18	Low	(-)	Easy
With Mitigation	3	1	1	1	1	6	Very Low	(-)	
Mitigation and Management Measures	— Containers could be treated as entering a confined space and similar procedures entering confined spaces could be in place, e.g. do not enter alone, gas testing prior to entering, ensure adequate ventilation. Particularly after any warning alarms have gone off, but possibly even normally.									

ENVIRONMENT - EMISSIONS TO WATER

Waste will be generated during the operation of the facility. This may include cooling water blow-down, laboratory waste (if included in the design), maintenance waste, e.g. oils, spills from batteries, coolant system, diesel trucks, transformers, oil drips from parked vehicles, fire water runoff control, kitchen waste and sewage, refrigerant release. These can cause pollution if not contained and excessive disposal costs if emissions are not limited. The operational impact on environment - emissions to water is outlined in **Table 8-145**.

Table 8-145: Operational Impact on environment - emissions to water

Potential Impact Environment - emissions to water	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	2	3	**27**	**Low**	(-)	Moderate
With Mitigation	2	2	3	2	2	**18**	**Low**	(-)	
Mitigation and Management Measures	— Implement bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area. — Provide containment and suitable treatment/disposal for sewage and any kitchen liquids. — Procedures for dealing with damaged/leaking equipment as well as clean-up of spills to be in place and implemented. — Conduct normal site practices for preventing and containing diesel/paint etc spills. — Waste management plan to be in place and provide measures for, but not limited to, liquid waste treatment or suitable removal and disposal. — Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. — Undertake reporting of reportable quantities in line with NEMA.								

ENVIRONMENT - EMISSIONS TO EARTH

The operation phase will generate solid waste. The disposal of solid-state batteries can cause environmental damage. The operational impact on environment - emissions to earth is outlined in Table 8-146**.**

Table 8-146: Operational Impact on environment - emissions to earth

Potential Impact Environment – waste generation	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	3	3	**30**	**Low**	(-)	Easy
With Mitigation	2	2	3	3	1	**10**	**Very Low**	(-)	
Mitigation and Management Measures	— Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The operation phase will require the usage of water and power, however if the usage is not controlled it will result in wastages. Operations will include the disposal of batteries or components, or disposal of containers. This may result in delays, excessive costs and disposal of large volumes of hazardous waste. The operational impact on environment - waste of resources e.g. water, power etc is outlined in Table 8-147**.**

Table 8-147: Operational Impact on environment - waste of resources e.g. water, power

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	2	4	20	Low	(-)	Easy
With Mitigation	1	1	1	2	2	10	Very Low	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site during construction. — Handling protocols must be provided by the battery supplier. — Develop and implement a water management plan and spill containment plan. — Investigate end of Life plan for solid state batteries including options for reuse / recovery / reconditioning. — Similarly, for decommissioned containers consider reuse / recovery / repurpose.								

PUBLIC - AESTHETHICS

Bright surfaces reflecting light and tall structures in a flat area may cause irritation. The operational impact on public - aesthetics is outlined in Table 8-148**.**

Table 8-148: Operational Impact on public

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	3	2	3	4	4	48	Moderate	(-)	Easy
With Mitigation	1	2	4	4	2	22	Low	(-)	
Mitigation and Management Measures	— Refer to Visual Impact Assessment which is to include the BESS installation once design details are available.								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays can cause financial loss. The operational impact on investors - financial is outlined in **Table 8-149**.

Table 8-149: Operational Impact on investors – financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	39	Moderate	(-)	Easy
With Mitigation	3	1	3	4	2	22	Low	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management with deviation monitoring.								

EMPLOYEES AND INVESTORS – SECURITY

On route to the operational site there is a risk of potential hi-jacking of valuable but hazardous loads. On site there is a risk of theft of operational equipment and battery installation facilities. There may also be civil unrest or violent strike by employees. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The operational impact on employees and investors – security is outlined in Table 8-150**.**

Table 8-150: Operational Impact on employees and investors – security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	3	1	3	2	4	36	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	2	18	Low	(-)	
Mitigation and Management Measures	— Fencing around electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — Consider motion detection lights and CCTV. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

Cyber security attacks aimed at the National Electricity Grid may result in the ransom of the National Electricity Grid. The operational impact on employees and investors – security is indicated in **Table 8-151**.

Table 8-151: Operational Impact on employees and investors – security

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	4	4	3	1	4	48	Moderate	(-)	Complex
With Mitigation	4	4	3	1	2	24	Low	(-)	
Mitigation and Management Measures	— Cyber security needs monitoring. — Remote access to system needs to be negotiated and controlled. — Install password controls, levels of authority etc. Protection of the National Electricity Grid from Cyber-attacks accessing through the BESS to be implemented. — Cyber emergency procedures should be in place prior to commissioning.								

EMERGENCIES

During the operational phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The operational impact on emergencies is outlined in Table 8-152.

Table 8-152: Operational Impact on emergencies

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— All safety measures listed above must be implemented. — Emergency procedures need to be practiced prior to commencement of operations. — Ensure escape door open outwards, and doors hooked open when persons are inside, i.e. they should not be automatically self-closing. — There must be more than one exit from buildings.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
	— Storage of spare batteries (e.g. in stores on site or elsewhere) also needs to consider possible thermal run away.								

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This may result in unknown hazards that may manifest due to using "cheaper supplier or less developed technology". The operational impact on investors – legal is indicated in Table 8-153**.**

Table 8-153: Operational Impact on investors – legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	40	Moderate	(-)	Moderate
With Mitigation	3	1	3	3	2	20	Low	(-)	
Mitigation and Management Measures	— Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art battery system are used and not old technologies prone to fires/explosions etc..								

VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

Operation and maintenance materials such as spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc., can result in occupational illness. The operational impact on human health - chronic exposure to toxic chemical or biological agents is indicated in **Table 8-154**.

Table 8-154: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	4	5	50	Moderate	(-)	Easy
With Mitigation	1	1	3	4	2	18	Low	(-)	
Mitigation and Management Measures	— The operation and maintenance phase to be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993. — A SHEQ policy to be in place. — A detailed risk assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning. — A SHE procedure to be in place, and include but not limited to, PPE specifications, management of change, integrity monitoring. — Ensure that relevant SHE appointees are in place. — Undertake training of staff on general hazards on site.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
	— All necessary health controls/ practices to be in place, e.g. ventilation of confined areas, occupational health monitoring if required and reporting programs in place. — Emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as: — appointment of emergency controller, — emergency isolation systems for electricity, — emergency isolation and containment systems for electrolyte, — provision of PPE for hazardous materials response, — provision of emergency facilities for staff at the main office building, — provision of first aid facilities, — first responder contact numbers etc.								

Compromised battery compartment vapours accumulate in the containers, as well as release solids/liquids on surfaces. Maintenance of battery components can cause corrosive and mildly toxic liquid on surfaces. This can result in dermatitis, and skin /eye/lung irritation. The operational impact on human health - chronic exposure to toxic chemical or biological agents is outlined in Table 8-155**.**

Table 8-155: Operational Impact on human health - chronic exposure to toxic chemical or biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	2	1	3	5	4	**44**	**Moderate**	(-)	Complex
With Mitigation	1	1	3	5	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Maintenance procedures to be in place should equipment need to be opened, e.g. pumps drained and decontaminated prior to repair in workshop etc. — Ensure PPE for handling battery parts and other equipment on site is specified and worn when required. — Training of staff on general hazards on site must be conducted. — Provide signage or labels on all equipment. — Confined space entry procedures if entering tanks and possibly battery containers. — Safety Data Sheets (SDSs) to be available on site. — Operating manuals to be provided including start-up, shut-down, steady state, monitoring requirements. — Maintenance manuals with make safe, decontamination and repair procedures to be in place. — A maintenance schedule must be developed and implemented to include the required daily, weekly, monthly, annual etc maintenance. — Provided portable equipment for calibration and for testing/verification of defective equipment, e.g. volt/current meters, infrared camera								

HUMAN HEALTH - EXPOSURE TO NOISE

Moving parts inside containers, buildings, pumps, compressors, cooling systems etc. can cause adverse impact on hearing of workers, or may be a nuisance factor at near -by residences or other activities. The operational impact on human health - exposure to noise is outlined in **Table 8-156**.

Table 8-156: Operational Impact on human health - exposure to noise

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	2	1	5	5	4	52	Moderate	(-)	Easy
With Mitigation	2	1	5	5	2	26	Low	(-)	
Mitigation and Management Measures	— Design the system to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g. emergency generator, air compressor etc. — Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

Workers may be exposed to extreme temperatures and/or humidity such as heat during the day and cold weather in winter. Batteries can also generate heat within enclosed buildings / containers, and night work requires lighting which can generate heat. This could result in heat stroke or hypothermia. The operational impact on human health - exposure to temperature extremes and/or humidity is indicated in **Table 8-157.**

Table 8-157: Operational Impact on human health - exposure to temperature extremes and/or humidity

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	4	2	3	1	2	20	Low	(-)	Easy
With Mitigation	3	2	3	1	1	9	Very Low	(-)	
Mitigation and Management Measures	— Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. — Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. — Adequate potable water to be provided during all phases of the project. — PPE for operations and maintenance staff to be suitable for the weather conditions.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

Isolated workstation and monotonous repetitive work can cause low performance, and system productivity suffers. The operational impact on human health - exposure to psychological stress is outlined in Table 8-158**.**

Table 8-158: Operational Impact on human health - exposure to psychological stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	2	3	3	2	2	20	Low	(-)	Easy
With Mitigation	1	3	3	2	1	9	Very Low	(-)	

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Mitigation and Management Measures	— Implement staff rotation to other activities within the site where necessary. — Performance monitoring of inspections / maintenance tasks in particular must be undertaken.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

Lifting heavy equipment and movement at awkward angles during maintenance, stretching to reach high level and bending to low level, including working at heights if equipment is located on top of roofs or elevated electrical equipment (e.g. pylons), can result in back and other injuries. The operational impact on human health **-** exposure to ergonomic stress is outlined in Table 8-159**.**

Table 8-159: Operational Impact on human health - exposure to ergonomic stress

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	5	1	3	2	3	33	Moderate	(-)	Easy
With Mitigation	4	1	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Training in lifting techniques must be provided. — Working at heights training must be provided. — If equipment is at height, ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. — A working at height procedure needs to be in place.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

During the operation of the facility there are chances of involvements in an external fire e.g. veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to batteries leading to shorting and heating can also be an issue along with high humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads and/or surges. Operator abuse, BMS failure or software failure. Incorrect extinguishing mediums can escalate the fire. Consequences include contaminated run off. Radiation burns unlikely to be severe as no highly flammable materials on site. Damaged equipment. Fire spreads to other units or offsite if grass/vegetation not controlled. The operational impact on human and equipment safety **-** exposure to fire radiation is outlined in Table 8-160**.**

Table 8-160: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	1	5	5	4	48	Moderate	(-)	Complex
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Grass cutting and fire breaks around the BESS installations. No combustible materials to be stored in or near the batteries or electrical infrastructure, e.g. separation of site diesel tank. Fire resistant barrier between the batteries and the PCS side if in the same container. — The Facility to comply with prescribed design standards such as the BESS design codes from the USA and standards of practice that (e.g. UL9540, NFPA 855 and DNV GL RP 43). — A detailed Failure Modes and Effects Analysis (FMEA) / (Hazard and Operability Analysis (HAZOP) / Bowtie methodology must								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
	be developed during design at the component level and system levels. — Conduct safety integrity level rating of equipment (failure probably) with suitable redundancy if required. — Conduct Site Acceptance Testing as part of commissioning of each unit and the overall system. — Abuse tests to be conducted by supplier. — Ensure an effective Battery Management System (BMS) is included in the design. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. — Diagnostics must be easily accessible. Diagnostics are able to distinguish cell from stack or cell from module faults. — Fire resistant barrier between the batteries and the PCS side if in the same container, or separate containers must form part of the design. — As per SANS Standards,suitable ingress protection level to be provided for electrical equipment, e.g. IP55 - 66. If air cooling into container, suitable dust filters to be provided if needed. — Install smoke detectors linked to BMS & alerts in control room. — Effects of battery aging to be considered. Temperature monitoring to be in place. Regular infrared scanning. Data needs to be stored for trend analysis. — An Emergency plan, from transport and construction phase, must be extended to operational phase. The plan must include the hazards of the electrically live system. This Plan must include procedures to address solid state container fires - extinguishing, ventilating, entering as appropriate or not. — PPE for container firefighting must include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. — A planned fire response to prevent escalation to an explosion or an environmental event must be developed. — Suitable supply of fire extinguishing medium and cooling medium must be provided. Fogging nozzles can be used to direct smoke. — Ensure procedures in place to clean up after event Lingering toxic residues in the soil and on adjacent structures.								

A Power Conversion System's (PCS – DC to AC) cooling failure can result in electrical fire. The consequence of this is that a fire can start in PCS or another section or room and spread to the battery area. The operational impact on human and equipment safety - exposure to fire radiation is outlined in Table 8-161.

Table 8-161: Operational Impact on human and equipment safety - exposure to fire radiation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	5	2	5	5	3	**51**	**Moderate**	(-)	Moderate
With Mitigation	5	2	5	5	1	**17**	**Low**	(-)	
Mitigation and Management Measures	— Consider separating the VRF building systems PCS from the batteries and other equipment and place it in another area.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

Transformer shorting / overheating / explosion can result in potential fatalities amongst first responders; or damage to nearby equipment. The operational impact on human and equipment safety - exposure to explosion over pressures is indicated in **Table 8-162**.

Table 8-162: Operational Impact on human and equipment safety - exposure to explosion over pressures

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	5	1	5	5	2	**32**	**Moderate**	(-)	Moderate
With Mitigation	5	1	5	5	1	**16**	**Low**	(-)	
Mitigation and Management Measures	— Electrical equipment to be specified to suit application. — An emergency response plan must be in place as referred to above and employee training on the plan must be provided.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

Human pathogens and diseases, sewage, food waste as well as snakes, insects, wild and domesticated animals and harmful plants can cause illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 8-163**.

Table 8-163: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	1	3	2	3	**30**	**Low**	(-)	Moderate
With Mitigation	3	1	2	2	2	**16**	**Low**	(-)	
Mitigation and Management Measures	— All necessary good hygiene practices to be in place, e.g. provision of toilets, eating areas, infectious disease controls. — Policies and practice for dealing with known vectors of disease such as Aids, TB, COVID 19 and others must be developed and implemented. — Conduct awareness training for persons on site, safety induction to include animal hazards. — First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. — Due to isolated locations and distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.								

Damaged battery components, leakage of electrolyte, or if the components are completely broken exposing hazardous chemicals, and thermal runaway and hazardous fumes are released, this can cause mild skin irritation from exposure to small leaks to serious corrosive burns for large exposure. The operational impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in Table 8-164.

Table 8-164: Operational Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	4	3	3	5	3	45	Moderate	(-)	Moderate
With Mitigation	3	3	3	5	2	28	Low	(-)	
Mitigation and Management Measures	— Corrosion resistant PPE (e.g. overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. — PPE to be increased (e.g. full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g. sampling, maintenance. — All operators/maintenance staff trained in the hazards of chemicals on site. — Ensure a 24/7 helpline response. — Adhere to standard dangerous goods requirements for Hazmat labels. — All operators/maintenance staff to be trained in the hazards.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights, traffic accidents and earthquake/tremors can cause injury or possibly fatality in unlikely worst case, damage to equipment, spills, and environment pollution. The operational impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 8-165**.

Table 8-165: Operational Impact on human and equipment safety - exposure to violent release of kinetic or potential energy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	5	1	5	5	3	48	Moderate	(-)	Moderate
With Mitigation	5	1	5	5	1	16	Low	(-)	
Mitigation and Management Measures	— Maintenance equipment to be serviced and personnel suitably trained in the use thereof. — Traffic signs, rules etc to be in place on site. — All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc procedures to be in place. — An emergency response plan must be in place. — Civil design to take seismic activity into account.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The operational phase will include the use of electrical machines, generators etc. In hot dry areas, static generation is highly likely, as well as lightning strike. This may cause electrocution, ignition, burns, injury and death, as well as damage to electrical equipment. The operational impact on human and equipment safety - exposure to electromagnetic waves is outlined in **Table 8-166**.

Table 8-166: Operational Impact on human and equipment safety - exposure to electromagnetic waves

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	5	2	5	5	3	51	Moderate	(-)	Complex
With Mitigation	5	2	5	5	1	17	Low	(-)	
Mitigation and Management Measures	— Adhere to codes and guidelines for electrical insulation. — Provide suitable PPE. — Low voltage equipment (e.g. batteries) to be separated from high voltage (e.g. transmission to grid). — Personnel to be trained in line with IEE 1657 – 2018 (Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries). — Adhere to Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — Software also need to be kept as update to date as reasonably practicable. — Consider suitably located Emergency stop buttons for the facility and the other equipment on site. — PPE to consider static accumulation for entering the facility, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. — The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. — All outside work must be stopped during thunder storms. — Lighting conductors may be required for the installation, to be confirmed during design								

ENVIRONMENT - EMISSIONS TO AIR

Refrigerant may be an asphyxiant if accidentally released indoors it can accumulate and displace oxygen. It is however noted that this is not expected on a normal basis. The operational impact on environment **-** emissions to air is outlined in Table 8-167**.**

Table 8-167: Operational Impact on environment - emissions to air

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	3	1	1	1	3	18	Low	(-)	Easy
With Mitigation	3	1	1	1	1	6	Very Low	(-)	
Mitigation and Management Measures	— Containers could be treated as entering a confined space and similar procedures entering confined spaces could be in place, e.g. do not enter alone, gas testing prior to entering, ensure adequate ventilation. Particularly after any warning alarms have gone off, but possibly even normally.								

ENVIRONMENT - EMISSIONS TO WATER

Waste will be generated during the operation of the facility. This may include cooling water blow-down, laboratory waste (if included in the design), maintenance waste, e.g. oils, spills from batteries, coolant system, diesel trucks, transformers, oil drips from parked vehicles, fire water runoff control, kitchen waste and sewage, refrigerant release or VRF electrolyte purging. These can cause pollution if not contained and excessive disposal costs if emissions not limited. These can cause pollution if not contained and excessive disposal costs if emissions are not limited. The operational impact on environment - emissions to water is outlined in Table 8-168**.**

Table 8-168: Operational Impact on environment - emissions to water

Potential Impact Environment - emissions to water	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	2	3	2	3	30	Low	(-)	Moderate
With Mitigation	3	2	3	2	2	20	Low	(-)	
Mitigation and Management Measures	— Electrolyte areas to be fully bunded to 110% of largest tank, or more. — Implement bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g. concrete) under truck parking area. — Provide containment and suitable treatment/disposal for sewage and any kitchen liquids. — Procedures for dealing with damaged/leaking equipment as well as clean-up of spills to be in place and implemented. — Conduct normal site practices for preventing and containing diesel/paint etc spills. — Waste management plan to be in place and provide measures for, but not limited to, liquid waste treatment or suitable removal and disposal. — Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. — Undertake reporting of reportable quantities in line with NEMA. — Process controls to be in place to prevent contamination and deterioration of electrolyte leading to excessive purging. — Ensure proposed locations of the BESS facilities are a suitable distance from the closest water course. In the event of a major spill if this is too close it may not allow time for mitigation to be taken. Adequate secondary and possibly tertiary containment systems may then be needed on site.									

ENVIRONMENT - EMISSIONS TO EARTH

The operation phase will generate solid waste. The disposal of battery components can cause environmental damage. The operational impact on environment - emissions to earth is outlined in Table 8-169**.**

Table 8-169: Operational Impact on environment - emissions to earth

Potential Impact Environment – emissions to earth	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	2	3	3	3	30	Low	(-)	Easy
With Mitigation	2	2	3	3	1	10	Very Low	(-)	
Mitigation and Management Measures	— Implement system for waste segregation (e.g. electronic equipment, chemicals) and management on the site.								

ENVIRONMENT – WASTE OF RESOURCES

The operation phase will require the usage of water and power. Operations will include the disposal of batteries or components. However, if the usage is not controlled it will result in wastages. Excessive purging of deteriorated or contaminated electrolyte may occur. These may result in delays, excessive costs and disposal of large volumes of hazardous waste. The operational impact on environment - waste of resources e.g. water, power etc is outlined in Table 8-170.

Table 8-170: Operational Impact on environment - waste of resources e.g. water, power etc

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	2	1	1	2	4	**24**	**Low**	(-)	Easy
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	
Mitigation and Management Measures	— Water usage to be monitored on site. — Handling protocols to be provided by supplier of electrolyte. — Water management plan and spill containment plans to be in place. — Investigate end of Life plan for electrolyte batteries including options for reuse / recovery / reconditioning. — Similarly, for decommissioned containers / equipment, consider reuse / recovery / repurpose.								

PUBLIC - AESTHETHICS

Bright surfaces reflecting light and tall structures in a flat area may cause irritation. The operational impact on public - aesthetics is outlined in Table 8-171.

Table 8-171: Operational Impact on public - aesthetics

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	2	2	4	4	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	1	2	4	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Visual impact assessment to include BESS installation when design details become available. Confirm any height limitations for VRFB BESS building (if utility scale).								

INVESTORS - FINANCIAL

The result of possible defective technology and extreme project delays can cause financial loss. The operational impact on investors - financial is outlined in Table 8-172.

Table 8-172: Operational Impact on investors - financial

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - Financial									
Without Mitigation	5	1	3	4	3	**39**	**Moderate**	(-)	Easy
With Mitigation	3	1	3	4	2	**22**	**Low**	(-)	
Mitigation and Management Measures	— Undertake adequate research during the planning and design phase to select the supplier and/contractor with the best technology that is internationally recognized and proven. — Project management with deviation monitoring.								

EMPLOYEES AND INVESTORS – SECURITY

On route to the operational site there is a risk of potential hi-jacking of valuable but hazardous loads. On site there is a risk of theft of operational equipment and battery installation facilities. There may also be civil unrest or violent strike by employees. This may result in theft, injury to burglars, damage to equipment possibly setting off thermal runaway. The operational impact on employees and investors – security is outlined in Table 8-173.

Table 8-173: Operational Impact on employees and investors – security

Potential Impact Employees and investors - Security	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	1	3	2	4	36	Moderate	(-)	Moderate
With Mitigation	3	1	3	2	2	18	Low	(-)	
Mitigation and Management Measures	— Fencing around electrical infrastructure to adhere to SANS standard and Eskom Guidelines. — Consider motion detection lights and CCTV. — The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g. Skull and Cross Bones or other signs. — Night lighting to be provided both indoors and outdoors where necessary.								

Cyber security attacks aimed at the National Electricity Grid may result in the ransom of the National Electricity Grid. The operational impact on employees and investors – security is indicated in Table 8-174.

Table 8-174: Operational Impact on employees and investors – security

Potential Impact Employees and investors - Security	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	4	4	3	1	4	48	Moderate	(-)	Complex
With Mitigation	4	4	3	1	2	24	Low	(-)	
Mitigation and Management Measures	— Cyber security needs monitoring. — Remote access to system needs to be negotiated and controlled. — Install password controls, levels of authority etc. Protection of the National Electricity Grid from Cyber-attacks accessing through the BESS to be implemented. — Cyber emergency procedures should be in place prior to commissioning.								

EMERGENCIES

During the operational phase, there is the potential for fires, explosions, noxious smoke, large spills, traffic accidents and equipment/structural collapse. Inadequate emergency response to small event can lead to escalation. Consequences of these include injuries which can turn to fatalities, and small losses become extended down time. The operational impact on emergencies is outlined in **Table 8-175**.

Table 8-175: Operational Impact on emergencies

Potential Impact Emergencies	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	4	2	3	4	3	39	Moderate	(-)	Complex
With Mitigation	4	2	3	4	2	26	Low	(-)	
Mitigation and Management Measures	— All safety measures listed above must be implemented.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Emergencies									
	— Emergency procedures need to be practiced prior to commencement of operations. — Escape doors should swing open outwards and not into the building/container. — There must be more than one exit from buildings.								

INVESTORS LEGAL

The battery industry is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. This may result in unknown hazards that may manifest due to using "cheaper supplier or less developed technology". The operational impact on investors – legal is indicated in Table 8-176**.**

Table 8-176: Operational Impact on investors – legal

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Moderate
With Mitigation	3	1	3	3	2	**20**	**Low**	(-)	
Mitigation and Management Measures	— Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. — Ensure only latest state of the art battery system are used and not old technologies prone to fires/explosions etc..								

8.18.3 DECOMMISSIONING PHASE

SOLID STATE LITHIUM-ION AND VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

Battery components may have a limited lifespan, there are damaged equipment, waste electrolyte etc. There could already be "waste" on the first day of commissioning and plans should be in place to deal with this. Ideally an End-of-Life plan needs to be in place before the first electrolyte / container / equipment is brought on site.

HUMAN HEALTH - CHRONIC EXPOSURE TO TOXIC CHEMICAL OR BIOLOGICAL AGENTS

The decommissioning impact on human health - chronic exposure to toxic chemical or biological agents is outlined in Table 8-177**.**

Table 8-177: Decommissioning Impact on human health - chronic exposure to toxic chemical or biological agents for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human health - Chronic exposure to toxic chemical or biological agents									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO NOISE

The decommissioning impact on human health **-** exposure to noise is outlined in **Table 8-178.**

Table 8-178: Decommissioning Impact on human health - exposure to noise for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to noise									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO TEMPERATURE EXTREMES AND/OR HUMIDITY

The decommissioning impact on human health - exposure to noise is outlined in **Table 8-179**.

Table 8-179: Decommissioning Impact on human health - exposure to temperature extremes and/or humidity for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health -exposure to temperature extremes and/or humidity									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - EXPOSURE TO PSYCHOLOGICAL STRESS

The decommissioning impact on human health - exposure to psychological stress is outlined in **Table 8-180**.

Table 8-180: Decommissioning Impact on human health - exposure to psychological stress for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to psychological stress									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN HEALTH - CHRONIC EXPOSURE TO ERGONOMIC STRESS

The decommissioning impact on human health - exposure to ergonomic stress is outlined in **Table 8-181**.

Table 8-181: Decommissioning Impact on human health - exposure to ergonomic stress for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human Health - exposure to ergonomic stress									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	High
With Mitigation	1	1	1	1	1	4	Very Low	(-)	High
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY – EXPOSURE TO FIRE RADIATION

The decommissioning impact on human and equipment safety - exposure to fire radiation is outlined in **Table 8-182**.

Table 8-182: Decommissioning Impact on human and equipment safety - exposure to fire radiation for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to fire radiation									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO EXPLOSION OVER PRESSURES

The decommissioning impact on human and equipment safety - exposure to explosion over pressures is outlined in **Table 8-183**.

Table 8-183: Decommissioning Impact on human and equipment safety - exposure to explosion over pressures for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to explosion over pressures									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ACUTE TOXIC CHEMICAL AND BIOLOGICAL AGENTS

The decommissioning impact on human and equipment safety - exposure to acute toxic chemical and biological agents is outlined in **Table 8-184**.

Table 8-184: Decommissioning Impact on human and equipment safety - exposure to acute toxic chemical and biological agents for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to acute toxic chemical and biological agents									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO VIOLENT RELEASE OF KINETIC OR POTENTIAL ENERGY

The decommissioning impact on human and equipment safety - exposure to violent release of kinetic or potential energy is outlined in **Table 8-185**.

Table 8-185: Decommissioning Impact on human and equipment safety - exposure to violent release of kinetic or potential energy for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety - exposure to violent release of kinetic or potential energy									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

HUMAN AND EQUIPMENT SAFETY - EXPOSURE TO ELECTROMAGNETIC WAVES

The decommissioning impact on human and equipment safety - exposure to electromagnetic waves is outlined in Table 8-186.

Table 8-186: Decommissioning Impact on human and equipment safety - exposure to electromagnetic waves for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Human and Equipment Safety – exposure to electromagnetic waves									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO AIR

The decommissioning impact on environment - emissions to air is outlined in **Table 8-187**.

Table 8-187: Decommissioning Impact on environment - emissions to air for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to air									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO WATER

The decommissioning impact on environment - emissions to water is outlined in **Table 8-188**.

Table 8-188: Decommissioning Impact on environment - emissions to water for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - emissions to water									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

ENVIRONMENT - EMISSIONS TO EARTH

Batteries / equipment will reach its end of life and may leak. This may result in environment damage from heavy metal ions. The decommissioning impact on environment - emissions to earth is outlined in **Table 8-189**.

Table 8-189: Decommissioning Impact on environment - emissions to earth for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
Without Mitigation	4	3	3	5	4	60	Moderate	(-)	Complex
With Mitigation	4	3	3	5	2	30	Low	(-)	
Mitigation and Management Measures	— Develop and implement End of Life shutdown procedure including a risk assessment of the specific activities involved.								

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment – emissions to earth									
	— Re-purpose the solid-state batteries / containers and equipment with associated Environmental impact considered. — Undertake disposal according to local regulations and other directives such as the European Batteries Directive. — End of life can be predefined and the monitoring can be in place to determine if it has been reached. — Consider impact of temperature and time, cycles								

ENVIRONMENT – WASTE OF RESOURCES

The decommissioning impact on environment - waste of resources e.g. water, power etc is outlined in **Table 8-190**.

Table 8-190: Decommissioning Impact on environment - waste of resources e.g. water, power etc for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Environment - waste of resources e.g. water, power etc									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

PUBLIC - AESTHETHICS

The decommissioning impact on public - aesthetics is outlined in **Table 8-191**.

Table 8-191: Decommissioning Impact on public - aesthetics for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Public - Aesthetics									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

INVESTORS - FINANCIAL

The decommissioning impact on investors - financial is indicated in **Table 8-192**.

Table 8-192: Decommissioning Impact on investors - financial for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
INVESTORS - FINANCIAL									
Without Mitigation	1	1	1	1	1	4	Very Low	(-)	Easy
With Mitigation	1	1	1	1	1	4	Very Low	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

EMPLOYEES AND INVESTORS – SECURITY

The decommissioning impact on employees and investors – security is outlined in **Table 8-193**.

Table 8-193: Decommissioning Impact on employees and investors – security for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Employees and investors - Security									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

EMERGENCIES

The decommissioning impact on emergencies is outlined in **Table 8-194.**

Table 8-194: Decommissioning Impact on emergencies for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
EMERGENCIES									
Without Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	Easy
With Mitigation	1	1	1	1	1	**4**	**Very Low**	(-)	
Mitigation and Management Measures	— As per construction and operational phases.								

INVESTORS LEGAL

Disposal of hazardous “waste” is rife with difficulties and numerous regulations that need to be complied with. The decommissioning impact on investors – legal is outlined in **Table 8-195**.

Table 8-195: Decommissioning Impact on investors – legal for both BESS types

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Investors - legal									
Without Mitigation	3	1	3	3	4	**40**	**Moderate**	(-)	Complex
With Mitigation	3	1	3	3	3	**30**	**Low**	(-)	
Mitigation and Management Measures	— Applicants should seek the opinion from a waste consultant on how to correctly dispose of hazardous waste.								

9 CUMULATIVE IMPACT ASSESSMENT

Although the objective of the NEMA S&EIR Process is to undertake an impact and risk assessment process, inclusive of cumulative impacts, which is essential to assessing and managing the environmental and social impacts of projects, it may be insufficient for identifying and managing the incremental impacts on areas or resources used or directly affected by a given development from other existing, planned, or reasonably defined developments at the time the risks and impacts are identified.

IFC PS 1 recognizes that, in some instances, cumulative effects need to be considered in the identification and management of environmental and social impacts and risks. For private sector management of cumulative impacts, IFC considers good practice to be two pronged:

- effective application of and adherence to the mitigation hierarchy in environmental and social management of the specific contributions by the project to the expected cumulative impacts; and
- best efforts to engage in, enhance, and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions that are beyond the capacity of an individual project proponent.

Even though Performance Standard 1 does not expressly require, or put the sole onus on, private sector clients to undertake a cumulative impact assessment (CIA), in paragraph 11 it states that the impact and risk identification process "*will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by relevant government authorities or other parties that are directly related to the project and its area of influence*" including "*master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or strategic environmental assessments where relevant*."

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities (IFC GPH).

Evaluation of potential cumulative impacts is an integral element of an impact assessment. In reference to the scope for an impact assessment, IFC's Performance Standards specify that "*Risks and impacts will be analysed in the context of the project's area of influence. This area of influence encompasses…areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.*" (IFC 2006).

A cumulative impact assessment is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC GPH).

Cumulative impacts with existing and planned facilities may occur during construction and operation of the proposed Mukondeleli WEF. While one project may not have a significant negative impact on sensitive resources or receptors, the collective impact of the projects may increase the severity of the potential impacts.

Therefore, a number of renewable energy developments within the surrounding area which have submitted applications for environmental authorisation (some of which have been approved and others now operational). It is important to note that the existence of an approved EA does not directly equate to actual development of the project.

These existing surrounding projects of varying approval status have been detailed in **Table 9.1.**

Potential cumulative impacts identified are summarised below

Table 9.1: Existing surrounding projects within a 55km radius of the Mukondeleli WEF and OHPL

DFFE REFERENCE	PROJECT TITLE	STATUS
14/12/16/3/3/2/754	Tutuka 65.9 MW Solar Photovoltaic (PV) Energy Facility and its associated infrastructure (Ref:) located 23km southwest of the site	Approved
14/12/16/3/3/1/452	Forzando North Coal Mine Solar PV Facility, 9.5MW, (Ref:) is located 55km northwest of the site	Approved
1/3/1/16/1 G-269	Proposed Impumelelo WEF to be located southeast of the site	In progress
MPP/EIA/0001063/2022	Proposed Vhuvhili Solar Energy Facility (NEAS No.) located approximately 10km east of the site	In progress

9.1 NOISE CUMULATIVE IMPACTS

Cumulative noise impacts generally only occur when noise sources (such as other wind turbines) are closer than 2,000m from each other (around 1,000m from the conceptual receptor located between them). The cumulative impact also only affects the area between the wind turbines of the various wind farms and normally only relate to the operational phase.

If the wind turbines of one wind farm are further than 2,000 m from the wind turbines of the other wind farm, the magnitude (and subsequently the significance) of the cumulative noise impact is reduced. If the distance between the wind turbines of two wind farms are further than 4,000m, cumulative noise impacts are non-existent. This is illustrated in **Figure 9-1**.

Apart from the proposed Impumelelo WEF, at this time this report was compiled, the author was not aware of any other WEFs within 30km from this WEF project. There is no potential for a cumulative noise impact, as there are no wind energy projects located within the potential area of influence of the WTG of this project.

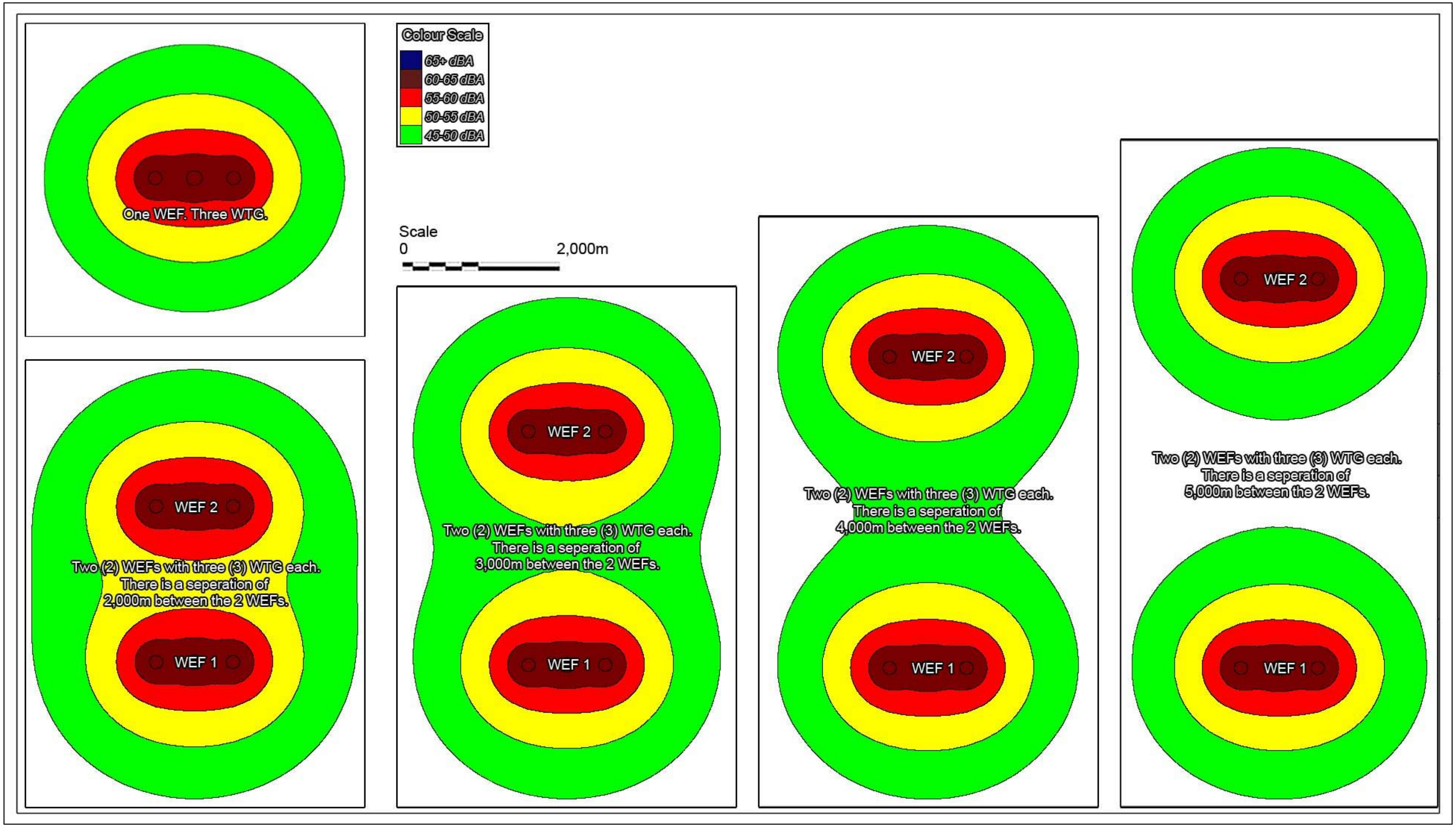


Figure 9-1: Effect of distance between wind turbines – potential cumulative noise

9.2 GEOTECNICAL CUMULATIVE IMPACTS

SOIL EROSION

The anticipated cumulative impacts due to soil erosion are outlined in **Table 9-2**.

Table 9-2: Cumulative Impact due to soil erosion

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
The displacement of natural earth material and overlying vegetation leading to: — Exposure of upper soil layer. — Increase in stormwater velocity. — Soil washed downslope into drainage channels leading to sedimentation. — The erosion of these slopes will be exacerbated during periods of heavy rainfall.									
Without Mitigation	3	2	3	3	4	**44**	**Moderate**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Use existing road network and access tracks. — Use of temporary berms and drainage channels to divert surface water. — Minimize earthworks and demolish footprints. — Rehabilitation of affected areas (such as revegetation). — Reinstate channelized drainage features. — Strip, stockpile and re-spread topsoil								

POTENTIAL OIL SPILILAGE

The anticipated cumulative impacts due to potential oil spillages are outlined in **Table 9-3**.

Table 9-3 Cumulative Impact due to potential oil spillages

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources..									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	High
With Mitigation	2	1	3	1	2	**14**	**Very Low**	(-)	High
Mitigation and Management Measures	— Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. — Frequent checks and conditional monitoring								

DISTURBANCE OF FAUNA AND FLORA

The anticipated cumulative impacts due to disturbance of fauna and flora are outlined in **Table 9-4**.

Table 9-4 Cumulative Impact due to disturbance of fauna and flora

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— The displacement of natural earth material and overlying vegetation leading to erosion.									
Without Mitigation	3	1	3	3	3	**30**	**Low**	(-)	High
With Mitigation	2	1	1	2	2	**12**	**Very Low**	(-)	High
Mitigation and Management Measures	— Limit and control excavations								

SLOPE STABILITY

The anticipated cumulative impacts due to slope stability are outlined in **Table 9-5**.

Table 9-5: Cumulative Impact due to slope stability

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Slope instability around structures.									
Without Mitigation	2	1	3	3	2	**18**	**Low**	(-)	High
With Mitigation	1	1	3	2	2	**14**	**Very Low**	(-)	High
Mitigation and Management Measures	— Avoid steep slope areas. — Design cut slopes according to detailed geotechnical analysis.								

SEISMIC ACTIVITY

The anticipated cumulative impacts due to seismic activity are outlined in **Table 9-6**.

Table 9-6: Cumulative Impact due to seismic activity

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
— Damage of proposed development.									
Without Mitigation	4	1	3	4	1	**12**	**Very Low**	(-)	High
With Mitigation	2	1	3	3	1	**9**	**Very Low**	(-)	High
Mitigation and Management Measures	— Design according to expected peak ground acceleration.								

9.3 AGRICULTURAL POTENTIAL CUMULATIVE IMPACTS

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. It is important to note that the cumulative impact assessment for a particular project, like what is being done here, is not the same as an assessment of the impact of all surrounding projects. The cumulative assessment for this project is an assessment only of the impacts associated with this project, but seen in the context of all surrounding impacts. It is concerned with this project's contribution to the overall impact, within the context of the overall impact, but it is not simply the overall impact itself.

The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss (including by degradation) of future agricultural production potential. The defining question for assessing the cumulative agricultural impact is this:

— What loss of future agricultural production potential is acceptable in the area, and will the loss associated with the proposed development, when considered in the context of all past, present or reasonably foreseeable future impacts, cause that level in the area to be exceeded?

DEFF requires compliance with a specified methodology for the assessment of cumulative impacts. This is positive in that it ensures engagement with the important issue of cumulative impacts. However, the required compliance has some limitations and can, in the opinion of the author, result in an over-focus on methodological compliance, while missing the more important task of effectively answering the above defining question.

DFFE compliance for this project requires considering all renewable energy project applications within a 35 km radius. According to the DFFE database, there is only one renewable energy projects within a 35 km radius, namely the 66 MW Tutuka Photovoltaic (PV) Energy Facility, DFFE reference number 14/12/16/3/3/2/754.

In quantifying the cumulative impact, the area of land taken out of agricultural use as a result of this one project plus the one being assessed (total generation capacity of 266 MW) will amount to a total of approximately 225 hectares. This is calculated using the industry standards of 2.5 and 0.3 hectares per megawatt for solar and wind energy generation respectively, as per the Department of Environmental Affairs (DEA) Phase 1 Wind and Solar Strategic Environmental Assessment (SEA) (2015). As a proportion of the total area within a 35 km radius (approximately 384,800 ha), this amounts to only 0.06% of the surface area. That is considered to be within an acceptable limit in terms of loss of agricultural land.

Both of these projects have the same agricultural impacts in a very similar agricultural environment, and therefore the same mitigation measures apply to both.

As discussed above, the risk of a loss of agricultural potential by soil degradation can effectively be mitigated for renewable energy developments. If the risk for each individual development is low, then the cumulative risk is also low.

Due to all of the considerations discussed above, the cumulative impact of loss of agricultural land use will not have an unacceptable negative impact on the agricultural production capability of the area. The proposed development is therefore acceptable in terms of cumulative impact, and it is therefore recommended that it is approved.

9.4 AQUATIC CUMULATIVE IMPACTS

In terms of drainage the Boesmanpruit, Leeuspruit and Grootspruit watercourses, their tributaries which surround the WEF all ultimately drain into the Vaal River which is a very important and strategic water source of South Africa and all care should be taken to protect the Vaal River from further pollution and other impacts.

Although the footprint area of the proposed Mukondeleli WEF is known, the grid solutions have not been finalised, it gives an indication of the expected position of the proposed infrastructure within the landscape setting. At a landscape level it is imperative that the WEF design is kept out of the wetlands as well as associated buffer area, as this will ensure that there is a degree of connectivity at a landscape level as the watercourses and tributaries of the Boesmanspruit River and Grootbossiespruit also provide corridors for movement for fauna and insects.

During the construction phase it is likely that vegetative cover as well as disturbance of soil will increase the prevalence of erosion and subsequently the amount of sediment present in the catchment. It is also foreseen that during the construction phase the disturbance caused can increase the spread of alien invasive plant species. It is expected that during the operational phase the impact on hydrological regime will be higher due to the cumulative impacts of the WEF, SEF, grid solutions and supporting infrastructure

In terms of aquatic biodiversity, the major cumulative impact is thought to be an increase in concentrated flows due to increase in runoff. The cumulative impact on the aquatic environment is outlined in **Table 9-7** and **Table 9-8.**

CHANGES IN WATER FLOW REGIME-CONSTRUCTION

Table 9-7: Cumulative Aquatic Impacts in water flow regimes during construction

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Aquatic impacts									
Without Mitigation	3	3	3	3	4	**48**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	4	2	**22**	**Low**	(-)	

CHANGES IN WATER FLOW REGIME – OPERATIONAL

Table 9-8: Cumulative Aquatic Impacts in water flow regimes during operation

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Cumulative Aquatic impacts									
Without Mitigation	3	3	3	4	4	**52**	**Moderate**	(-)	Moderate
With Mitigation	2	2	3	3	2	**20**	**Low**	(-)	

9.5 BIODIVERSITY CUMULATIVE IMPACTS

Four renewable energy developments occur within 55 km from the site and were taken into consideration for cumulative impacts. The two developments Forzando SEF and the Tutuka SEF have been approved while the other two developments, Impumelelo WEF and Vhuvhili SEF are proposed.

VEGETATION LOSS AND HABITAT DESTRUCTION

Vegetation loss, habitat destruction and possibly loss of SCC, can occur when considering all developments. The habitat destruction will lead to changes in the physical features of the habitat, with concomitant changes in ecological processes. Secondary vegetation will develop at sites where the vegetation was cleared or the soil compacted. The species composition may change and alien species might invade. Vegetation loss will also constitute the loss of animal habitat. It should however be noted that in the case of wind energy facilities vegetation loss due to habitat destruction is far more contained than in the case of solar facilities. The contribution by the Mukondeleli site to the cumulative impact will therefore be small.

Table 9-9: Cumulative Impact on vegetation loss and habitat destruction

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Vegetation loss and habitat destruction									
Without Mitigation	4	3	3	4	3	**42**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible. — Placement of infrastructure should be done in such a way that no SCC are affected and CBAs avoided. — Positioning of the wind turbines in the most environmentally responsible manner is crucial								

COMPROMISING INTEGRITY OF CBA, ESA AND NPAES

According to the mapping of CBAs in Mpumalanga, some of the proposed developments are located/partially located within CBAs in the current layout. Development within CBAs is not encouraged as such development may result in biodiversity loss and therefore compromise the integrity of the CBA. However, a wind energy facility may be regarded as a permissible land-use in a CBA and the contribution by the Mukondeleli site to the cumulative impact will likely be small. Although there are currently not many projects within 50 km from the Mukondeleli site, this could in future change and the integrity of the CBAs could be compromised and consequently the biodiversity target for the ecosystem could be affected.

The development does not affect a NPAES. The site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).

It is assumed that the terms 'CBA irreplaceable' in the MBSP is equivalent of a CBA1 and a 'CBA optimal' refers to a CBA2. The CBA indicates the presence of CBA1 and a CBA2 across a large section of especially the western part of the Mukondeleli site, mostly in Habitats 4 & 5 (natural and disturbed grassland) which were rated as having a low sensitivity rating in the current study. Two turbines are located in a CBA1 area and their positions should be reconsidered, i.e.. MK28 and MK37. A number of wind turbines are also located in CBA2 areas, i.e. Turbines MK11, MK24, MK26, MK36 & MK39. These 7 sites must be microsited prior to approval of final layout such that the site can be groundtruthed and any sensitive areas are avoided.

Table 9-10: Cumulative Impact on CBA, ESA and NPAES

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Compromising integrity of CBA, ESA and NPAES									
Without Mitigation	3	3	3	4	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— As far as possible avoid placing of turbines and other large infrastructure in CBAs. — MK11, MK24, MK26, MK28, MK36, MK37 & MK39 must be microsited prior to approval of final layout such that the site can be groundtruthed and any sensitive areas are avoided. — Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided. — Minimise the development footprint as far as possible. — Stringent construction-phase monitoring of activities at the site to ensure that mitigation measures are adhered to and that the overall ecological impact of the development is maintained at a low level. — Align roads and other infrastructure so that transformation within the CBAs is minimised. — The use of structures which may inhibit movement of fauna, e.g. mesh or electric fencing should be avoided, where feasible.								

REDUCED ABILITY TO MEET CONSERVATION OBLIGATIONS & TARGETS

The loss of unprotected vegetation types on a cumulative basis from the area may impact the countries' ability to meet its conservation targets (**Table 9-11**). Very few statutorily conserved areas occur in the Vulnerable Soweto Highveld Grassland and almost half of it has been transformed mostly by cultivation, plantations, mining and urbanisation. It has a conservation target of 24% and was classified as Not Protected (0.6%) in the 2018National Biodiversity Assessment (Skowno et al. 2018). The layout of the Mukondeleli WEF should be amended to fall within the heavily and moderately transformed areas wherever possible. These transformed areas have already been included in the transformed % for the vegetation type and will thus not affect its conservation status. However, the Mukondeleli site is not located in a protected area nor does it fall within a protected area expansion strategy and thus will not have an impact on the expansion of Protected Areas.

Table 9-11: Cumulative Impact on meeting conservation obligations and targets

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Reduced ability to meet conservation obligations & targets									
Without Mitigation	4	3	3	4	3	**42**	**Moderate**	(-)	Moderate
With Mitigation	2	3	3	4	2	**24**	**Low**	(-)	
Mitigation and Management Measures	— Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided. — Minimise the development footprint as far as possible..								

LOSS OF LANDSCAPE CONNECTIVITY AND DISRUPTION OF BROAD-SCALE ECOLOGICAL PROCESSES

The presence of the facility and the associated transformation of intact vegetation could pose a threat to the connectivity of the landscape. Subterranean species that have to emerge from the soil to cross roads will be affected. The severity of these impacts for subterranean species is likely to be relatively low as the roads required for operation are likely to still be of a natural surface such as gravel and would experience low traffic volumes.

Because of the relatively small footprint of the wind turbines, the facility is unlikely to disrupt pollination and dispersal processes that could cause spatial fragmentation of populations (**Table 9-12**).

Table 9-12: Cumulative Impact on landscape connectivity and disruption of broad-scale ecological processes

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Loss of landscape connectivity and disruption of broad-scale ecological processes									
Without Mitigation	3	3	3	4	3	**39**	**Moderate**	(-)	Moderate
With Mitigation	3	3	3	4	2	**26**	**Low**	(-)	
Mitigation and Management Measures	— Preconstruction walk-through of the facility infrastructure to ensure that sensitive areas are avoided and least-impact locations are identified for river/stream crossings. — Minimising the development footprint wherever possible. — Revegetation of all cleared and bare areas created by the facility with local plant species. — Fences and other structures which impede faunal movement should be avoided. — Roads should not have steep curbs.								

9.6 AVIFAUNA CUMULATIVE IMPACTS

The potentially low impact of this development should be contextualised alongside related local/regional developments. According to the official database of DFFE and other documents in the public domain, there are currently at least four planned wind and solar energy facilities within a 55km radius around the proposed development). These are the following:

— The 65.9MW Tutuka Photovoltaic (PV) Energy Facility (approximately 20km southeast) (*approved*).
— The 9.5MW Forzando North Coal Mine Solar PV Facility (approximately 55km northeast) (*approved*).
— The 300MW Vhuvhili Solar PV Energy Facility (approximately 4km northeast) (*pending approval*)
— The 200MW Impumelelo WEF (approximately 27km east) (*pending approval*)

The proposed Mukondeleli WEF will consist of up to 54 turbines in total. According to information that that is available, there is only one additional proposed wind turbine facility (the 200MW Impumelelo WEF) that is planned within a 30km radius in broadly similar habitat. The 200MW Impumelelo WEF is intended to comprise 46 wind turbines, and as such as such, the Mukondeleli WEFs' contribution of over 50% of the total number of confirmed turbines, and by implication to the cumulative impact of all the planned turbines, is **high**.

The total area of similar habitat (grassland, wetlands, and agriculture, but excluding opencast mining and urban areas) available to birds in the 30km radius around the project sites is approximately 4445 km². Given the total of 100 proposed wind turbines within this region, this translates into approximately 1 turbine/44.5km² which is a low density. The turbine density, if all the turbines are constructed, and by implication the cumulative impact on avifauna of the currently planned wind energy projects within this area, is therefore considered to be **low**, pending diligent implementation of recommended mitigation measures.

9.7 BATS CUMULATIVE IMPACTS

BAT MORTALITIES DURING FORAGING

Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers over a larger area if bats are negatively impacted. The cumulative impact and associated mitigation measures are outlined in **Table 9-13**.

Table 9-13: Cumulative Impact on bat mortalities during foraging

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Bat mortalities during foraging									
Without Mitigation	4	3	3	4	4	**56**	**Moderate**	(-)	Hard
With Mitigation	4	3	3	4	3	**42**	**Moderate**	(-)	
Mitigation and Management Measures	— Each WEF adhere to its respective sensitivity map criteria (already implemented at Mukondeleli WEF). — Turbine layout adjustments to adhere to the sensitivity maps, and where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions. — Bat mortality impact during operation should be measured and ensure that the WEF impacts remain within sustainable levels. — Acoustic deterrents are developed well enough to be trialled, if the operational study indicates above threshold mortalities. — Each WEF should measure its bat mortality impact during operation and ensure that the WEF impacts remain within sustainable levels.								

BAT MORTALITIES DURING MIGRATION.

Bat mortalities over long periods of time can negatively impact species genetic diversity in a population. If this occurs over a larger area of several wind farms, it decreases the chances of bat populations recovering to a prior state. Bats play an important role in controlling insect numbers, certain species of insects may increase in numbers over a larger area if bats are negatively impacted. For migrating bats the area of influence are dependent on the migration routes, and may therefore involve WEF's not in the immediate larger area**.** The cumulative impact and associated mitigation measures are outlined in **Table 9-14**.

Table 9-14: Cumulative Impact on bat mortalities during migration

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Bat mortalities during migration.									
Without Mitigation	4	4	3	4	4	**60**	**Moderate**	(-)	Hard
With Mitigation	4	4	3	4	2	**30**	**Low**	(-)	
Mitigation and Management Measures	— Reducing blade movement at selected turbines if a migration route is discovered. — Acoustic deterrents are developed well enough to be trialled. — Each WEF should measure its bat mortality impact during operation and ensure that the WEF impacts remain within sustainable levels								

INCREASED BAT MORTALITIES DUE TO LIGHT ATTRACTION AND HABITAT CREATION.

Floodlights and other lights at turbine bases or nearby buildings, will attract insect eating bats and therefore significantly increase the likelihood of these bats being impacted on by moving turbine blades. Habitat creation in the roofs of nearby buildings or by creating wetlands or open water sources due to stormwater drainage can cause a similar increased risk factor. Considering several WEF's, the overall mortality rate will be significantly higher with an increased likelihood of impact. The cumulative impact and associated mitigation measures are outlined in **Table 9-15.**

Table 9-15: Cumulative Impact on bat mortalities due to light attraction

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Increased bat mortalities due to light attraction and habitat creation.									
Without Mitigation	4	3	3	4	3	**42**	**Moderate**	(-)	Moderate
With Mitigation	4	3	3	4	2	**28**	**Low**	(-)	
Mitigation and Management Measures	— Each WEF to only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools. This will be at turbine bases (if applicable and other infrastructure buildings). — For buildings, avoid tin roofs and roof structures that offer entrance holes into the roof cavity. — The stormwater management plan should prevent the creation of any artificial wetlands and open water sources within 300m of any turbine bases.								

9.8 VISUAL AND LANDSCAPE CUMULATIVE IMPACTS

Although it is important to assess the visual impacts of the proposed Mukondeleli WEF specifically, it is equally important to assess the cumulative visual impact that could materialise if other renewable energy facilities (both wind and solar facilities) and associated infrastructure projects are developed in the broader area. Cumulative impacts occur where existing or planned developments, in conjunction with the proposed development, result in significant incremental changes in the broader study area. In this instance, such developments would include:

— existing mining / quarrying activities,
— existing industrial development including the Sasol Secunda synthetic fuel plant; and
— other existing / proposed renewable energy facilities within a 30km radius.

Existing mining / quarrying and industrial development, including the Sasol Secunda fuel plant have already resulted in large scale visual impacts, especially to the north and north-west of the Mukondeleli WEF. These developments have significantly altered the sense of place and visual character in the broader region.

Renewable energy facilities have the potential to cause large-scale visual impacts, and although the level of transformation already present in the landscape will reduce the contrast and overall visual impact of the new development, the incremental change in the landscape will be increased and the visual impacts on surrounding visual receptors would be exacerbated. The South African Renewable Energy EIA Application Database from DFFE (REEA_OR_2022_Q2) records only two approved renewable energy projects within 55kms of the Mukondeleli WEF project area, this being a Solar Photovoltaic (PV) facility located at the Tutuka Power Station and the Forzando North Coal Mine Solar PV. These projects are however some 23 km south-east and 55km northeast of the Mukondeleli project area respectively and it is not anticipated that these developments will result in any significant cumulative impacts affecting the landscape or the visual receptors within the visual assessment zone for the Mukondeleli WEF. Two other renewable energy projects within 55kms of the Mukondeleli WEF project area are pending approval, these being the proposed Impumelelo WEF to be located approximately 25km west of the site and the proposed Vhuvhili Solar Energy Facility located approximately 10km east of the site.

However, it is known that the Mukondeleli WEF project forms part of a larger Renewable Energy cluster of projects proposed in the greater Secunda area. This complex, including wind (Impumelelo WEF) and solar facilities (Vhuvhili SEF) as well as associated grid connection infrastructure, will affect much of the landscape to the south and south-east of Secunda.

From a visual perspective, the concentration of renewable energy facilities in close proximity to existing mining and industrial development as proposed will further change the visual character of the broader area and alter the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. In addition, it is possible that these developments in close proximity to each other could be seen as one large Renewable Energy Facility (REF) rather than several separate developments. Although this will not necessarily reduce impacts on the visual character of the area, it could potentially reduce the cumulative impacts on the landscape.

Potential cumulative visual impacts identified of the project are listed below:

— Additional renewable energy and associated grid connection infrastructure developments in conjunction with mining and industrial development in the broader area will alter the natural character of the study area towards a more industrial landscape and expose a greater number of receptors to visual impacts.
— Visual intrusion of multiple renewable energy developments may be exacerbated, particularly in more natural undisturbed settings.
— Additional renewable energy facilities in the area would generate additional traffic on gravel roads thus resulting in increased impacts from dust emissions and dust plumes.
— The night-time visual environment could be altered as a result of operational and security lighting at multiple renewable energy facilities in the broader area.

The cumulative visual and landscape impact and associated mitigation measures are outlined in **Table 9-16**.

Table 9-16: Cumulative Impact on the visual landscape

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impacts									
Without Mitigation	4	3	3	5	4	**64**	**High**	(-)	Moderate

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impacts									
With Mitigation	4	3	3	4	4	56	Moderate	(-)	
Mitigation and Management Measures	— Carefully plan to minimise the construction period and avoid construction delays. — Position laydown areas and related storage/stockpile areas in unobtrusive positions in the landscape, where possible. — Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. — Where possible, the operation and maintenance buildings should be consolidated to reduce visual clutter. — As far as possible, limit the number of maintenance vehicles which are allowed to access the facility. — Ensure that dust suppression techniques are implemented on all gravel access roads. — As far as possible, limit the amount of security and operational lighting present on site whilst adhering to relevant safety standards. — Light fittings for security at night should reflect the light toward the ground and prevent light spill. — Lighting fixtures should make use of minimum lumen or wattage whilst adhering to relevant safety standards. — Mounting heights of lighting fixtures should be limited, or alternatively foot-light or bollard level lights should be used. — If possible, make use of motion detectors on security lighting.									

9.9 HERITAGE CUMULATIVE IMPACTS

Various other projects are proposed in the wider area and might impact upon heritage resources. Cumulative impacts would occur through the construction, operation and decommissioning of many projects in the same general area. The projects considered in the assessment of cumulative impacts are listed in Table 7. In terms of archaeology, a known site is under threat from the Mukondeleli powerline which results in a high probability of impacts but mitigation would still bring the significance down from **high negative** to **very low negative** (Table 8). Graves are generally unlikely to be impacted but are present widely in the landscape and one graveyard in the present project is at risk of impacts. Mitigation would reduce the impact significance from **very high negative** to **very low negative**. Cumulative impacts to the landscape are likely to be **moderate negative** both before and after mitigation for all three phases.

The proposed facility will be providing electricity to South Africa which will result in obvious benefits to society at many levels. There will be local job creation during construction and operation but, more widely, an improvement in electricity supply in South Africa will stimulate the economy and result in new job opportunities opening up and quality of life improving. These are clear economic and social benefits and, if mitigation is applied as suggested above, then the socio-economic benefits outweigh the residual impacts.

There are currently no obvious threats to heritage resources on the site aside from the natural degradation, weathering and erosion that will affect archaeological materials. Trampling from grazing animals and/or farm/other vehicles could also occur. These impacts would be of **negligible negative** significance. The local landscape, which is generally agricultural in nature, is, as noted above, already impacted by the Sasol facility and coal mines. Although the significance of this impact could be considered as **moderate to high negative**, such facilities are an expected part of the Highveld landscape and have been for many years.

IMPACTS TO ARCHAEOLOGICAL RESOURCES

The cumulative impacts as well as the mitigation measures are outlined in **Table 9-17**.

Table 9-17: Cumulative Impact on archaeological resources

Potential Impact Damage to or destruction of archaeological resources	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	3	3	5	5	5	**80**	**High**	(-)	High
With Mitigation	1	3	5	5	1	**14**	**Very Low**	(-)	

IMPACTS TO GRAVES

The cumulative impacts as well as the mitigation measures are outlined in **Table 9-18.**

Table 9-18: Cumulative Impact on graves

Potential Impact Damage to or destruction of graves	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	5	3	5	5	5	**90**	**Very High**	(-)	High
With Mitigation	1	3	3	2	5	**14**	**Very Low**	(-)	

IMPACTS TO THE CULTURAL LANDSCAPE

The cumulative impacts as well as the mitigation measures are outlined in **Table 9-19.**

Table 9-19: Cumulative Impact on cultural landscapes

Potential Impact Visual intrusion into and change of character of the cultural landscape	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Without Mitigation	2	3	3	2	5	**50**	**Moderate**	(-)	High
With Mitigation	1	3	3	2	5	**45**	**Moderate**	(-)	

9.10 TRANSPORT CUMULATIVE IMPACTS

To assess the cumulative impact, it will be assumed that all authorised and proposed renewable energy projects within the vicinity of the site, would be constructed at the same time. It must be noted that this is a conservative approach.

There are four (4) renewable energy projects located within a 55km radius of the site, namely:

— The authorised Tutuka 65.9 MW Solar Photovoltaic (PV) Energy Facility and its associated infrastructure (Ref: 14/12/16/3/3/2/754) located 23km southwest of the site.

— The authorised Forzando North Coal Mine Solar PV Facility, 9.5MW, (Ref: 14/12/16/3/3/1/452) is located 55km northwest of the site.

— The proposed Impumelelo WEF to be located southeast of the site.

— The proposed Vhuvhili Solar Energy Facility (NEAS No. MPP/EIA/0001063/2022) located approximately 10km east of the site.

Table 9-20: Cumulative Impact of noise and dust pollution associated potential traffic

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust & exhaust pollution due to additional trips on the national and district roads.									
Without Mitigation	3	3	3	3	4	48	Moderate	(-)	Easy
With Mitigation								(-)	

Table 9-21: Cumulative Impact during operation phase due to vehicle trips on Mukondeleli site

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Noise, dust & exhaust pollution due to vehicle trips on-both the Mukondeleli site.									
Without Mitigation	2	2	3	4	2	22	Low	(-)	Easy

9.11 SOCIAL CUMULATIVE IMPACTS

SENSE OF PLACE

The potential cumulative impacts on the areas sense of place will be largely linked to potential visual impacts. In this regard the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These issues are also likely to be relevant to solar facilities and associated infrastructure. The relevant issues identified by Scottish Natural Heritage study include:

— Combined visibility (whether two or more wind farms will be visible from one location).
— Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
— The visual compatibility of different wind farms in the same vicinity.
— Perceived or actual change in land use across a character type or region.
— Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one renewable energy facility and the associated infrastructure at a time, but if each successive stretch of the road is dominated by views of renewable energy facilities, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

As indicated above, the only historic application indicated on the DFF&E's renewable energy applications website located within a 35 km range of the site, is the proposed (2016) 66 MW Tutuka SEF located south east of the site. Enertrag is currently also proposing the Vhuvhili SEF (separate application) located to the north east of the Mukondeleli WEF site. There is therefore the possibility of combined and sequential impacts. However, give the location of the site the potential impact of the proposed WEF and associated infrastructure on the areas sense of place is likely to be limited. The cumulative impacts are also likely to be low with mitigation, specifically given the location of the site next to the existing, large Secunda petrochemical facility and associated coal mines. The cumulative impact on the sense of place and the landscape is outlined in **Table 9-22.**

Table 9-22: Cumulative Impact on sense of place and the landscape

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
Visual impacts associated with the establishment of more than one REF and the potential impact on the area's rural sense of place and character of the landscape.									
Overall impact of the proposed project considered in isolation	2	2	3	4	2	26	Low	(-)	Moderate
Cumulative impact of the project and other projects in the area	2	3	1	4	3	36	Moderate	(-)	
Mitigation and Management Measures	— The recommendations contained in the Visual Impact Assessment should be implemented.								

LOCAL SERVICES AND ACCOMMODATION

The establishment of a number of REFs has the potential to place pressure on local services and accommodation, specifically during the construction phase. The objective will be to source as many low and semi-skilled workers for the construction phase from the GML. This will reduce the pressure on local services and accommodation and the nearby town of Secunda. However, given the relatively short duration of the construction phase the potential impact is likely to be limited.

The potential impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of the proposed facility and associated renewable energy projects in the GMDM. These benefits will create opportunities for investment in the GMM, including the opportunity to up-grade and expand existing services and the construction of new houses. The cumulative impact on local services is outlined in **Table 9-23.**

Table 9-23: Cumulative Impact on local services

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The establishment of a number of renewable energy facilities has the potential to place pressure on local services, specifically medical, education and accommodation.									
Overall impact of the proposed project considered in isolation	2	2	N/A	2	2	12	Very Low	(-)	Easy
Cumulative impact of the project and other projects in the area	3	3	N/A	3	2	18	Low	(-)	
Mitigation and Management Measures	— The proponent should liaise with the GMM to address potential impacts on local services.								

LOCAL ECONOMY

In addition to the potential negative impacts, the establishment of renewable energy facilities and associated infrastructure, including the proposed WEF, will also create several socio-economic opportunities for the GMM. The positive cumulative opportunities include creation of employment, skills development and training opportunities, and downstream business opportunities.

The potential cumulative benefits for the local and regional economy are associated with both the construction and operational phase of renewable energy projects and associated infrastructure and extend over a period of 20-25 years. However, steps must be taken to maximise employment opportunities for members from the local communities in the area and support skills development and training programmes. The cumulative impact on the local economy is outlined in **Table 9-24**.

Table 9-24: Cumulative Impact on local economy

Potential Impact	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Ease of mitigation
The establishment of a number of renewable energy facilities will create employment, skills development and training opportunities, creation of downstream business opportunities. .									
Overall impact of the proposed project considered in isolation	2	2	N/A	4	4	**32**	**Moderate**	(+)	Easy
Cumulative impact of the project and other projects in the area	4	3	N/A	4	5	**55**	**Moderate**	(+)	
Mitigation and Management Measures	— The proponent should liaise with the GMM to identify potential opportunities for the local economy and businesses.								

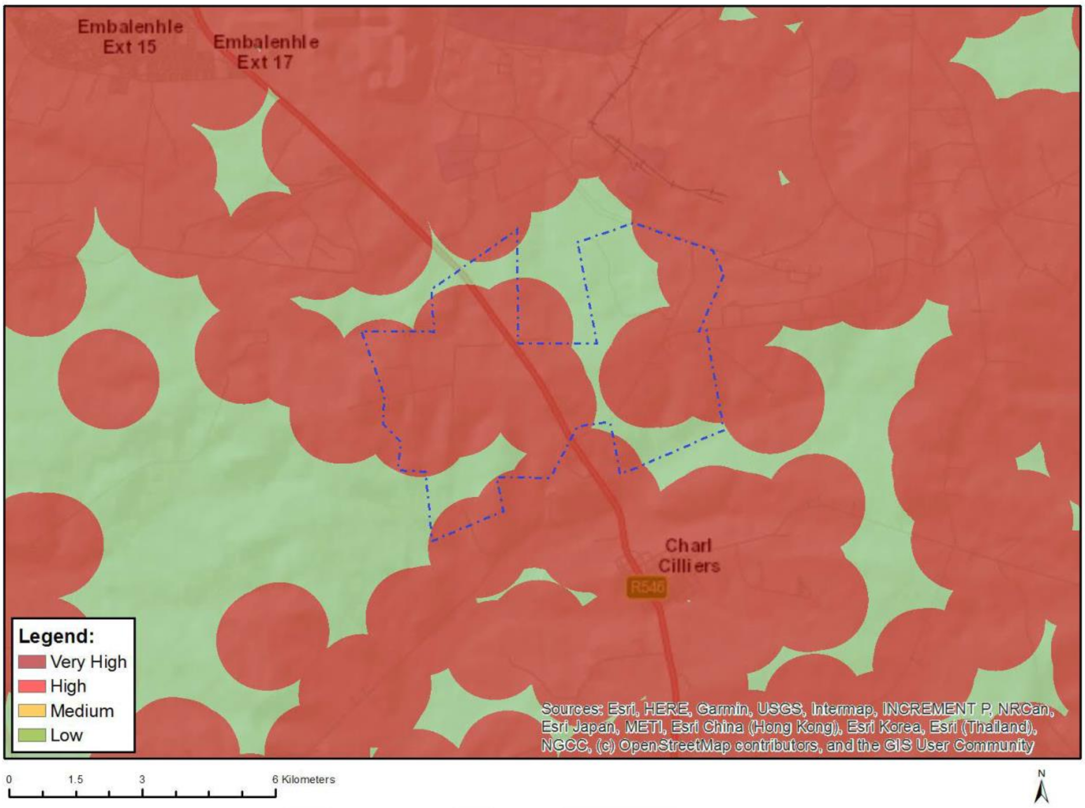
10 ENVIROMENTAL IMPACT STATEMENT

10.1 ENVIRONMENTAL SENSITIVITIES

10.1.1 NOISE SENSITIVITY

Based on the DFFE Screening Tool, the site contains areas of Very High sensitivity due to the presence of potential temporarily or permanent inhabited residences. The remaining area within the development footprint is deemed to be of low sensitivity **(Figure 10-1**).

MAP OF RELATIVE NOISE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Area of low sensitivity
Very High	Potential temporarily or permanently inhabited residence

Figure 10-1: DFFE Screening Tool outcome for the Noise theme

Potential noise-sensitive developments, receptors and communities (NSR) were identified using tools such as Google Earth® up to a distance of 2 000 m (recommendation SANS 10328:2003) from WTG locations. Two potential receptors (that could include a number of people and animals) was identified, highlighted in **Figure 10-2**. Other noise-sensitive areas are indicated in green polygons. Also indicated on this figure are generalized 500, 1 000 and 2 000 m buffer zones. Generally, noises from wind turbines:

— could be significant within 500 m, with receptors staying within 500 m from operational WTG subject to noises at a potentially sufficient level to be considered disturbing;

— are normally limited to a distance of approximately 1,000m from operational wind turbines (subject to WTG layout, as the WTG cumulatively contribute to noise levels with 2,000m from WTG). Night-time ambient sound levels could be elevated and the potential noise impact measurable; and

— likely to be audible up to a distance of 2,000m at night. Noises from the WTG are of a low concern at distances greater than 2,000m, although the sound of the WTGs may be audible at greater distances during certain metrological phenomena (sound levels are generally very low at distances greater than 2,000m

The potential noise-sensitive areas illustrated on **Figure 10-3.**

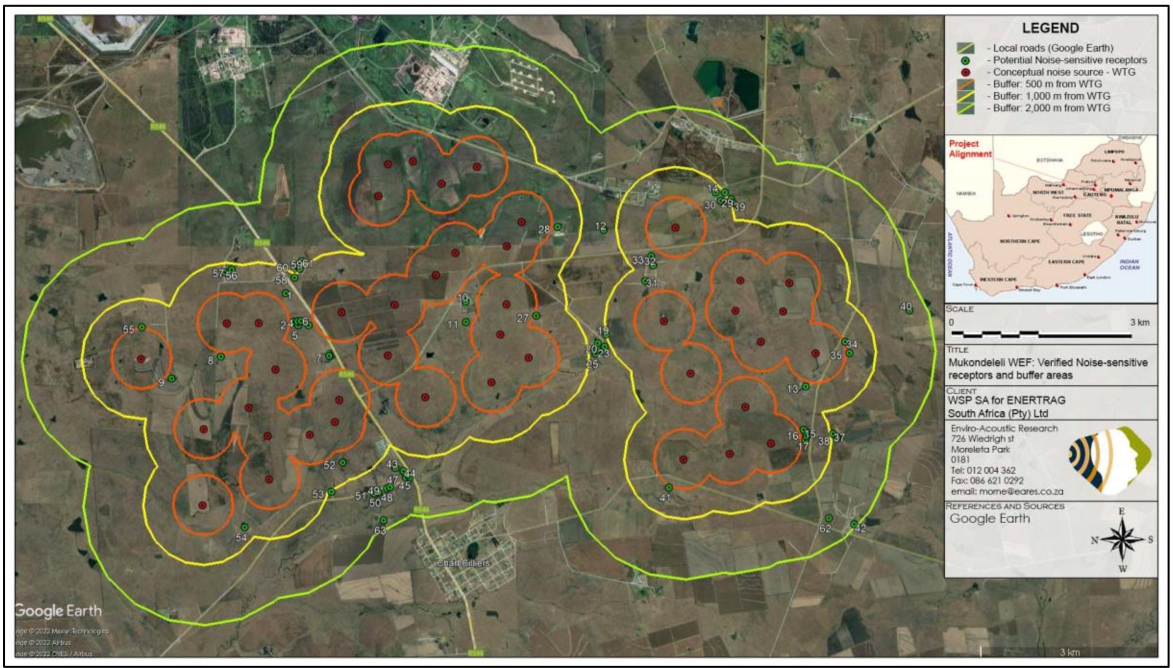


Figure 10-2: Study area and potential noise-sensitive receptors close to the Mukondeleli WEF

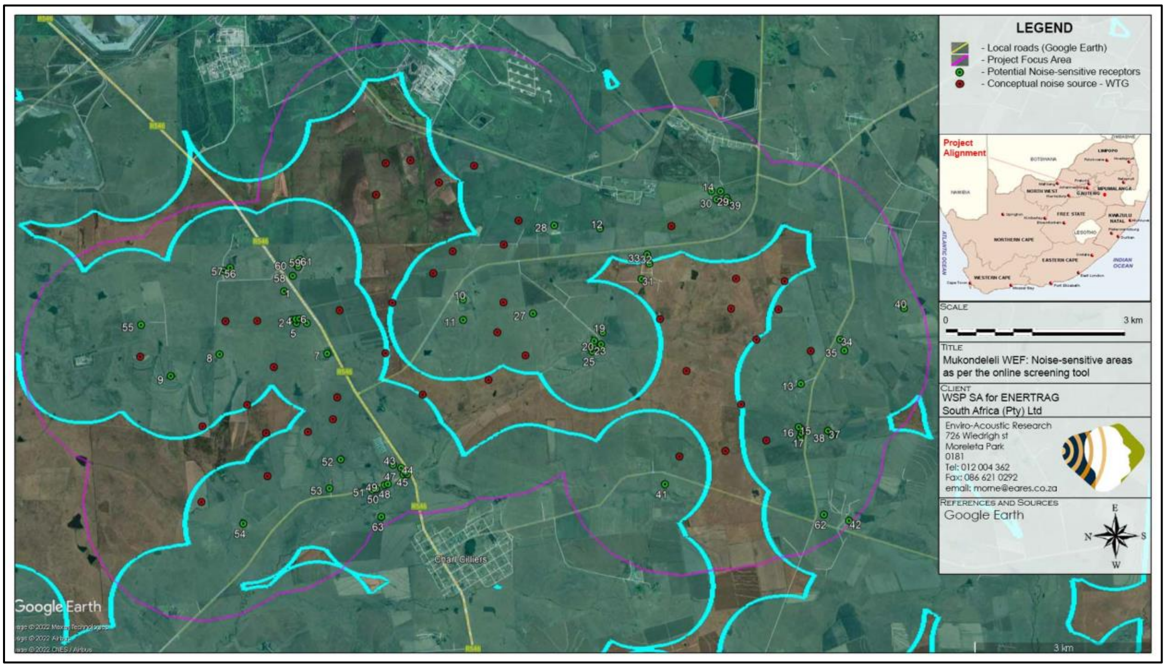
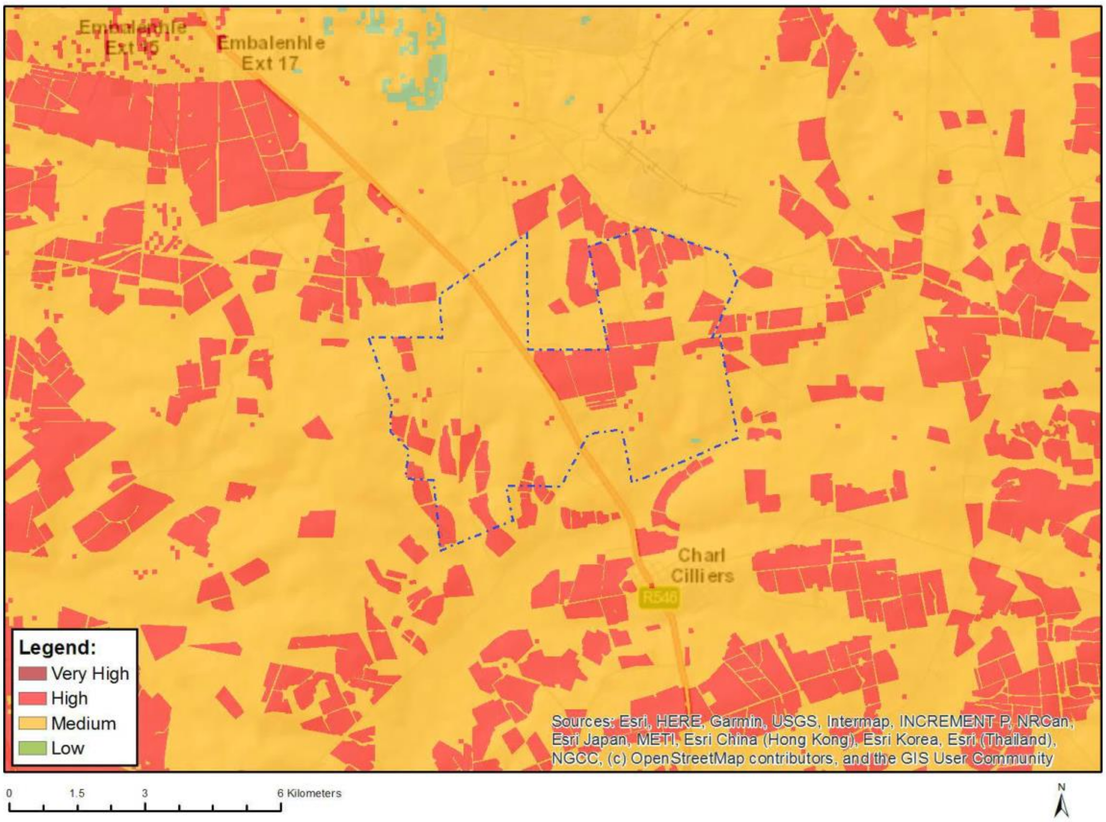


Figure 10-3: Study area and potential noise-sensitive areas identified by the online screening tool

10.1.2 AGRICULTURAL SENSITIVITIES

Based on the DFFE Screening Tool, the site contains areas of both High and medium sensitivity **(Figure 10-4).**

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

Figure 10-4: DFFE Screening Tool outcome for the Agricultural Theme

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. All arable land that can support viable crop production, is classified as high (or very high) sensitivity. This is because there is a scarcity of arable production land in South Africa and its conservation for agricultural use is therefore a priority. Land which cannot support viable crop production is much less of a priority to conserve for agricultural use, and is rated as medium or low agricultural sensitivity.

It is important to recognise that the agricultural sensitivity of land, in terms of a particular development, is not only a function of the screening tool sensitivity, but is also a function of the severity of the impact which that development poses to agriculture. This is not recognised in the screening tool classification of sensitivity. The agricultural impact of wind farms is completely constrained by their very small agricultural footprint and the screening tool sensitivity of the land actually has very little influence on the significance of the agricultural impacts of a wind farm.

The screening tool classifies agricultural sensitivity according to only two independent criteria – the land capability rating and whether the land is used for cropland or not. All cropland is classified as at least high sensitivity, based on the logic that if it is under crop production, it is indeed suitable for it, irrespective of its land capability rating.

The screening tool sensitivity categories in terms of land capability are based upon the Department of Agriculture's updated and refined, country-wide land capability mapping, released in 2016. The data is generated by GIS modelling. Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land, based on its soil, climate and terrain. The higher land capability values (≥8 to 15) are likely to be suitable as arable land for crop production, while lower values are only likely to be suitable as non-arable grazing land.

The land capability of the site on the screening tool is predominantly 8, but varies from 5 to 9. The small scale differences in land capability across the project area are not very accurate or significant at this scale and are more a function of how the land capability data is generated by modelling, than actual meaningful differences in agricultural potential on the ground. Values of 5 translate to a low agricultural sensitivity, values of 6 to 8 translate to a medium agricultural sensitivity, and values of 9 translate to a high agricultural sensitivity. However, there are only a few, isolated pixels across the site that are of a land capability value of 9, and they are therefore not very significant.

In reality the soils (and therefore the land capability) vary in a fairly complex pattern across the landscape, which is not reflected at the scale of the land capability data and cannot practically be achieved through soil mapping. The most reliable indication of soil cropping potential is historical land use. The suitable versus the unsuitable soils have been identified over time through trial and error. In an agricultural environment like the one being assessed, all the suitable soils are generally cropped, and uncropped soils can therefore fairly reliably be considered to have limitations that make them unsuitable for crop production.

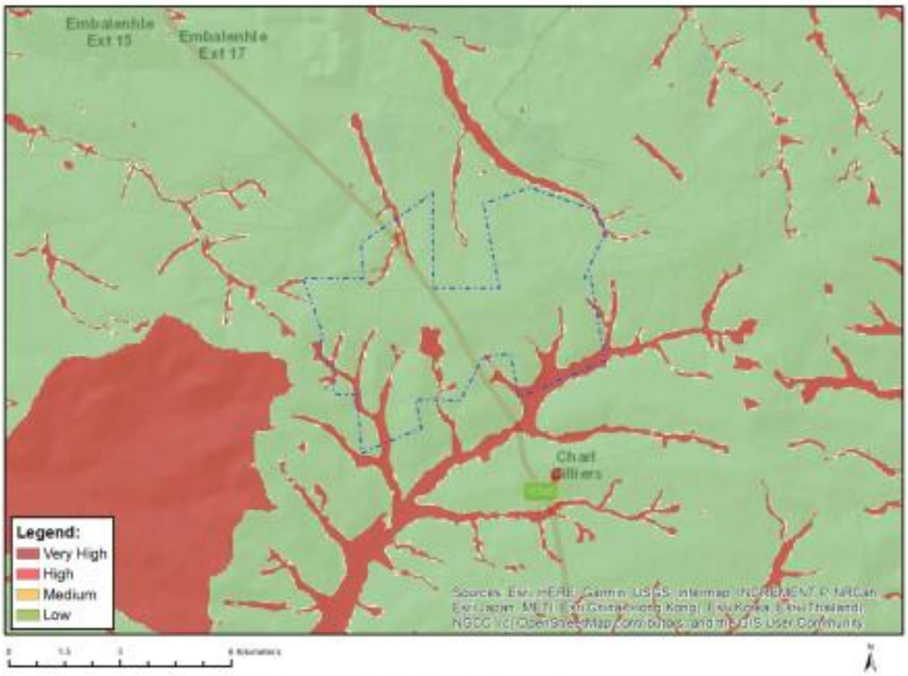
The allocation of high sensitivity to parts of the site are because these parts are classified as cropland in the data set used by the screening tool. However, that data set is outdated. On this site, the extent of cropland has only slightly reduced since the data set for the screening tool was obtained. The suitability for cropping changes with a changing agricultural economy. Slightly poorer soils that may have been cropped with economic viability in the past, are abandoned as cropland because they become too marginal for viable crop production in a more challenging agricultural economy with higher input costs.

This site sensitivity verification verifies those parts of the site that are indicated as cropland as being of high agricultural sensitivity and the rest of the site as being of medium agricultural sensitivity.

10.1.3 AQUATIC SENSITIVITIES

Based on the DFFE Screening Tool, the site contains areas of Very High sensitivity due to the presence of wetlands and estuaries. The remaining area within the development footprint is deemed to be of low sensitivity **(Figure 10-5**).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands and Estuaries

Figure 10-5: DFFE Screening Tool outcome for the aquatic biodiversity theme

In terms of the desktop assessment the study site has conservation significance both in terms of national as well as provincial conservation planning. The site verification assessment indicated that the proposed layout encroaches on the wetlands and their associated buffer areas.

The desktop assessment conducted by DWS indicated that the sub quaternary reaches surrounding the study site are largely natural (B) to moderately modified (C). The site verification indicated that the wetlands are moderately (C) to seriously modified (E) whilst the aquatic macroinvertebrates indicated that the aquatic ecosystems are mostly seriously/critically (E/F) modified. Therefore, the wetland and aquatic ecosystems surrounding the study site are more impacted than expected.

Based on the field assessments, the wetland delineation and buffer indicate that the current layout encroaches on the wetlands as well as their respective buffer areas. Although the wetland and aquatic ecosystems are impacted, they still fulfil important ecosystem services and also form part of national and provincial conservation targets. It is therefore recommended that the layout plans should be updated to remove the footprint of the WEF out of the wetlands and buffer areas. No site alternatives were provided to the specialists for consideration.

Based on the above outcomes, the Aquatic specialist agrees with the environmental sensitivities identified on site. The findings have been informed by a site visit undertaken by the Specialist in 1st to 4th of February 2022.

In conclusion, the DFFE Screening Tool identified two sensitivity ratings within the development footprint, namely, very high and low. Although there is some overlap with the findings on site and the Screening Tool's outcome, the development footprint contains various sensitivities (very high, and low) that were identified following the undertaking of the site visit and spatial input considerations.

The environmental sensitivity input received from the aquatic ecology specialist has been considered and appropriate layout and development restrictions were implemented within the development footprint to ensure that the impact to aquatic ecology is deemed acceptable by the aquatic ecologist.

Based on the Species Environmental Assessment Guideline (SANBI, 2020) wetlands and specialised habitats should be assessed based on their Site Ecological Importance (SEI). The SEI is outlined in **Table 10-1** and illustrated in **Figure 10-6**.

Table 10-1: Ecological Importance of all wetland areas recorded on the study site

HABITAT	CONSERVATION IMPORTANCE (CI)	FUNCTIONAL INTEGRITY (FI)	BIODIVERSITY IMPORTANCE	RECEPTOR RESILIENCE	SITE ECOLOGICAL IMPORTANCE
Wetland Area	High – Confirmed occurrence of wetlands within the development footprint	Medium – Some historical impacts and AIS recorded	Medium – Based on CI and FI	Very Low – Wetlands are not easily restored without significant rehabilitation. Many species are dependent on functional wetland habitat.	Based on BI – Medium and RR – Very Low = High

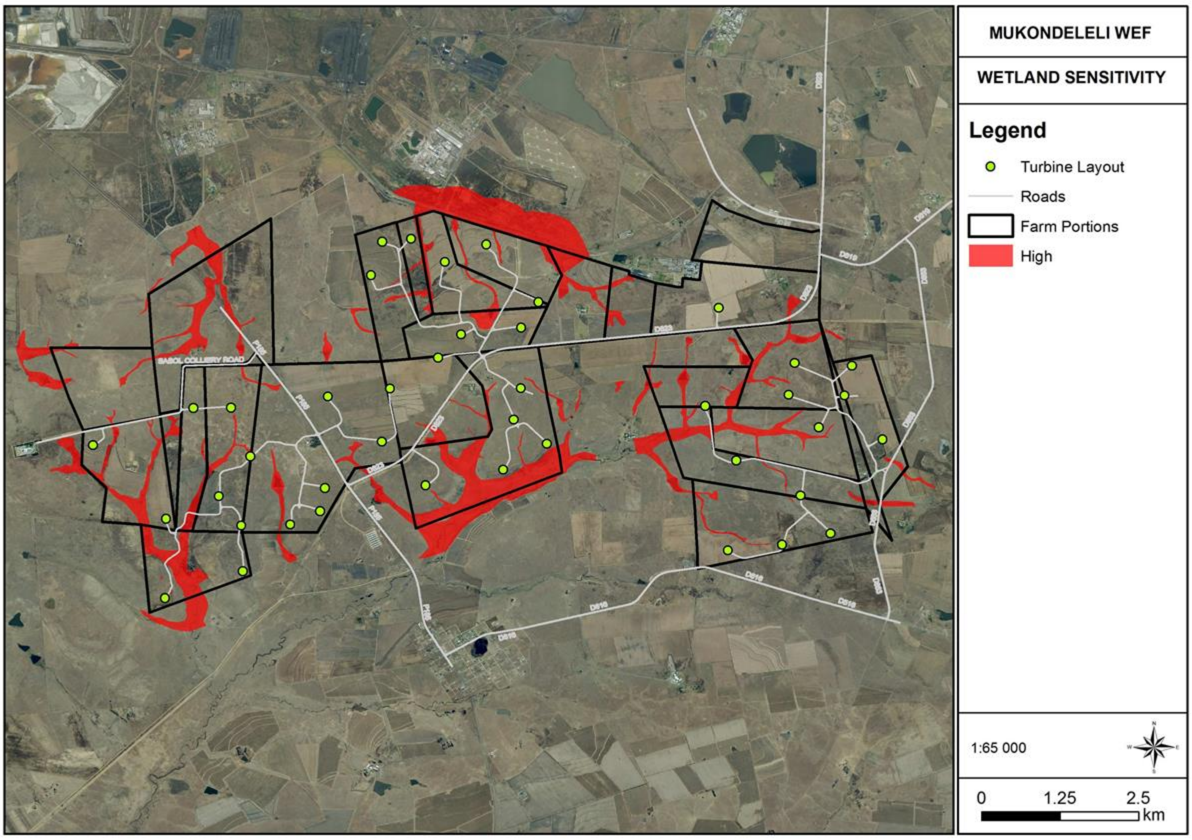


Figure 10-6: Wetland sensitivity based on the Site Ecological Importance (SANBI, 2020) for the proposed Mukondeleli WEF study area.

10.1.4 TERRESTRIAL BIODIVERSITY SENSITIVITIES

The biodiversity theme sensitivity as indicated in the DFFE Screening Tool was derived to be Very High (**Figure 10-7**). This is due to presence on site of Vulnerable Ecosystem, CBAs and Protected Areas Expansion Strategy. The theme indicates the entire study area as being in the Very High sensitivity category.

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Critical biodiveristy area 2
Very High	Ecological support area: landscape corridor
Very High	Ecological support area: local corridor
Very High	Protected Areas Expansion Strategy
Very High	Vulnerable ecosystem

Figure 10-7: DFFE Screening Tool outcome for the terrestrial biodiversity theme

This theme considers the presence of protected areas, National Protected Area Expansion Strategy (NPAES), CBAs, ESAs and National Freshwater Ecosystem Priority Areas (NFEPAs).

The study area is not located in a protected area nor does it fall in an area earmarked for the NPAES (NPAES 2010). It is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA). The background study confirms that the Soweto Highveld Grassland vegetation type on site is listed as 'Vulnerable'. Our background study indicated that although there are CBAs present on site, our sensitivity analysis rated most of these areas as being of low sensitivity. Nevertheless, wind turbines should preferably not be located within the area demarcated as CBA.

There are ESA Landscape corridors and ESA Local corridors indicated on site, but the presence of the WEF would not impact negatively on them.

Freshwater Ecosystem Priority Areas (FEPAs) or water catchments were not flagged by the screening tool. Based on the site assessment of the vegetation most of the area mapped as upstream river FEPA was rated as having a low or medium sensitivity, with only the drainage lines having a high sensitivity. Several wetland FEPAs are present on site (see aquatic specialist report), but these were also not highlighted by the Screening Tool.

Unfortunately, the screening tool on site limits the sensitivity outcome of the Relative Terrestrial Biodiversity Theme to either very high or low. This is an issue which should be revisited by DFFE since it does not give a proper representation of the site conditions. Although we agree with the presence of the CBA, the entire site does not qualify as CBA, since a large proportion of the site is degraded and under cropland or abandoned cropland. Thus if the same 4-tiered scale were to be applied to this theme, as in the case of the other themes, we would rate it as medium to low.

The above information was used in conjunction with methodology to calculate Site Ecological Importance, described in the Terrestrial Biodiversity Assessment report. A map of habitat sensitivity on site in relation to project infrastructure was provided by the terrestrial specialist (**Figure 10-8** and **Figure 10-9**). The proposed infrastructure in relation to sensitivities is as follows:

- Access routes: The access route from the R346 is acceptable if it follows existing roads
- Wind Turbines: It is assumed that the terms 'CBA irreplaceable' in the MBSP is equivalent of a CBA1 and a 'CBA optimal' refers to a CBA2. The CBA map indicates the presence of CBA1 and a CBA2 across a large section of especially the western part of the Mukondeleli site, mostly in Habitats 4 & 5 (natural and disturbed grassland) which were rated as having a low sensitivity rating in the current study. Two turbines are located in a CBA1 area and their positions should be reconsidered, i.e.. MK28 and MK37. A number of wind turbines are also located in CBA2 areas, i.e. Turbines MK11, MK24, MK26, MK36 & MK39. These 7 sites must be microsited prior to approval of final layout such that the site can be groundtruthed and any sensitivity areas avoided. No turbines were located in Mpumalanga Highveld Wetlands, e.g. channelled valley-bottom wetlands, but turbine MK16 occurs within an areas demarcated as seep. The current layout of the wind turbines avoided the areas with shallow soils on rocky sheets (Habitat 1 –medium sensitivity) or within or near watercourses (Habitat 7 – high sensitivity)
- On-site switching station E (SS E): The substation site falls partly within an area demarcated as CBA1 and its location should be reconsidered (micro-sited). The substation site also falls in an area demarcated as a seep. The site location is however acceptable in terms of our sensitivity findings for the habitats on site i.e. low sensitivity based on the criteria used.
- On-site switching station E (SS F): The substation site falls partly within an area demarcated as CBA1 and CBA2 and its location should be reconsidered (micro-sited). The substation site also falls in an area demarcated as a seep. The site location is however acceptable in terms of our sensitivity findings for the habitats on site i.e. low sensitivity based on the criteria used.
- Construction camp and batching plants: The four proposed site locations are acceptable in terms of our sensitivity findings for the habitats on site.
- Temporary laydown areas: The four proposed site locations are acceptable in terms of our sensitivity findings for the habitats on site.

Sensitivity is the vulnerability of a plant community or habitat to an impact, for example a wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be assessed to derive a sensitivity score, such as:

- 1. Threatened status of the regional vegetation types wherein the proposed site is situated.
- 2. Percentage of IUCN threatened (red-listed) plant species per habitat.
- 3. Number of protected tree species per habitat.
- 4. Percentage of provincially protected plant species per habitat.
- 5. Presence of endemic plant species per habitat or site (endemic to vegetation type).
- 6. Conservation value of plant community (habitat).
- 7. Species richness per habitat or per sample plot (number of plant species).
- 8. Degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating.
- 9. Soil erosion potential.

— 10. Resilience (this is a measure of the ability of a particular habitat to recover after an impact, i.e. high resilience infers low rating).

Overall, the grassland on shallow soils (rocky sheets) (Habitat 1 – medium sensitivity) and drainage lines (including dams) (Habitat 7 – high sensitivity) were more sensitive than the other habitats on site. Habitats 6, 8, 9 & 10 are man-made habitats with a low sensitivity rating, e.g., cropland, planted pasture, plantations, wind breaks, diggings and dams.

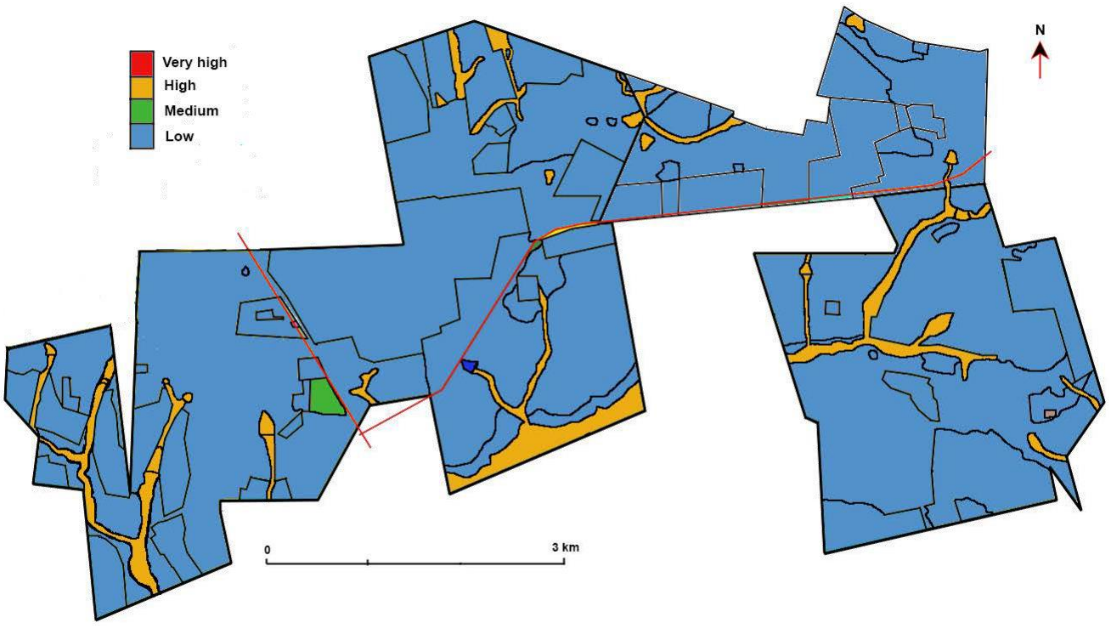


Figure 10-8: Sensitivity map of the Mukondeleli site.

Figure 10-9: Current layout of the infrastructure in the Mukondeleli site in relation to habitat sensitivity on site (Ekotrust, 2022) (Key: Pink squares SS E = switching station E; White squares SS F = switching station F; Yellow rectangles = construction and batching sites; Pink squares = laydown areas; and Turquoise = Main roads)

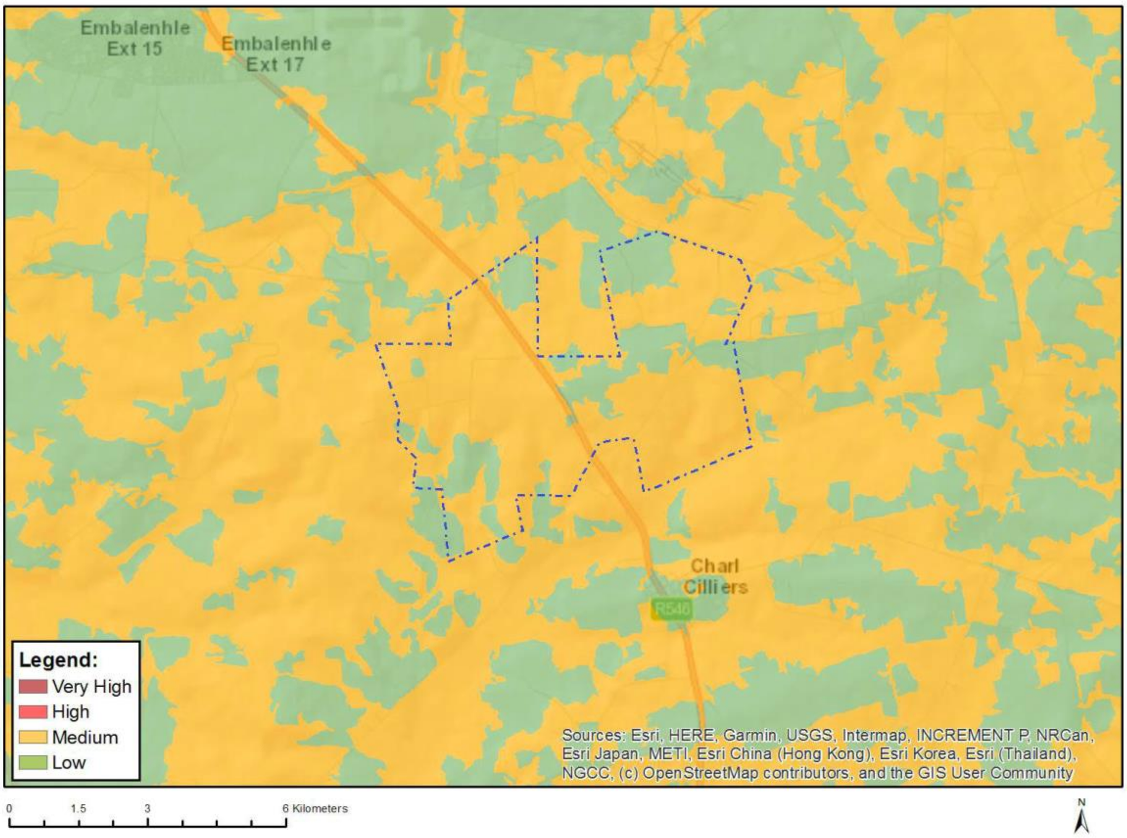
The wind turbines avoided the medium and high sensitive areas. Some of the proposed internal roads would cross some of the drainage lines, however roads should be aligned so that transformation within the CBAs and sensitive wetlands is minimised. Along the watercourses, buffers are applicable to the development. A buffer zone of 32 m is usually applied to drainage lines, but the aquatic specialists may apply wider buffer zones along these habitats.

Apart from the drainage lines, with high sensitivity, the CBAs did not emerge as being highly sensitive according to the criteria used in the habitat sensitivity model that was applied. However, other criteria were used for delineating CBAs in Mpumalanga. The areas mapped as FEPAs were largely incorporated into the CBAs and likewise did not emerge as being highly sensitive in the sensitivity model that was applied.

10.1.5 PLANT SPECIES SENSITIVITY

The Screening Tool rated the sensitivity of the Plant Species Theme as medium (**Figure 10-10**) and highlighted two species with an IUCN status of Vulnerable as being of concern.

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Sensitive species 691

Figure 10-10: DFFE Screening Tool outcome for the Plant Species Theme

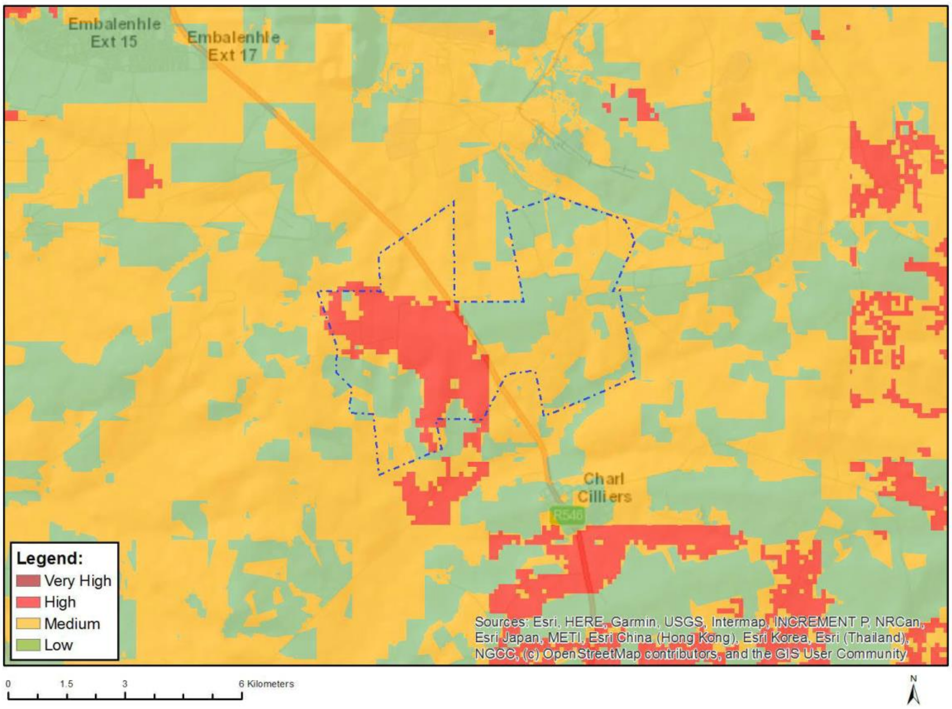
Our field survey and application of a sensitivity model indicated that most of site had a low sensitivity. None of the SCC highlighted by the screening tool were recorded on site.

- Sensitive species 691 occurs in damp depressions in shallow soil over rock sheets. This type of habitat occurs on a small area on site, but the species was not encountered during the vegetation survey.
- The habitats on site do not present suitable habitat for sensitive species 1252 because of a lack of wooded habitat.
- A low sensitivity rating is recommended for the Plant Species Theme

10.1.6 ANIMAL SPECIES SENSITIVITY

The Screening Tool rated the sensitivity of the Animal Species Theme as high (**Figure 10-11**).

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Sagittarius serpentarius
Low	Subject to confirmation
Medium	Aves-Sagittarius serpentarius
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Circus ranivorus
Medium	Insecta-Lepidochrysops procera
Medium	Mammalia-Crocidura maquassiensis

Figure 10-11: DFFE Screening Tool outcome for the Animal Species Theme

The Screening Tool listed *Lepidochrysops procera* (Lepidoptera) as a SCC for the site. However, it was not listed in the ADU database, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops procera* was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was not present on site.

The Maquassie Musk Shrew *Crocidura maquassiensis* was not listed in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province. It was not recorded on site during the survey. The Maquassie Musk Shrew depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. The main threats are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat.

Crocidura maquassiensis has not been reported from Mpumalanga Province post-1999 and thus there is a very low probability for it to occur on site.

Overall sensitivity of animal theme (avifaunal and bat components excluded) is thus rated as medium. However, if the suggested mitigation measures are followed the animal SCC should not be negatively affected.

10.1.7 AVIFAUNAL SENSITIVITY

Based on the DFFE Screening Tool[19], Animal Species theme, relevant to the Mukondeleli WEF, the project area is classified as **Low, Medium and High Sensitivity** (**Figure 10-11**), based on the potential presence of several SCC namely Grey Crowned Crane (Globally and Regionally Endangered), Martial Eagle (Globally and Regionally Endangered), Southern Bald Ibis (Globally and Regionally Vulnerable), White-bellied Korhaan (Regionally Vulnerable), Secretarybird (Globally Endangered and Regionally Vulnerable) and Wattled Crane (Globally Vulnerable and Regionally Critically Endangered). The high sensitivity classification is linked to the potential occurrence of Secretarybird (Globally Endangered, Regionally Vulnerable). The Medium sensitivity is linked to African Marsh Harrier (Globally Least Concern, Regionally Endangered), Caspian Tern (Globally Least Concern, Regionally Vulnerable), White-bellied Bustard (Globally Least Concern, Regionally Vulnerable), and Secretarybird

The project site contains confirmed habitat for these species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020), namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened, and Data Deficient species.

The occurrence of Secretarybird (Globally Endangered, Regionally Vulnerable) and additional SCC was confirmed during the surveys i.e., Black-winged Pratincole (Globally Near Threatened, Regionally, Near Threatened), Blue Crane (Globally, Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally, Vulnerable, Regionally Least Concern), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), and Lanner Falcon (Globally Least Concern, Regionally Vulnerable) were recorded in the project site.

In summary, based on the Site Sensitivity Verification field surveys conducted, habitat within the project site is suitable for Black-winged Pratincole, Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, and Secretarybird. Therefore, a classification of **High Sensitivity** for avifauna in relation to the Terrestrial Animal Species theme is suggested for the project site

The following specific environmental sensitivities were identified from an avifaunal perspective:

- **Very high sensitivity all infrastructure exclusion zones: 100m buffers around dams and pans, and 32m buffers around drainage lines and associated wetlands**
  Wetlands and pan/dam edges are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for Blue Crane (Globally Vulnerable, Regionally Near Threatened) African Marsh Harrier (Globally Least Concern, Regionally Endangered), and Caspian Tern (Globally Least

[19] The avifaunal wind theme in the screening tool is only applicable to projects in a Renewable Energy Development Zone (REDZ)

Concern, Regionally Vulnerable). Turbine blade swept area should not fall within these buffer zones. Road and grid line crossings across these features should be restricted to what is unavoidable.

— **High sensitivity limited development zone: High sensitivity grassland**
Grassland on shallow soils, rocky grassland, and natural grassland. Development in the remaining high sensitivity grassland in the project site must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species, including several SCC. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), Black-winged Pratincole (Global and SA status Near-threatened), Secretarybird (Global status Endangered, SA status Vulnerable), Pallid Harrier (Global and SA status Near-threatened), Lanner Falcon (SA status Vulnerable).

Figure 10-12 indicates the avifaunal sensitivities identified in the course of the study, from a wind energy perspective.

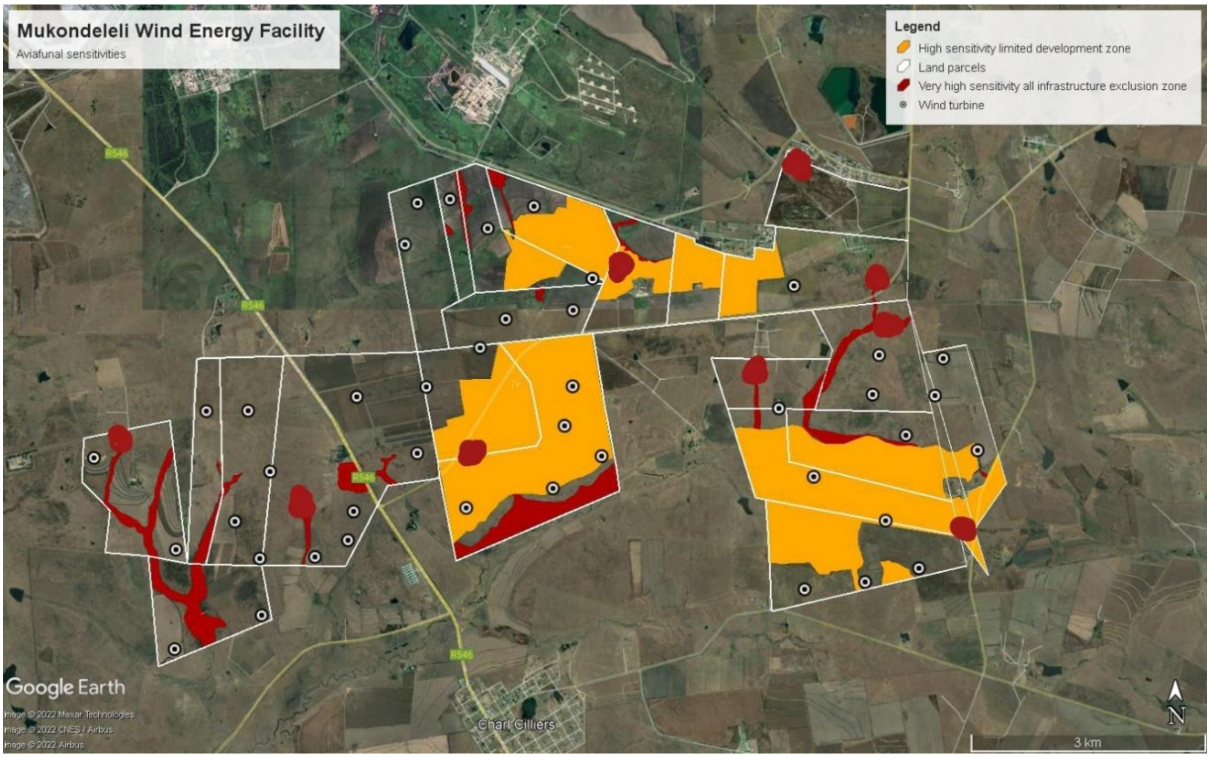
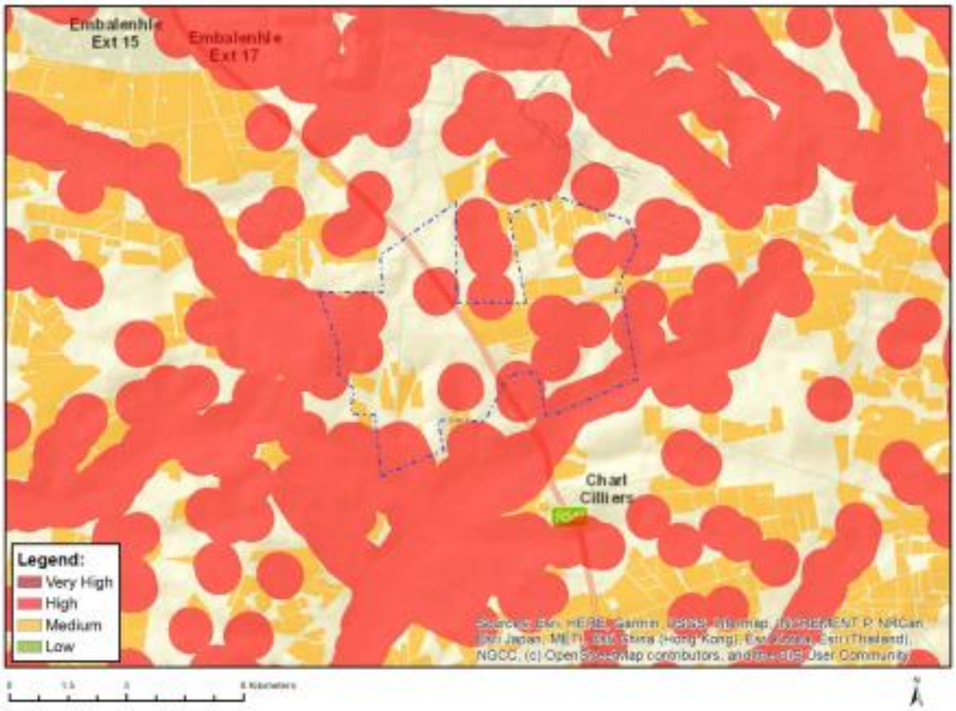


Figure 10-12: Avifaunal sensitivity zones (Chris van Rooyen Consulting, 2022)

10.1.8 BAT SENSITIVITY

The DFFE Screening Tool denotes areas of the Mukondeleli WEF site as High sensitivity with regards to with regards to being within 500m of a river and within 500m of a wetland; a “Medium sensitivity” is also denoted with regards to the presence of croplands (**Figure 10-13**)

MAP OF RELATIVE BATS (WIND) THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 500 m of a river
High	Wetland
High	Within 500 m of a wetland
Medium	Croplands

Figure 10-13: DFFE Screening Tool outcome for the bats (wind) theme

The Bat Specialist used Google Earth satellite imagery and verifications during site visits were used to spatially demarcate areas of the site with high and medium sensitivities relating to bat species ecology and habitat preferences, where high sensitivities and their buffers are no-go zones for turbines and turbine blade overhang (**Table 7-24** and **Table 7-25**). In other words, no turbine blades may intrude into high sensitivity buffers. Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity, but turbines are allowed to be constructed in medium sensitivity areas.

Figure 10-14 depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are most likely to occur on site.

During the Scoping Phase a total of 10 turbines were intruding into high bat sensitivity buffer. The EIA Phase turbine layout is respecting the bat sensitivity map and turbine positions were adjusted by the applicant to avoid high bat sensitivity buffers. Therefore, no turbines are intruding into any high bat sensitivity buffers with the EIA Phase layout.

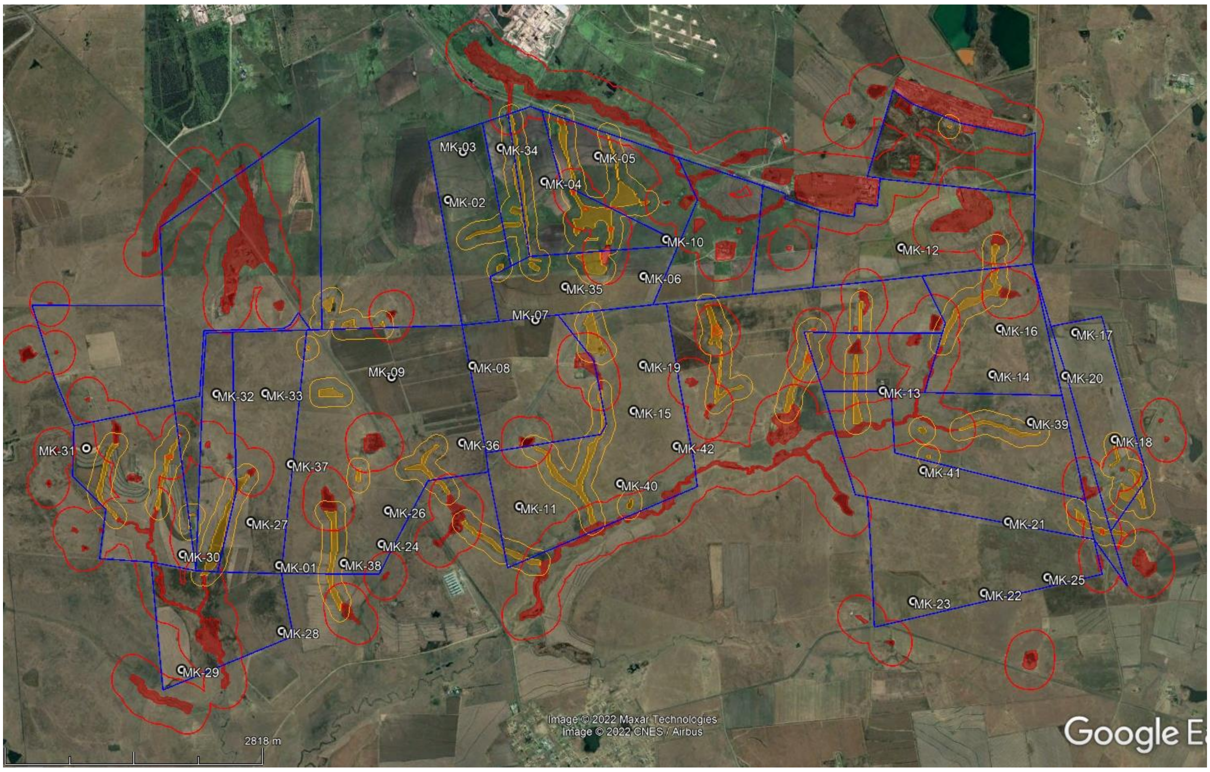
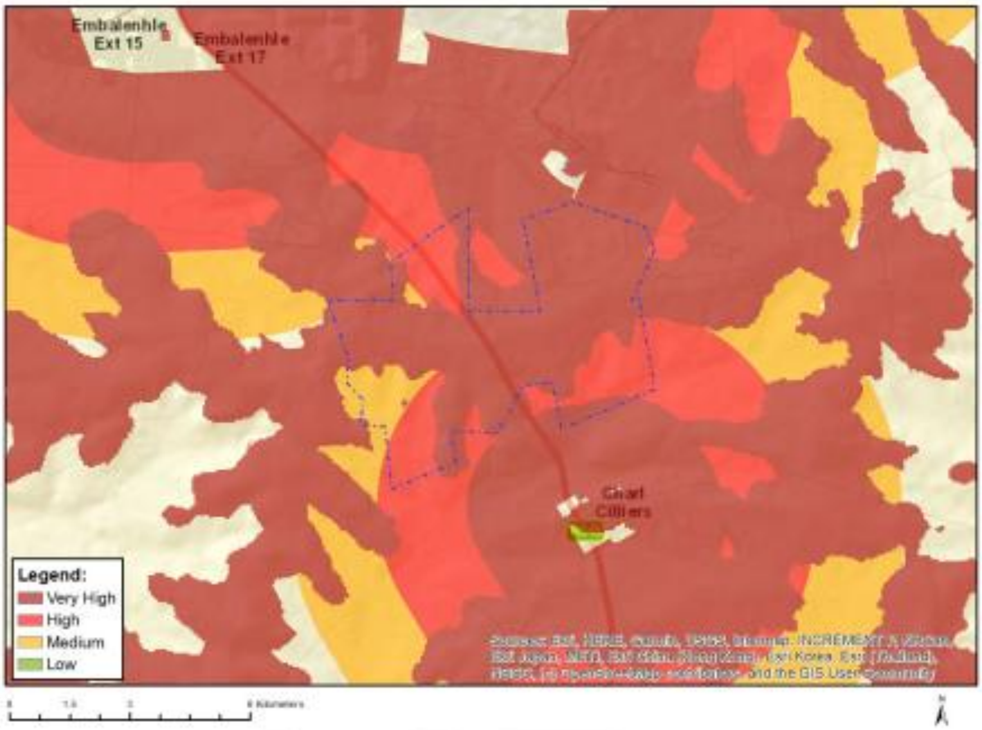


Figure 10-14: Bat sensitivity map of the site. Site area indicated in a blue boundary. Sensitivity polygons are provided in .kml format with this report. Shaded red = high sensitivity; Red line = 200m high sensitivity buffer; Shaded orange = moderate sensitivity; Or

10.1.9 VISUAL SENSITIVITY

In assessing the visual sensitivity of the proposed Mukondeleli WEF project area, consideration was given to the Landscape and Flicker Themes of the National Environmental Screening Tool. The Landscape Theme of the National Environmental Screening Tool identifies areas of very high sensitivity in respect WEF development in the Mukondeleli WEF project area (**Figure 10-15**). According to the Screening Tool, the project area is associated with “mountain tops and high ridges” and this factor has resulted in areas of “Very High” landscape sensitivity in the central and south and north-eastern sectors of the site.

MAP OF RELATIVE LANDSCAPE (WIND) THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

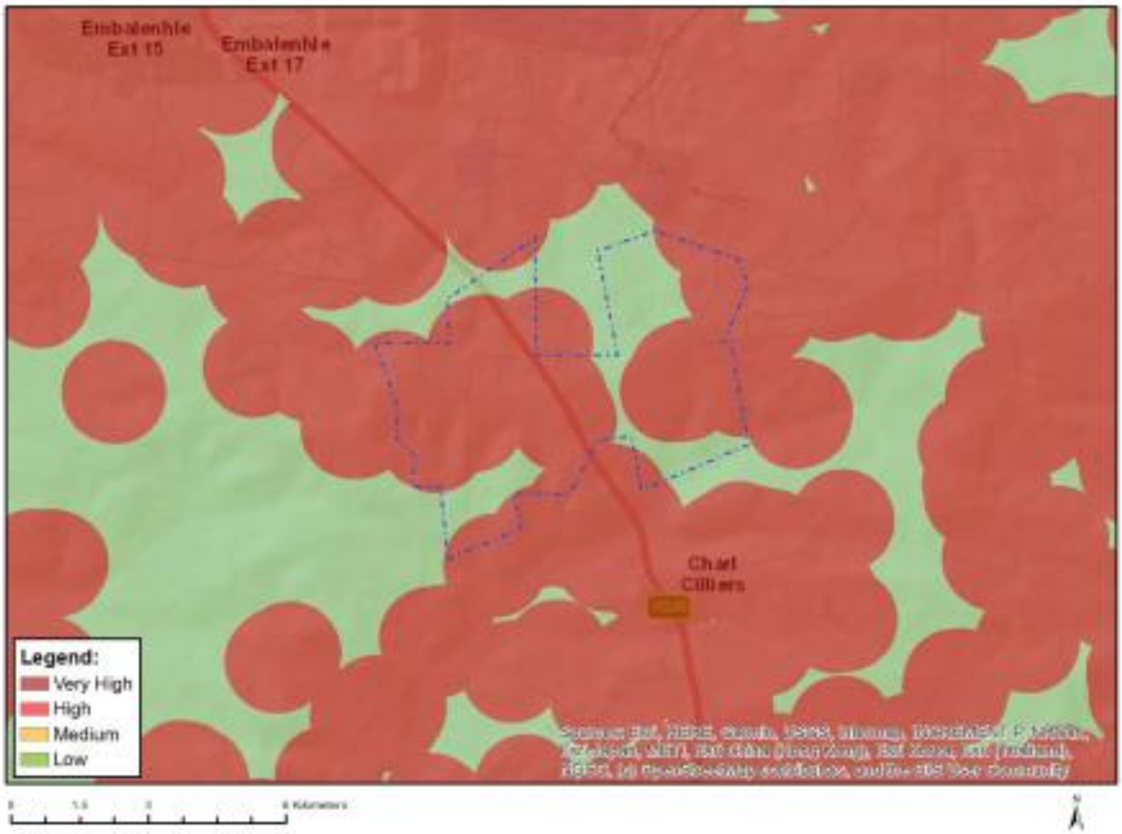
Sensitivity Features:

Sensitivity	Feature(s)
High	Slope between 1:4 and 1:10
High	Between 2 and 4 km of a town or village
Medium	Between 4 and 6 km of a town or village
Very High	Mountain tops and high ridges
Very High	Within 2 km of a town or village

Figure 10-15: Relative Landscape Sensitivity within the Mukondeleli WEF project area (April 2022)

The flicker theme demarcates areas (1 km buffers) of sensitivity around identified receptors in the area. Under this theme, potential flicker receptors have been identified on the site, or within 1 km of the site boundary. Buffers demarcated around these receptors have been assigned a “very high” sensitivity rating (**Figure 10-16**).

MAP OF RELATIVE FLICKER THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Area of low sensitivity
Very High	Potential temporarily or permanently inhabited residence

Figure 10-16: Flicker Sensitivity within the Mukondeleli WEF site (March 2022)

The Screening Tool is however a very high level, desktop assessment and as such the results of the study must be viewed against the findings of the field investigation as well as factors affecting visual impacts such as:

— the presence of visual receptors;
— the distance of those receptors from the proposed development;
— the likely visibility of the development from the receptor locations; and
— the degree of landscape transformation and / or degradation already present

Visual sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e., topography, landform and land cover), the spatial distribution of potential receptors, and the likely value judgements of these receptors towards a new development (Oberholzer: 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational or nature-based tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the receiving environment, a matrix has been developed based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer: 2005).

Based on the criteria in the matrix (**Table 10-2**), the visual sensitivity of the area is broken up into a number of categories, as described below:

- **i.** High **-** The introduction of a new development such as a WEF be likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these
- **ii.** Moderate – Receptors are present, but due to the nature of the existing visual character of the area and likely value judgements of receptors, there would be limited negative perception towards the new development as a source of visual impact.
- iii. Low **-** The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

The table below outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area

Table 10-2: Environmental factors used to define visual sensitivity of the study area

FACTORS	DESCRIPTION	RATING 1	2	3	4	5	6	7	8	9	10
Pristine / natural / scenic character of the environment	Study area is largely pastoral with some areas of scenic value, although some areas are significantly transformed.										
Presence of sensitive visual receptors	Few sensitive receptors have been identified in the study area, although several *potentially* sensitive receptors are present.										
Aesthetic sense of place / visual character	Visual character is a typical rural / pastoral landscape, although significantly transformed by urban / industrial development and mining activity.										
Irreplaceability / uniqueness / scarcity value	Few areas of scenic value were found within the study area.										
Cultural or symbolic meaning	Much of the area is a typical rural / pastoral landscape, although areas have been heavily transformed.										
Protected / conservation areas in the study area	No protected or conservation areas were identified in the study area.										
Sites of special interest present in the study area	No sites of special interest were identified in the study area.										
Economic dependency on scenic quality	No tourism/leisure-based facilities were found in the area										
International / regional / local status of the environment	Study area is typical of rural / pastoral landscapes, although significantly transformed by urban / industrial development and mining activity.										
**Scenic quality under threat / at risk of change	Introduction of a WEF will alter the visual character and sense of place, giving rise to significant cumulative impacts										

**Any rating above '5' for this specific aspect will trigger the need to undertake an assessment of cumulative visual impacts.

KEY

LOW					MODERATE					HIGH
10	20	30		40	50	60	70	80	90	100

Based on the above factors, the total score for the study area is 32, which according to the scale above, would result in the area being rated as having a LOW visual sensitivity. It should be stressed however that the concept of visual sensitivity has been utilised indicatively to provide a broad-scale indication of whether the landscape is likely to be sensitive to visual impacts and is based on the physical characteristics of the study area, economic activities and land use that predominates. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs and this has been factored into the sensitivity rating above. However, no formal protected areas, and very few leisure-based tourism activities or sensitive receptor locations were identified in the study area.

During the Scoping Phase of the EIA process, all project specialists were requested to indicate environmentally sensitive areas within the WEF project area. The aim of this exercise was to demarcate any areas that should be precluded from the WEF development footprint. From a visual perspective, sensitive areas would be those where the establishment of wind turbines would result in the greatest probability of visual impacts on potentially sensitive visual receptors.

Using GIS-based visibility analysis, it was possible to determine that the tip of at least one turbine blade (I.e., at a maximum height of 300m) would be visible from many of the identified potentially sensitive receptors in the study area and as such, no areas on the site are significantly more visible than the remainder of the site. However, the visual prominence of a very tall structure such as a wind turbine would be exacerbated if located on higher ridges or relatively higher-lying plateaus on the site. From a visual perspective therefore, it would be preferred if wind turbines are not located on the highest ridges within the WEF development area, although it is understood that these locations are often the most suitable in terms of wind yield. While these ridges could be seen as areas of potentially high visual sensitivity, the study area as a whole is rated as having a low visual sensitivity, and as such, the sensitivity rating would be reduced to "Medium". Hence the ridges are not considered to be "no go areas", but rather should be viewed as zones where turbine placement would be least preferred.

From a visual perspective, another concern is the direct visual impact of the turbines on any farmsteads or receptors located on, or within 500m of the application site. Accordingly, a 500m zone of potential visual sensitivity has been delineated around the existing residences on the application site and also around any receptors located within 500m of the site boundary. In addition, it is recommended that sensitivity zones are applied along certain roads, specifically a 500m zone on either side of the R546 Main Road and a 300m zone on either side of the D823 and D863 district roads which traverse the WEF project area.

Limiting the development of wind turbines in these areas will reduce visual impacts and prevent significantly adverse impacts of flicker on the local residents and on passing motorists, although the full extent of these impacts can only be determined by way of a Flicker Impact Assessment. At this stage however, the visual sensitivity zones are not considered "no go" areas, but rather should be viewed as zones where development should preferably be limited. It should be stressed that these zones apply to turbine development only. The visual impacts resulting from the associated on-site infrastructure are considered to have far less significance when viewed in the context of the WEF as a whole and as such the associated on-site infrastructure has been excluded from the sensitivity analysis.

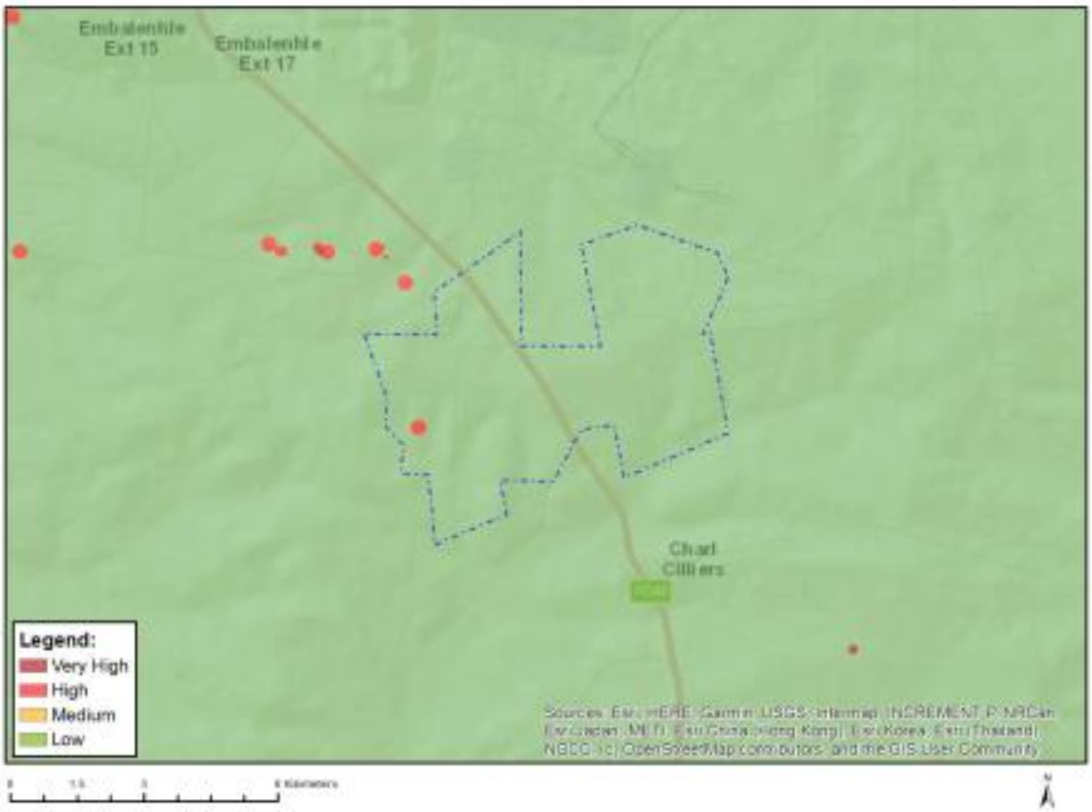
Although the Screening Tool identifies significant areas of very high landscape and flicker sensitivity within the Mukondeleli WEF project area, the site sensitivity verification exercise conducted in respect of this VIA (Appendix D) did not indicate the presence of mountaintops, high ridges or any significantly steep slopes. This assessment, confirmed by the field investigation, showed the presence of low ridges and plateaus in a largely undulating landscape. The sensitivity analysis above has recognised these ridges and identified the higher ridges as zones where development would be least preferred.

The presence of receptors, either on the Mukondeleli WEF application site, or within 1km of the site boundary, was confirmed by the site sensitivity verification exercise. However, an assessment of receptor locations using Google Earth showed that there were no receptors present at some of the locations identified by the National Screening Tool. The remaining (confirmed) receptors were factored into the sensitivity analysis, together with a 500m buffer which is considered sufficient to reduce any adverse effects of shadow flicker. It should be noted that most of the affected receptors are not expected to be sensitive to the proposed development due to the fact that they are located within the WEF project area and it is assumed that the relevant land owners support the proposed project.

10.1.10 HERITAGE SENSITIVITY

Based on the DFFE Screening Tool the Mukondeleli WEF site is classified as Low sensitivity with regards to the archaeological and cultural heritage theme, with the exception of one small area of high sensitivity in the west that appears to be associated with a farmstead where heritage resources were found (**Figure 10-17**).

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 150m of a Grade IIIa Heritage site
Low	Low sensitivity

Figure 10-17: DFFE Screening Tool outcome archaeological and cultural heritage theme sensitivity

The site visit showed that in fact the majority of the site is of low sensitivity but that a number of small areas (where heritage resources were found) considered to be of medium to high sensitivity. **Figure 10-18** shows the areas considered to be sensitive from a heritage point of view. Medium to high cultural significance site (orange and red) can be considered high sensitivity while low cultural significance sites can be considered as being of medium sensitivity.

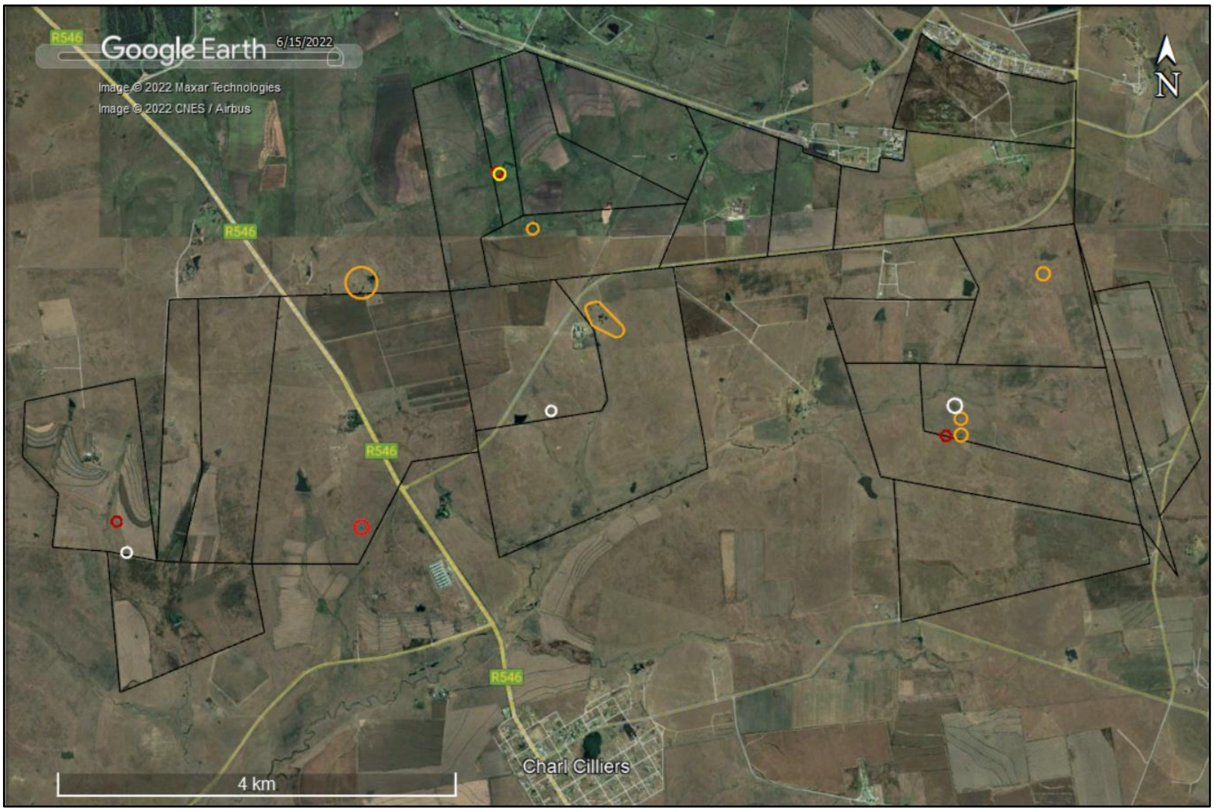
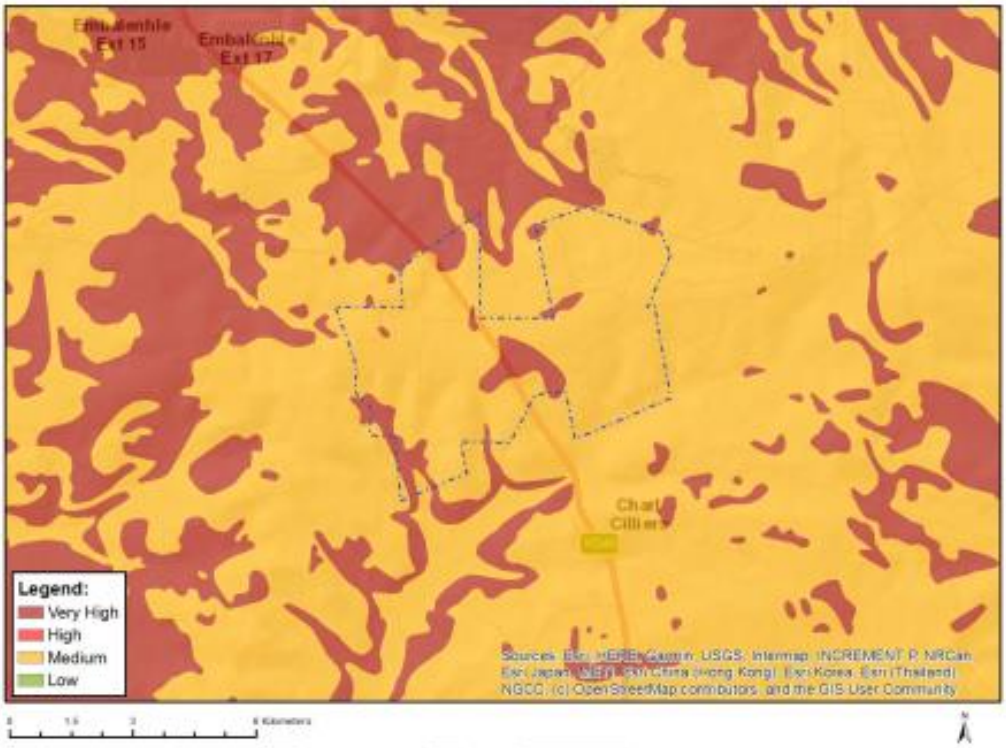


Figure 10-18: Grade map of the study area showing the locations of all sites found. They are coloured as follows: Graded IIIA = dark red, GPA = orange, GPB = yellow and GPC = white.

10.1.11 PALAEONTOLOGY SENSITIVITY

Based on the DFFE Screening Tool the Mukondeleli WEF site is classified as Very High Sensitivity with regards to the palaeontology theme, due to the occurrence of features with Very High Palaeontological sensitivity (**Figure 10-19**).

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 10-19: DFFE Screening Tool outcome palaeontology theme sensitivity

The palaeontological sensitivity of the area under consideration is presented in **Figure 10-20**. The site for development mainly is in the Jurassic dolerite but there are a few outcrops of the Vryheid Formation.

The **Vryheid Formation** lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins, but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. There are also delta-front deposits, evidence of delta switching, and fluvial deposits with associated meandering rivers, braided streams, back swamps or interfluves and abandoned channels (Cadle et al., 1993; Cairncross, 1990; 2001; Johnson et al., 2006). Coal seams originated where peat swamps developed on broad abandoned alluvial plains, and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

Since dolerite is an igneous (volcanic) rock, it does not preserve any fossils. In fact, the dolerite usually destroys any fossils in its near vicinity that were present in the sediments through which it has intruded.

Figure 10-20: SAHRIS palaeosensitivity map for the site for the proposed Mukondeleli WEF (within the white polygon. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

10.2 SENSITIVITY MAPPING

A consolidated environmental sensitivity map (**Figure 10-21** and **Figure 10-22**) has been compiled based on the sensitivities and buffers outlined in the specialist studies.

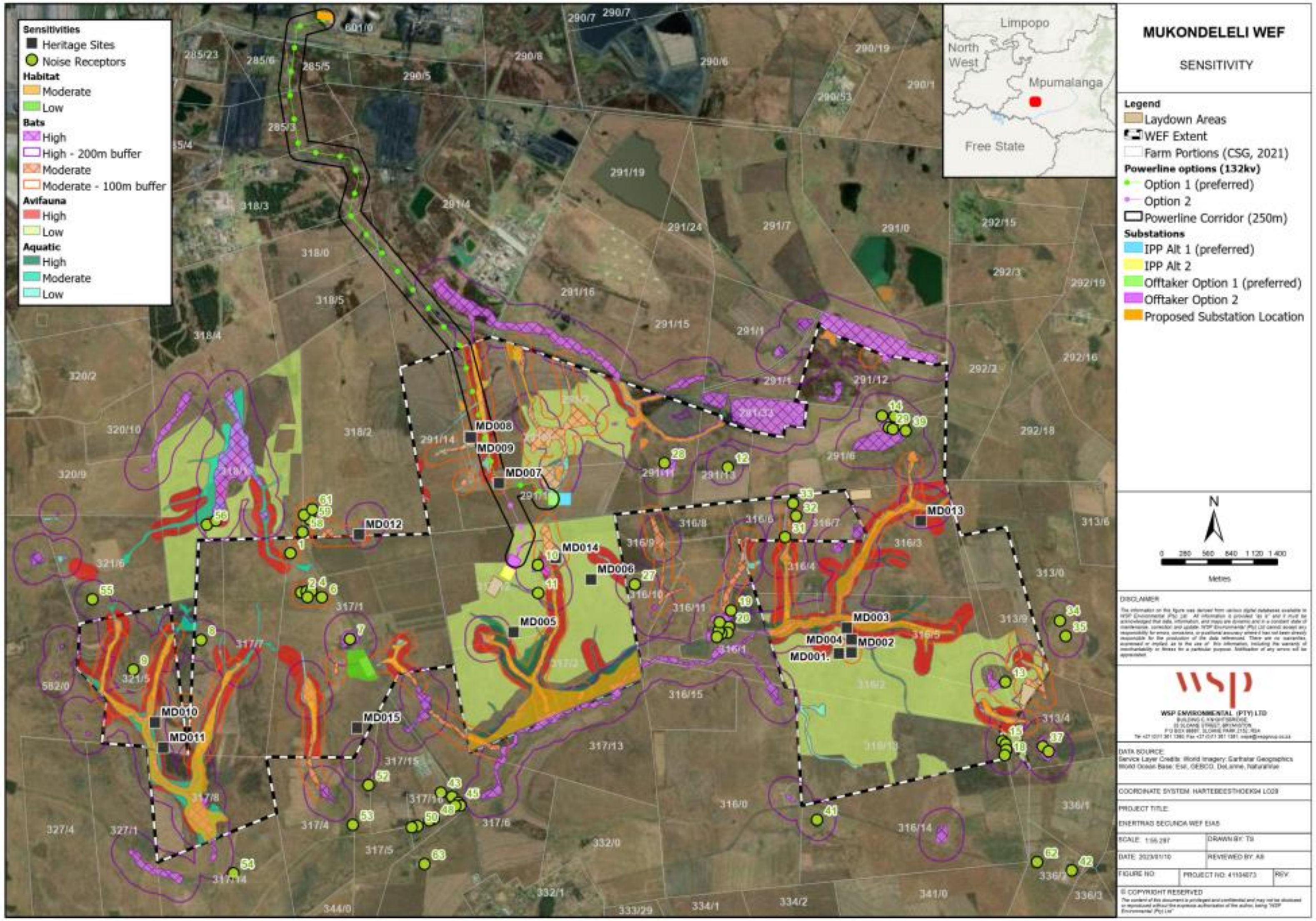


Figure 10-21: Combined Environmental Sensitivity Map

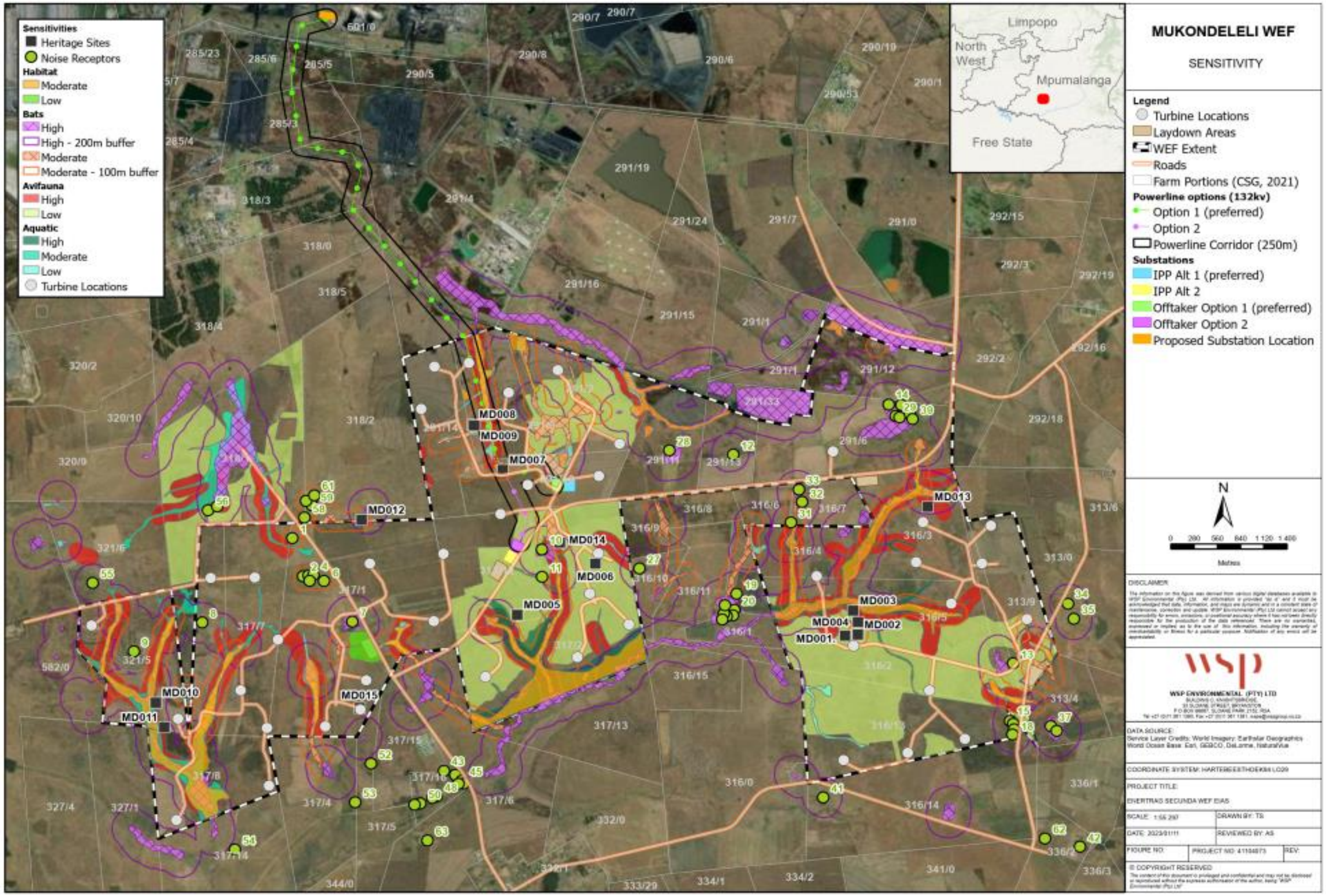


Figure 10-22: Site Layout overlain onto Environmental Sensitivity Map

10.3 SPECIALIST CONCLUSIONS

10.3.1 NOISE IMPACT ASSESSMENT

It was determined that the potential noise impacts, without mitigation, would be:

- of a **low significance** for the daytime construction activities (hard standing areas, excavation and concreting of foundations and the erection of the wind turbines and other infrastructure);
- of a **moderate significance** for the night-time construction activities. Mitigation is available to reduce the significance of the noise impact to **low**;
- of a **low significance** for daytime operational activities (noises from wind turbines) when considering the worst-case SPL; and
- of a **moderate significance** for night-time operational activities (noises from wind turbines) when considering the worst-case SPL. Mitigation is available and included in this report that would result in a reduction in noise levels, as well as the significance of the noise impact to **low**.

There is no potential for a cumulative noise impact from other WEFs in the area, with the noise modelling considering the cumulative effect from numerous WTG operating simultaneously.

Because the projected noise levels are higher than 42 dBA, active noise monitoring is recommended once before the construction phase, as well as once during the operational phase.

While there may be a noise impact of **moderate** significance during the night-time operational phase (as well as **moderate** for night-time construction activities), this can be reduced to a **low** significance with the implementation of the recommended mitigation measures.

The proposed layout (turbine placement) may not be acceptable from a noise perspective, though slight changes in the layout, coupled with the use of a quieter WTG will ensure that the total noise levels are less than 45 dBA at all structures used for residential purposes. If the applicant can reduce the noise levels to less than 45 dBA at all receptors (structures used for residential purposes), it is recommended that the proposed Mukondeleli WEF and associated infrastructure project be authorized.

It is recommended that the applicant remodel the updated layout once mitigation measures are selected to ensure that noise levels are less than 45 dBA at all NSR. No further noise studies are required, although it is recommended that the applicant implement a noise monitoring programme as recommended in this report.

It should be noted that the applicant must re-evaluate the noise impact:

- should the layout be revised where:
  - any WTG, located within 1,500 m from an identified and verified NSR, are moved closer to the NSR;
  - any new WTG are introduced within 1,500 m from an identified and verified NSR;
  - the number of WTG within 2,000 m from any identified and verified NSR are increased; and
- should the applicant make use of a wind turbine with a maximum SPL exceeding 109.0 dBA re 1 pW.

To ensure that noise does not become an issue for future residents, landowners or the local communities, it is recommended that the applicant get written agreement from current landowners/community leaders that:

- no new residential dwellings will be developed within areas enveloped by the 42 dBA noise level contour, and
- structures located within the 45 dBA noise level contour should not be used for residential use.

10.3.2 GEOTECHNICAL DESKTOP ASSESSMENT

The geotechnical assessment considered the entire development but the three main parts of the development, namely large structures (turbines), cable trenches and access roads were the primary consideration. From a geotechnical perspective the impact of the Mukondeleli WEF was found to be "*Negative moderate to low* *impact* - The anticipated impact will have negative effects and will require mitigation." With mitigation measures the impact will be "*Negative very low*".

The WEF application site is considered suitable for the proposed development provided that the recommendations presented in this report are adhered too and which need to be verified by more detailed geotechnical investigations during detailed design.

A detailed intrusive site investigation is recommended to further characterize site conditions, to better understand the key geotechnical risks characteristics in order to refine the development of the WEF. Based on the current lack of previous geotechnical investigation data, the primary objectives of the proposed intrusive investigation must include:

— Determination of the founding conditions for all structures. The scope of the intrusive investigation should comprise test pitting, the drilling of a representative number of boreholes and laboratory testing
— Investigation of subgrade conditions for service roads
— Investigation for materials to be used during construction
— Non-intrusive investigation techniques, such as geophysical (seismic refraction) surveys, thermal and electrical resistivity for ground earthing requirement

Based on WSP's overall desktop study, the proposed Mukondeleli Wind Energy Facility site is suitable for the operation of a WEF.

The completed desktop assessment of the geotechnical conditions at the proposed development site and grid servitude of the Mukondeleli WEF has shown the site to be generally suitable for the proposed development. The proposed development should, from a geotechnical impact perspective, be authorized. There is no preferred grid servitude option with respect to the geotechnical impact assessment.

A geotechnical site investigation must be undertaken to provide detailed geotechnical information for the design of the proposed structures and roads.

The most significant geotechnical condition that will affect the development is the expected hard excavation conditions where shallow rock is present.

Minimal slope stability issues are expected as slope areas are minimal. Access roads can be developed as gravel road with suitable wearing-course to protect the subgrade likely being obtained from local weathered dolerite rock deposits.

10.3.3 AGRICULTURE ASSESSMENT

The conclusion of the Agricultural Assessment is that the agricultural impact of the proposed development is acceptable because it offers a valuable opportunity for renewable energy development with very little loss of future agricultural production potential.

This is substantiated by the following points:

— The proposed development will only exclude an insignificantly small proportion of the land from agricultural production. The amount of agricultural land loss is well within the allowable development limits prescribed by the agricultural protocol. These limits reflect the national need to conserve valuable arable land and therefore to steer, particularly renewable energy developments, onto land of lower production potential.
— The proposed development will generate a reliable additional income that will improve the financial security for farming operations on the site, without significantly compromising the existing farming production or income.
— The proposed development offers security benefits against stock theft and other crime.
— The proposed development offers an improved road network, with associated storm water handling system, that can be used for farming operations.
— It is the net sum of positive and negative effects that determines the overall agricultural impact. Tiny losses of agricultural land are likely to be more than compensated for by the positive impacts, so that the net overall impact is likely to be positive.
— The proposed development poses a low risk in terms of causing soil degradation, which can be adequately and fairly easily managed by standard, best-practice management actions.

- The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.
- In addition, the proposed development will contribute to the country's urgent need for energy generation, particularly renewable energy that has much lower environmental and agricultural impact than existing, coal powered energy generation.
- All renewable energy development in South Africa decreases the need for coal power and thereby contributes to reducing the large agricultural impact that open cast coal mining has on highly productive agricultural land throughout the coal mining areas of the country.

The impact of the proposed development on the agricultural production capability of the site is assessed as being acceptable because of the above factors. Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

The conclusion of this assessment on the acceptability of the proposed development and the recommendation for its approval is not subject to any conditions, other than recommended mitigation.

10.3.4 AQUATIC IMPACT ASSESSMENT

The desktop assessment indicated that the study site is situated in an area which has conservation significance in both national as well as provincial level.

A large number of wetlands were recorded on the study site. The wetlands were divided into several types including:

- Seepage wetlands;
- Valley Bottom Wetlands; and
- Depressional Pan wetlands.

The wetlands fall into three distinct catchment areas, with wetland 1-8, all located in catchment C12E and all draining into Boesmanspruit System. Furthermore, wetland 7 forms the headwaters of the Boesmanspruit System. Wetland 9 and 10 are located in the catchment C11K and drains into the Leeuspruit System. Lastly the remaining wetlands (Wetland 11-19) all drain into the Grootspruit System. Wetland 20 and 21 are also located in catchment C12E but are hydrologically isolated as pan wetlands that drain inward and does not flow into any nearby wetland system.

The desktop assessment conducted by DWS indicated that the sub quaternary reaches surrounding the study site are largely natural (B) to moderately modified (C). The site verification indicated that the wetlands are moderately (C) to seriously modified (E) whilst the aquatic macroinvertebrates indicated that the aquatic ecosystems are mostly seriously/critically (E/F) modified with only one tributary of the Grootbossiespruit being largely natural (B). Therefore, the wetland and aquatic ecosystems surrounding the study site are more impacted than expected.

Four Wind Energy Turbines was found to be recorded within a wetland itself, or within a wetland buffer. All of these structures are located near to agricultural land and should ideally be moved between 20-100 m in each case to protect the watercourses. It is recommended that the layout of the proposed Mukondeleli WEF be refined to exclude the wetlands as well as their respective buffer zones. This will be one of the major mitigation measures proposed and will have a significant influence on the impact of the WEF, the remainder of the structures are well enough buffered to have minimal impacts on the wetlands and although the majority still remain within the DWS regulated area of 500 m, some are located distances of 500 m or more from a wetland and thus has very little chance of impacting on any watercourse.

Prior to the proposed mitigation measures most impacts rated moderate and post mitigation they ranked low in both the construction and operational phase. Cumulative impacts include the impacts of the proposed Mukondeleli WEF in combination with the other projects within a 50 km radius. Similarly, if the wetlands and buffer zones are excluded, where possible from the proposed Mukondeleli WEF and grid routings (subject to separate applications) as well, the impacts should be reduced significantly.

If the proposed mitigation measures are adhered to and the design layout of the six Wind Energy Structures that is currently located in wetlands or wetland buffer is moved into degraded areas such as agricultural lands to avoid encroachment on the wetland and wetland buffer zones the proposed development is supported by the specialist.

10.3.5 TERRESTRIAL BIODIVERSITY ASSESSMENT

Provided all mitigation measures and management actions proposed to conserve protected fauna and flora on the site, are taken into consideration, and the positioning of some wind turbines are amended to avoid sensitive habitats, the resulting low sensitivity rating and low impact significance for many of the habitats means the project could go ahead. We thus recommend authorisation of the project provided all mitigation measures are implemented.

A brief summary of the most important considerations is provided below:

- Vegetation and flora:
  - Screening Tool: Our field survey and application of a sensitivity model indicated that most of site had a low sensitivity. None of the SCC highlighted by the screening tool were recorded on site.
  - Vegetation types: The Soweto Highveld Grassland vegetation type is listed as "Vulnerable" and consequently the layout of the wind infrastructure should give preference to the habitats on site where past disturbance has occurred e.g. disturbed areas, cultivated cropland or abandoned cropland.
  - Threatened plant species: No IUCN threatened or red-listed plant species were encountered during the field survey.
  - Protected plant species: No ToPS species or protected tree species were recorded on site. A number of Mpumalanga protected species were recorded on site, but none with a threatened IUCN status.
  - CITES: *Aloe ecklonis, Aloe transvaalensis* and *Euphorbia clavarioides* were the CITES species recorded on the Mukodeleli site.
  - Habitats: Four of the six habitats on site had a low sensitivity rating with one habitat (Habitat 1) rated as of medium sensitivity (rocky sheets and rocky outcrops). The wetland habitat (Habitat 7) had a high sensitivity.
  - Overall sensitivity of plant theme based on the status of the habitats (plant communities): Rated as low. Some infrastructure should be repositioned to habitats of low sensitivity and to avoid CBAs.
- Fauna (avifaunal and bat components excluded):
  - Screening Tool: The species that were highlighted by the Screening tool, viz. the Maquassie musk shrew (*Crocidura maquassiensis*) and *Lepidochrysops procera* were not encountered on site and are not listed on the ADU database for the region.
  - Threatened animal species: The giant girdled lizard (*Smaug giganteus*) is listed for the region on the ADU database, but was not highlighted by the Screening Tool. No individuals were recorded on site. As a precautionary measure, it is recommended that a survey should be done for this reptile once the proposed final layout has been established.
  - Near Threatened species: three Near Threatened mammal species are reported for the site, according to the landowners. i.e. the serval (*Leptailurus serval*) and the Southern African hedgehog (*Atelerix frontalis*). None of these species were however highlighted by the Screening Tool.
  - Overall sensitivity of animal theme (avifaunal and bat components excluded): This is rated as medium. If the suggested mitigation measures are followed the animal SCC should not be negatively affected.
- Conservation:
  - Protected Areas: The study area is not located in a protected area.
  - National Protected Areas Expansion Strategy (NPAES): The development will not interfere with the protected areas expansion strategy according to the NPAES spatial data of 2010. The site is also not earmarked in the 5-year plan of the Mpumalanga PAES (data supplied by M. Lötter, MTPA).
  - Critical Biodiversity Areas (CBAs): MK11, MK24, MK26, MK28, MK36, MK37 & MK39 must be microsited prior to approval of final layout such that the site can be groundtruthed and any sensitive areas are avoided.
  - Ecological Support Areas (ESAs): There are ESAs (Landscape and Local corridors) distinguished within the boundary of the Mukondeleli site.
  - Freshwater Ecosystem Priority Area (FEPA): FEPAs or water catchments were not flagged by the screening tool. Based on the site assessment of the vegetation most of the area mapped as upstream river FEPA was rated as having a low sensitivity, with only the drainage lines having a high sensitivity. The wetland FEPAs were largely incorporated into the delineation of the CBAs.

- Mpumalanga Highveld wetlands: These wetlands were largely incorporated into the delineation of the CBAs (refer to aquatic specialist report for wetlands).
- Ecological processes, function and drivers:
  - Overall, it is unlikely that the development will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.
  - The disturbance caused by the construction of the WEF will inevitably create conditions favourable for invasion by alien species.
  - Fire is an important driver of vegetation dynamics in the Grassland Biome and can occur when the fuel load is high. To avoid damage to the infrastructure, fire will have to be suppressed. If the grass layer is regularly mowed/brush cut, it should prevent grasses from becoming moribund in the absence of fire, although regular mowing could affect seed set.

Overall the significance of the environmental impacts was rated as low to moderate. In summary:

- Since the turbine footprint is relatively small and spread across the site, the loss of prime habitat within the Soweto Highveld Grassland vegetation type can be constrained by well-planned positioning of the turbines. Service roads generally have a larger impact on vegetation clearance, however since the roads will have a gravel surface animal movement should not be impaired. Beyond the permanent infrastructure footprint, environmental functions and processes should however, not be altered.
- From an ecological point of view, large portions of the site have been heavily modified and not prime examples of the Soweto Highveld Grassland. If the development is thus contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered for the allocation of a vulnerable status of the vegetation type.
- Habitat 7 was rated as highly sensitive in the current assessment. No turbines are located in this habitat.
- Most of the habitats covered by the proposed infrastructure were rated as having a low sensitivity with a small section having a medium sensitivity. The area of medium sensitivity was avoided in the layout.
- None of the species highlighted by the screening tool were encountered on site, thus the impact on populations of threatened or protected species will be negligible if all mitigation measures are applied.
- The giant girdled lizard (Smaug giganteus) is listed for the region on the ADU database, but was not highlighted by the Screening Tool. No individuals were recorded on site. As a precautionary measure, it is proposed that a survey by a herpetologist should be done for this reptile to establish the presence/absence of the species once the proposed final layout has been established.
- Depending on the type of fencing to be erected at some of the infrastructure, the WEF will contribute minimally to obstruction of animal movement.

10.3.6 AVIFAUNA ASSESSEMENT

The proposed Mukondeleli WEF could have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collision mortality caused by the wind turbines in the operational phase.
- Electrocution on the 33kV MV overhead lines in the operational phase.
- Collisions with the 33kV MV overhead lines in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase

The proposed Mukondeleli WEF could have a **high** to **moderate** impact on avifauna which, in most instances, could be reduced to a **low** through appropriate mitigation, although some moderate residual impacts will still be present after mitigation. No fatal flaws were discovered during the onsite investigations. The proposed WEF development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

10.3.7 BAT ASSESSMENT

The Bat Environmental Impact Assessment Report considered information gathered from site visits between November 2020 and December 2021, the scientific literature, and satellite imagery. The bat species most likely to be impacted on by the proposed Impumelelo WEF are *Miniopterus natalensis, Laephotis* (formally *Neoromicia*) *capensis* and *Tadarida aegyptiaca*. These species are of special importance based on their likelihood of being impacted by the proposed WEF, due to high abundances and certain behavioural traits. They have also been dominating records of fatalities at wind energy facilities in South Africa. These more abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers.

Roosting and foraging habitats may be significantly impacted during the construction phase of this project. This is primarily due the fact that such facilities require large areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts. Natural vegetation can support higher insect food quantities and diversity than cleared land, therefore foraging habitat can also be displaced.

At its nearest, the dolomitic geology of the greater area extends to approximately 48km north-west of the WEF. Dolomite is known to be prone to good cave formation, and many bat colonies are supported in such caves in the country, particularly in the province of Gauteng. Museum records of bats collected from one cave within approximately 100km of the site exist. Specimens of *Rhinolophus clivosus*, *Cloeotis percivali*, and *Miniopterus natalensis* were collected from Wonderboom cave (95km to the north), although the Strategic Environmental Assessment (SEA) wind energy buffer of 50km for large bat roosts does not extend to the area of influence around the proposed Impumelelo WEF. Should any possible cave/roost locations be found to be supporting large enough bat colonies within 50km of the proposed site, this will have implications for the development.

The High Bat Sensitivity areas designated by the specialist in the Sensitivity Map supplied with this report are expected to have elevated levels of bat activity and support greater bat diversity. High Bat Sensitivity areas and their buffers are 'no–go' areas due to expected elevated rates of bat fatalities due to wind turbines. Avoidance is the most effective mitigation measure for reducing the impact on bats, and should be implemented as the first layer of mitigation. No turbine blades may intrude into high sensitivity buffers, therefore turbine base points must be a minimum of 100m from the high bat sensitivity buffer edge (considering the proposed 200m rotor diameter). Medium sensitivities indicate areas of probable increased risk due to seasonal fluctuations in bat activity, but turbines are allowed to be constructed in medium sensitivity areas. Table 4-3 provides details on the significance of the sensitivity criteria on each infrastructure type. The bat sensitivity map has been respected and turbine layouts adjusted by the applicant to avoid high bat sensitivity buffers.

The site is located in the Highveld Grasslands ecoregion according to Olson *et al.* (2012), and this ecoregion is not covered in the pre-construction guidelines. Therefore, the bat mortality risk cannot be assigned according to the guidelines in MacEwan *et al.* (2020) utilising median average hourly bat passes, and the probability of active mitigations being required during operation need to be determined by the results of the operational mortality monitoring.

The most effective and required method of mitigation (after adhering to the sensitivity map) can be determined from pre-construction acoustic bat activity data, climatic data and the results from the operational bat mortality monitoring. The operational bat mortality monitoring will determine the need for mitigation. If required, the specific turbines to be mitigated, in combination with the data from the pre-construction and operational studies, will enable a detailed mitigation schedule to be implemented as needed. The months when mitigation is most likely to be necessary, are indicated by the data to be 1 October – 30 April. The prominent bat activity peaks detected across all systems for certain are likely to be due to weather conditions being favourable to bats and their insect prey during such months. Such favourable weather conditions may occur when low wind speeds coincide with higher temperatures.

The presence of security lights on and around these facilities creates significant light pollution that can impact bat feeding habits and species compositions negatively, by artificially discouraging photophobic (light averse) species and favouring species that readily forage around insect-attracting lights. Additionally, if the buildings and associated infrastructure for these facilities are placed close to wind turbines, the light pollution at these buildings can attract photophilic bat species, thereby significantly increasing their chances of being killed by moving blades of turbines within close proximity.

Cumulative impacts at Mukondeleli WEF can be mitigated by the same mitigation applied to the Impumelelo WEF for most identified impacts. This should be considered during the turbine layout design phase of the Impumelelo WEF.

The pre-construction bat monitoring has now been completed and informs the EIA phase; passive bat activity data has been gathered, which provides comparative bat activity and species assemblages across all seasons as well as various habitats, terrain and/or areas of the site. If the proposed WEF is approved, a minimum of 2 years of operational bat mortality monitoring should be conducted from the start of the operation of the facility.

From a bat impact perspective, if all recommended mitigation measures are adhered to and included in the EMPr and operational monitoring is carried out, no reasons have been identified for the Mukondeleli WEF development not to receive Environmental

10.3.8 VISUAL AND LANDSCAPE ASSESSMENT

A visual study was conducted to assess the magnitude and significance of the potential visual impacts associated with the development of the proposed Mukondeleli WEF near Secunda in Mpumalanga Province. The VIA has demonstrated that the study area has a somewhat mixed visual character, transitioning from the heavily transformed urban / peri-urban landscape associated with the Embalenhle and Secunda urban areas, the Sasol Secunda fuel plant and associated infrastructure in the north / north-west to a more rural / pastoral character across the remainder of the study area. Hence, although a WEF development would alter the visual character and contrast with this rural / pastoral character, the location of the proposed WEF in relatively close proximity to Embalenhle, Secunda the Sasol fuel plant and associated mining activity will significantly reduce the level of contrast.

A broad-scale assessment of visual sensitivity, based on the physical characteristics of the study area, economic activities and land use that predominates, determined that the area would have a low visual sensitivity. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. No formal protected areas were identified and the area is not typically valued for its tourism significance. In addition, very few leisure-based tourism facilities (lodges/accommodation facilities) were identified inside the study area and this factor in conjunction with the high levels of transformation in the north-west have reduced the overall visual sensitivity of the broader area.

A total of ninety-seven (97) potentially sensitive receptors were identified within 10 km of the proposed Mukondeleli WEF project area, all of which are inside the viewshed for the proposed turbines. Ten of these receptors are however more than 10kms from the nearest wind turbine. Two of the remaining receptors, namely Rhino Game Lodge (SR1) and Zorgen Vrij Wedding Venue (SR2) were found to be linked to leisure / tourism facilities and are therefore considered to be sensitive. However, both of these receptors are expected to experience only moderate levels of visual impact as a result of the proposed WEF.

Most of the remaining eighty-three (83) locations are assumed to be farmsteads and residences which could be regarded as potentially sensitive visual receptors as they are located within a mostly rural setting with pastoral / natural vistas that will likely be altered by the proposed development. Five (5) of these potentially sensitive receptor locations (VR27, VR39, VR73, VR93. And VR94) are expected to experience high levels of visual impact, although two of these (VR27 and VR94) are located within the Mukondeleli WEF project area and as such the respective landowners are not expected to perceive the proposed development in a negative light

Fifty-six (56) receptor locations are expected to experience moderate levels of impact as a result of the Mukondeleli WEF development, although five of these are located within the Mukondeleli WEF project area and the respective landowners are not expected to perceive the proposed development in a negative light. The remaining twenty-two (22) receptors would only experience low levels of visual impact.

Although the R546 and R50 receptor roads traverse the study area, motorists travelling along these routes are only expected to experience moderate impacts from the proposed Mukondeleli WEF

A preliminary assessment of overall impacts revealed that impacts associated with all the proposed Mukondeleli WEF are of low significance during both construction and decommissioning phases. During operation however, visual impacts from the WEF would be of moderate significance with relatively few mitigation measures available to reduce the visual impact.

Considering the presence of the Sasol fuel plant and associated mining activity and the proposals for other renewable energy facilities in the broader area, the introduction of new renewable energy facilities in the area will result in further change in the visual character of the area and alteration of the inherent sense of place, extending an increasingly industrial character into the broader area, and resulting in significant cumulative impacts. It is however anticipated that these impacts could be mitigated to acceptable levels with the implementation of the recommended mitigation measures. Considering this, cumulative impacts have been rated as moderate.

A comparative assessment of site alternatives for the on-site Substation / BESS was undertaken in order to determine which of the alternatives would be preferred from a visual perspective. No fatal flaws were identified in respect of either of the site alternatives and both alternatives were found to be Favourable.

From a visual perspective therefore, the proposed Mukondeleli WEF project is deemed acceptable, and the Environmental Authorisation (EA) should be granted. SLR Consulting is of the opinion that the visual impacts associated with the construction, operation and decommissioning phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

10.3.9 HERITAGE ASSESSMENT

Although archaeological materials were seen in various places, these were infrequent and are of generally low to medium significance. A few more important sites also occur and have been avoided by the turbine layout. The primary concern for any project in this area is graves and one likely graveyard is under threat from turbine MK-24. With so little of the layout surveyed there is always a chance that more graves may come to light. Aside from this one likely graveyard, there are no significant concerns for this project based on current knowledge, but a pre-construction survey will be very important to minimise potential impacts, especially considering that the full layout is as yet unknown. A good number of turbines are within ploughed lands and these are considered as being of very low sensitivity and would not need to be checked by the pre-construction survey.

Although the expected impacts are the same for both substation alternatives, Alternative 1 is marginally preferred simply because it is located slightly further from the public road.

The vast majority of the study area is, or is likely to be, of low sensitivity. Micro-siting of infrastructure during the final EMPr approval stage is likely to be able to deal with any further impacts that might be discovered during a pre-construction survey. There is only one significant concern – the likely graveyard at MK-24 – but this should be easily avoided through micro-siting of infrastructure. As such, and so long as the MK-24 site is avoided, there are no significant heritage concerns for this project and it is the opinion of the heritage consultant that the proposed Mukondeleli WEF may be authorised in full with either of the substation alternatives.

10.3.10 PALAEONTOLOGY ASSESSMENT

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the dolerite or in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below in the shales of the early Permian Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and amenities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. Since the impact on the palaeontology would be low, as far as the palaeontological heritage is concerned, the project should be authorised provided that the fossil chance find protocol is followed for the small areas that lie on the Vryheid Formation

- Southwestern margin Farm 321
- Northern margin Farm Brandwacht 316
- Central part along R546 on Farm Tweefontein 321
- Western margin Farm Knoppiesfontein 313

10.3.11 TANSPORT ASSESMENT

Traffic impact assessments are generally assessed for the operation phase of a development. Based on similar studies, wind energy facilities have a low peak hour traffic impact with less than 50 peak hour trips expected to be generated. Considering the envisaged low traffic demand posed by the development during the operation phase, the development is supported from a transport perspective provided that the recommendations made in this study are adhered to.

10.3.12 SOCIAL IMPACT ASSESSMENT

The findings of the SIA indicate that the proposed Mukondeleli WEF project will create a number of social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phase. In addition, the WEF will generate renewable energy to produce green hydrogen and ammonia.

The findings of the SIA also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be **Low Negative** with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. The Mukondeleli WEF is therefore supported by the findings of the SIA.

10.3.13 RISK ASSESSMENT

GENERAL

This Risk Assessment has found that with suitable preventative and mitigative measures in place, none of the identified potential risks are excessively high, i.e., from a Safety, Health and Environment (SHE) perspective no fatal flaws were found with either type of technology for the BESS installation at the proposed Mukondeleli WEF near Secunda, nor for the BESS installation within the Sasol Secunda Industrial Complex..

At a large facility, without installation of the state-of-the art battery technology that includes protective features, there can be significant risks to employees and first responders. The latest battery designs include many preventative and mitigative measures to reduce these risks to tolerable levels. State-of-the-art technology should be used, i.e., not old technology that may have been prone to fire and explosion risks.

The design should be subject to a full Hazard and Operability Study (HAZOP) prior to commencement of procurement. A HAZOP is s detailed technical systematic study that looks at the intricacies of the design, the control system, the emergency system etc. and how these may fail under abnormal operating conditions. Additional safeguards may be suggested by the team doing the study.

LITHIUM SOLID STATE CONTAINERIZED BATTERIES

With lithium solid-state batteries, the most significant hazard with battery units is the possibility of thermal runaway and the generation of toxic and flammable gases. There have been numerous such incidents around the world with batteries at all scales and modern technology providers include many preventative and mitigative features in their designs. This type of event also generates heat which may possibly propagate the thermal runaway event to neighbouring batteries if suitable state of the art technology is not employed.

The flammable gases generated may ignite leading to a fire which accelerates the runaway process and may spread the fire to other parts of the BESS or other equipment installed near the BESS.

If the flammable gases accumulate within the container before they ignite, they may eventually ignite with explosive force. This type of event is unusual but has happened with an older technology container installed at McMicken in the USA in 2019.

Due to a variety of causes, thermal runaway could happen at any point during transport to the facility, during construction or operation / maintenance at the facility or during decommissioning and safe making for disposal.

Due to the containerized approach as well as the usual good practice of separation between containers, which should be applied on this project, and therefore the likely restriction of events to one container at a time, the main risks are close to the containers i.e. to transport drivers, employees at the facilities and first responders to incidents.

In terms of a worst conceivable case container fires, the significant impact zone is likely to be limited to within 10m of the container and mild impacts to 20m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

In terms of a worst conceivable case explosion, the significant impact zone is likely to be limited to with 10m of the container and minor impacts such as debris within 50m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

In terms of a worst reasonably conceivable toxic smoke scenario, provided the units are placed suitably far apart to prevent propagation from one unit to another and large external fires are prevented, the amount of material burning should be limited to one container at any one time. In this case, beyond the immediate vicinity of the fire, the concentrations of harmful gases within the smoke should be low.

For the Mukondeleli WEF, location Alternative 1 is over 500m from any occupied farmhouse / Kennels etc. Location Alternative 2 is only 180m from the Kennels which may have significant numbers of persons and certainly numerous caged animals.

For the BESS within the Sasol Secunda Industrial Complex, it is located in a low occupancy area. With the exception of the South Gate where there is a large office bock, most of the occupied facilities within 500m are industrial facilities with few permanent employees, e.g. West Steam Station Cooling Towers. It should also be noted that there are numerous flammable and toxic gas risks already posed by the existing chemical plants within the Sasol facility. The risks posed by the BESS will be low compared to the existing risks.

VANADIUM REDOX FLOW BATTERY INSTALLATIONS

The most significant hazard with VRF battery units is the possibility of spills of corrosive and environmentally toxic electrolyte. Many preventative and mitigative features will be included in the design and operation, e.g., full secondary containment, level control on tanks, leak detection on equipment etc. (Refer to tables in section 4 under preventative and mitigative measures).

VRF batteries do not present significant fire and electrical arcing hazards provided they are correctly designed, operated, maintained and managed. Suitable Battery Management System (BMS), safety procedures, operating instructions, maintenance procedures, trips, alarms and interlocks should be in place.

TECHNOLOGY AND LOCATION OF BESS FACILITIES

From a safety and health point of view, the above Risk Assessment shows that risks posed by VRFB systems may be slightly lower than those of SSL facilities, particularly with respect to fire and explosion risks. From an environmental spill and pollution point of view the VRFB systems present higher short-term risks than the SSL systems. However, the above conclusions may be due to the fact that the VRFB technology is not as mature as SSL technology and therefore there is not as much operating experience and accident information available for the VRFB. Overall, from and SHE RA points of view, there is no specific preference for a type of technology.

From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses, isolated farmhouses or other occupied facilities, this would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and SSL batteries to fires producing toxic smoke and fire fighting which may result in contaminated of firewater runoff. One would not want these liquids to enter water courses nor the smoke to pass close to houses / public traffic.

For the WEF, location Alternative 1 is further from occupied facilities than location Alternative 2 and is therefore preferred from a safety and health point of view for solid state battery types (possible toxic smoke). However, location 2 is further from water courses than Location 1, as is therefore preferred from an environmental point of view for redox flow type batteries (possible spills of electrolyte). Secure secondary, and possibly tertiary, water and fire water runoff may be required at location Alternative 1.

Without knowing the type of battery that will finally be chosen, overfall, from a SHE RA point of view location Alternative 1 would be preferable in the WEF. For the BESS within the Sasol complex there is no specific preference, although at this location it may be easier to contain liquid spills from redox batteries than deal with toxic smoke from solid state batteries.

10.4 IMPACT SUMMARY

A summary of the identified impacts and corresponding significance ratings for the Mukondeleli WEF is provided in **Table 10-3.**

Table 10-3: Impact Significance Summary

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
Air Quality	Generation of dust and PM.	Construction	**Moderate**	Negative	**Low**	Negative
Noise and Vibrations	Construction Impact on Noise - Daytime		**Low**	Negative	**Low**	Negative
	Construction Impact on Noise – Night-time		**Moderate**	Negative	**Low**	Negative
	Operational Impact on Noise - Daytime	Operation	**Low**	Negative	**Low**	Negative
	Operational Impact on Noise – Night-time		**Moderate**	Negative	**Low**	Negative
Topography & Geology	Soil Erosion	Construction	**Moderate**	Negative	**Low**	Negative
	Oil Spillage		**Moderate**	Negative	**Very Low**	Negative
	Disturbance of Fauna and Flora		**Low**	Negative	**Very Low**	Negative
	Slope Stability		**Low**	Negative	**Very Low**	Negative
	Seismic Activity		**Very Low**	Negative	**Very Low**	Negative
	Soil Erosion	Operation	**Low**	Negative	**Very Low**	Negative
	Oil Spillage		**Moderate**	Negative	**Very Low**	Negative
	Soil Erosion	Decommissioning	**Moderate**	Negative	**Very Low**	Negative
	Oil Spillage		**Moderate**	Negative	**Very Low**	Negative
	Disturbance of Fauna and Flora		**Low**	Negative	**Very Low**	Negative
	Slope Stability		**Low**	Negative	**Very Low**	Negative
Soils, Land Capability and Agricultural Potential	Agricultural Production Potential loss by land occupation	Construction	**Moderate**	Negative	**Moderate**	Negative
	Agricultural Production Potential loss by soil degradation		**Very Low**	Negative	**Very Low**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Agricultural Potential enhancement Through Financial Security	Operation	**Low**	Negative	**Low**	Negative
Aquatic	Changes in Water Flow Regime	Construction	**Moderate**	Negative	**Low**	Negative
	Changes in sediment entering and exiting the system		**Moderate**	Negative	**Low**	Negative
	Introduction and spread of alien vegetation		**Moderate**	Negative	**Low**	Negative
	Loss and disturbance of watercourse habitat and fringe vegetation		**Moderate**	Negative	**Low**	Negative
	Changes in water quality due to pollution		**Moderate**	Negative	**Low**	Negative
	Loss of Aquatic Biota		**Moderate**	Negative	**Low**	Negative
	Changes in Water Flow Regime	Operation	**Moderate**	Negative	**Low**	Negative
	Changes in sediment entering and exiting the system		**Moderate**	Negative	**Low**	Negative
	Introduction and spread of alien vegetation		**Moderate**	Negative	**Low**	Negative
	Loss and disturbance of watercourse habitat and fringe vegetation		**Moderate**	Negative	**Low**	Negative
	Changes in water quality due to pollution		**Moderate**	Negative	**Low**	Negative
	Loss of Aquatic Biota		**Moderate**	Negative	**Low**	Negative
Biodiversity	Clearing of Natural Vegetation	Construction	**Moderate**	Negative	**Low**	Negative
	Loss of threatened, protected & endemic plant species		**Moderate**	Negative	**Low**	Negative
	Loss of Faunal Habitat		**Low**	Negative	**Very Low**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Direct faunal mortalities due to construction and increased traffic		**Low**	Negative	**Low**	Negative
	Increased dust deposition		**Low**	Negative	**Very Low**	Negative
	Increased human activity, noise and light levels		**Moderate**	Negative	**Low**	Negative
	Establishment of alien vegetation		**Moderate**	Negative	**Very Low**	Negative
	Increased water run-off and erosion		**Moderate**	Negative	**Low**	Negative
	Changes in animal behaviour		**Moderate**	Negative	**Low**	Negative
	Direct faunal mortalities	Operation	**Low**	Negative	**Very Low**	Negative
	Increased light and noise levels and changes in animal behaviour		**Low**	Negative	**Very Low**	Negative
	Establishment of alien vegetation		**Low**	Negative	**Very Low**	Negative
	Increased water run-off and erosion		**Moderate**	Negative	**Low**	Negative
	Faunal mortalities	Decommissioning	**Low**	Negative	**Very Low**	Negative
	Increased dust deposition		**Low**	Negative	**Very Low**	Negative
	Establishment of alien vegetation		**Low**	Negative	**Very Low**	Negative
	Increased water run-off and erosion		**Low**	Negative	**Very Low**	Negative
Avifauna	Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.	Construction	**Moderate**	Negative	**Low**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.		**Moderate**	Negative	**Low**	Negative
	Mortality of priority species due to collisions with the wind turbines	Operation	**High**	Negative	**Moderate**	Negative
	Electrocution of priority species on the medium voltage infrastructure.		**High**	Negative	**Very Low**	Negative
	Mortality of priority species due to collisions with the medium voltage infrastructure.		**High**	Negative	**Very Low**	Negative
	Displacement of priority species due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.	Decommissioning	**Moderate**	Negative	**Low**	Negative
Bats	Loss of foraging habitat by clearing of vegetation.	Construction	**Low**	Negative	**Low**	Negative
	Roost destruction during earthworks.		**Low**	Negative	**Very Low**	Negative
	Bat mortalities during foraging.	Operation	**High**	Negative	**Moderate**	Negative
	Bat mortalities during migration.		**Moderate**	Negative	**Low**	Negative
	Increased bat mortalities due to light attraction and habitat creation.		**High**	Negative	**Low**	Negative
Visual and Landscape	Visual impact on visual receptors due to construction.	Construction	**Moderate**	Negative	**Low**	Negative
	Visual impact of wind turbines and associated infrastructure.	Operation	**Moderate**	Negative	**Moderate**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Visual impact on visual receptors due to decommissioning	Decommissioning	**Moderate**	Negative	**Low**	Negative
Heritage and Cultural Resources	Impacts to Archaeological Resources	Construction	**Moderate**	Negative	**Very Low**	Negative
	Impacts to Graves		**High**	Negative	**Very Low**	Negative
	Impacts on Cultural Resources		**Moderate**	Negative	**Moderate**	Negative
	Impacts on Cultural Resources	Operation	**Moderate**	Negative	**Moderate**	Negative
	Impacts on Cultural Resources	Decommissioning	**Moderate**	Negative	**Moderate**	Negative
Palaeontology	Impacts on Palaeontological resources	Construction	**Very Low**	Negative	**Very Low**	Negative
Transport	Noise, dust pollution due to vehicle trips on-site.		**Moderate**	Negative	**Moderate**	Negative
	Noise, dust & exhaust pollution due to additional trips on the national and district roads.	Operation	**Low**	Negative	**Low**	Negative
Social	Creation of employment and business opportunities.	Construction	**Low**	Positive	**Moderate**	Positive
	Impacts on family structures and social networks associated with the presence of construction workers.		**Moderate**	Negative	**Low**	Negative
	Influx of job seekers into local community.		**Low**	Negative	**Low**	Negative
	Risk to safety, livestock and damage to farm infrastructure.		**Moderate**	Negative	**Low**	Negative
	Increased risk of grass fire		**Low**	Negative	**Low**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Nuisance impacts associated with construction activities.		**Moderate**	Negative	**Low**	Negative
	Impact on loss of productive farmland.		**Moderate**	Negative	**Low**	Negative
	Improve energy security and support renewable sector.	Operation	**Moderate**	Negative	**Moderate**	Positive
	Creation of employment, skills development and business opportunities.		**Low**	Positive	**Moderate**	Positive
	Generation of additional income for affected farmers.		**Low**	Positive	**Moderate**	Positive
	Visual impact and impact on the areas rural sense of place.		**Low**	Negative	**Low**	Negative
	Visual impact and impact on property values.		**Low**	Negative	**Very Low**	Negative
	Impact of the WEF on local tourism operations and activities.		**Very Low**	Negative	**Very Low**	Negative
	Social Impacts associated with decommissioning	Decommissioning	**Low**	Negative	**Low**	Negative
Climate Change	Reduced GHGs and contribution of cleaner energy to the National grid.	Operation	**High**	Positive	**High**	Positive
Hazardous Substances and Pollutants	Soil, groundwater and surface water contamination	Construction	**Low**	Negative	**Low**	Negative
	Soil, groundwater and surface water contamination	Operation	**Low**	Negative	**Low**	Negative
Waste Management	Generation of general and hazardous waste	Construction	**Moderate**	Negative	**Low**	Negative
	Generation of sanitation waste		**Moderate**	Negative	**Low**	Negative

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
Safety, Health and Environmental Risk	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS	Construction	**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for SSL BESS		**Low**	(-)	**Low**	(-)
	Human health - exposure to ergonomic stress for SSL BESS		**Low**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS		**High**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for SSL BESS		**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for SSL BESS		**Low**	(-)	**Low**	(-)
	Environment - waste of resources e.g. water, power etc for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for SSL BESS		**Low**	(-)	**Low**	(-)
	Investors – financial for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Emergencies for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Investors – legal for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for VRF BESS		**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human health - exposure to ergonomic stress for VRF BESS		**Low**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for VRF BESS		**Very Lowe**	(-)	**Very Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for VRF BESS		**High**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for VRF BESS		**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for VRF BESS		**Low**	(-)	**Low**	(-)
	Environment - waste of resources e.g. water, power etc for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Investors – financial for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for VRF BESS		**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Emergencies for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Investors – legal for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS	Operational	**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human health - exposure to noise for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human health - exposure to temperature extremes and/or humidity for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Human health - exposure to psychological stress for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Human health - exposure to ergonomic stress for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to fire radiation for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to explosion over pressures for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS		**Low**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human and equipment safety - exposure to acute toxic chemical and biological agents for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for SSL BESS		**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Environment - waste of resources e.g. water, power etc for SSL BESS		**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Investors – financial for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Emergencies for SSL BESS		**Moderate**	(-)	**Low**	(-)
	Investors – legal for SSL BESS		**Moderate**	(-)	**Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human health - chronic exposure to toxic chemical or biological agents for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human health - exposure to noise for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human health - exposure to temperature extremes and/or humidity for VRF BESS		**Low**	**(-)**	**Very Low**	**(-)**
	Human health - exposure to psychological stress for VRF BESS		**Low**	**(-)**	**Very Low**	**(-)**
	Human health - exposure to ergonomic stress for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human and equipment safety - exposure to fire radiation for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human and equipment safety - exposure to fire radiation for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human and equipment safety - exposure to explosion over pressures for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS		**Low**	**(-)**	**Low**	**(-)**
	Human and equipment safety - exposure to acute toxic chemical and biological agents for VRF BESS		**Moderate**	**(-)**	**Low**	**(-)**

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human and equipment safety - exposure to violent release of kinetic or potential energy for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human and equipment safety - exposure to electromagnetic waves for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Environment - emissions to air for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Environment - emissions to water for VRF BESS		**Low**	(-)	**Low**	(-)
	Environment - emissions to earth for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Environment - waste of resources e.g. water, power etc for VRF BESS		**Low**	(-)	**Very Low**	(-)
	Public – aesthetics for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Investors – financial for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Employees and investors – security for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Emergencies for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Investors – legal for VRF BESS		**Moderate**	(-)	**Low**	(-)
	Human health - chronic exposure to toxic chemical or biological agents for both BESS types	Decommissioning	**Very Low**	(-)	**Very Low**	(-)
	Human health - exposure to noise for both BESS types		**Very Low**	(-)	**Very Low**	(-)

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Human health - exposure to temperature extremes and/or humidity for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human health - exposure to psychological stress for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human health - exposure to ergonomic stress for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human and equipment safety - exposure to fire radiation for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human and equipment safety - exposure to explosion over pressures for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human and equipment safety - exposure to acute toxic chemical and biological agents for both BESS types		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human and equipment safety - exposure to violent release of kinetic or potential energy for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Human and equipment safety - exposure to electromagnetic waves for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Environment - emissions to air for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Environment - emissions to water for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Environment - emissions to earth for SSL BESS		**Moderate**	**(-)**	**Low**	**(-)**
	Environment - waste of resources e.g. water, power etc for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**

ASPECT	IMPACT DESCRIPTION	PHASE	SIGNIFICANCE (WITHOUT MITIGATION)	NATURE	SIGNIFICANCE (WITH MITIGATION)	NATURE
	Public – aesthetics for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Investors – financial for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Employees and investors – security for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Emergencies for SSL BESS		**Very Low**	**(-)**	**Very Low**	**(-)**
	Investors – legal for SSL BESS		**Moderate**	**(-)**	**Low**	**(-)**

10.5 ALTERNATIVES ASSESSMENT

Project alternatives in terms of activity, technology, location and layout were considered as part of this EIAR process. It is important to note that while there are advantages and disadvantages for the alternatives considered, including the Site Substation & BESS Alternative 1 (preferred) and Alternative 2 as discussed in **Section 6.3**, all site alternatives are considered feasible from an environmental perspective. The revised layout avoids sensitivities as much as possible.

The Site Substation & BESS Alternative 1 is the preferred option as it provides the shorter connection to the preferred collector substation. However, both Alternatives are considered feasible and reasonable for the proposed Mukondeleli WEF. **Table 10-4** outlines the preferred alternatives, in terms of the turbines, on-site substation and BESS locations, considered feasible and preferred from an environmental perspective (that is, as per the input from the Specialists).

Table 10-4: Preferred Site Alternatives

ALTERNATIVE	PREFERRED	COMMENT
Site	Mukondeleli WEF development area — Portion 0 of the Farm Knoppies No. 314 — Portion 1 of the Farm van Tondershoek No. 317 — Portion 2 of the Farm van Tondershoek No. 317 — Portion 2 of the Farm Brandwacht No. 316 — Portion 2 of the Farm Bosjesspruit No. 291 — Portion 3 of the Farm Brandwacht No. 316 — Portion 4 of the Farm Brandwacht No. 316 — Portion 5 of the Farm Brandwacht No. 316 — Portion 5 of the Farm Tweefontein No. 321	There is no site alternative for the Mukondeleli WEF. The location of the project infrastructure was subjected to a site selection process as described in **Section 6.5**.

ALTERNATIVE	PREFERRED	COMMENT
	— Portion 6 of the Farm Bosjesspruit No. 291 — Portion 7 of the Farm van Tondershoek No. 317 — Portion 8 of the Farm van Tondershoek No. 317 — Portion 11 of the Farm van Tondershoek No. 317 — Portion 8 of the Farm Bosjesspruit No. 291 — Portion 9 of the Farm Knoppiesfontein No. 313 — Portion 9 of the Farm Bosjesspruit No. 291 — Portion 10 of the Farm Bosjesspruit No. 291 — Portion 11 of the Farm Bosjesspruit No. 291 — Portion 12 of the Farm Bosjesspruit No. 291 — Portion 12 of the Farm van Tondershoek No. 317 — Portion 13 of the Farm Brandwacht No. 316 — Portion 13 of the Farm Bosjesspruit No. 291 — Portion 14 of the Farm Bosjesspruit No. 291	
Activity	Wind technology	Wind technology has been identified as the preferred activity in terms of generating electricity from a renewable resource.
Layout and Design	— Revised Layout (42 turbines) —	The Mukondeleli WEF layout, including the associated infrastructure was revised during the Scoping Phase, from the initial 54 turbines to 42 turbines. The turbine layout was revised in order to avoid sensitive features and buffer areas. Based on the current revised layout: — Design and layout alternatives are unlikely to make any material difference to the significance of the agricultural impacts. The same applies to technology alternatives, and there are therefore no preferred alternatives from an agricultural impact perspective. All alternatives are considered acceptable. — no new residential dwellings will be developed within areas

ALTERNATIVE	PREFERRED	COMMENT
		enveloped by the 42 dBA noise level contour, and — structures located within the 45 dBA noise level contour should not be used for residential use — Four Wind Energy Turbines were found to be recorded within a wetland itself, or within a wetland buffer: All of these structures should ideally be moved between 20-100 m in each case to protect the watercourses — From a visual perspective, there are no fatal flaws associated with EIA Phase WEF development footprint — Some turbines, e.g. Turbines MK28 & MK37, are located within areas demarcated as CBA1s while turbines MK11, MK24, MK26, MK36 and MK39 are located in a CBA2 area. — No turbines were located in Mpumalanga Highveld Wetlands, e.g. channelled valley-bottom wetlands, but turbine MK16 occurs within an areas demarcated as seep — The current layout of the wind turbines avoided the areas with shallow soils on rocky sheets (Habitat 1 – medium sensitivity) or within or near watercourses (Habitat 7 – high sensitivity) Laydown areas: — The four proposed site locations are acceptable in terms of our sensitivity findings for the habitats on site — Two of the four laydown sites occur within seeps, but could be micro-sited to nearby acceptable locations — The four proposed site locations are acceptable in terms of the CBA map — Construction camps and batching plant areas: — The four proposed site locations are acceptable in terms of our sensitivity findings for the habitats on site — The four proposed site locations are acceptable in terms of the CBA map.

ALTERNATIVE	PREFERRED	COMMENT
		— Three of the four construction and batching sites occur within seeps, but could be micro-sited to nearby acceptable locations
IPP Substation and BESS	— Site Substation & BESS Alternative 1 (Preferred) — Site Substation & BESS Alternative 2	— From a visual perspective, no fatal flaws were identified for either of the proposed site alternatives for the substation / BESS for Mukondeleli WEF and both alternatives were found to be favourable. — The current proposed BESS location Alternative 1 is over 500m from isolated farmhouses / other occupied facilities and is therefore possibly more suitable than location Alternative 2 which is a mere 180m from a Pet Kennel facility — It should be noted that location Alternative 1 is closer to existing water courses than Alternative 2. — From a SHE risks assessment point of view; there is a slight preference for BESS alternative location Alternative 1 which is further from occupied facilities. Although it is closer to water bodies this can be mitigated with secure secondary, and possible tertiary, containment systems — The substation site falls partly within an area demarcated as CBA1 and its location should be reconsidered (micro-sited). — The substation site also falls in an area demarcated as a seep. — The site location is however acceptable in terms of our sensitivity findings for the habitats on site, i.e. low sensitivity based on the criteria used

10.5.1 NO-GO ALTERNATIVE

The No-Go Alternative assumes that the proposed Mukondeleli WEF and associated infrastructure will not be developed, and the current *status quo* will continue. This includes continued use of the land for cultivation and livestock production, as well as the possibility of future mining. The No-Go Alternative provides the baseline against which other alternatives are compared and has been considered throughout this EIR and relevant specialist studies. Should the 'No-Go' alternative be considered, there would be no impact on the existing environmental baseline and no benefits will be derived from the implementation of an additional land-use to the local economy and affected communities. The alternative also bears the opportunity cost of missed socio-economic benefits to the local community that would otherwise realise from establishing the farms which form part of the project areas. The option of not developing also entails that the bid to provide renewable/clean energy to the national grid and contribute to meeting the country's energy demands will not be realised.

Conversely, in this scenario, environmental impacts of the project (as outlined in **Section 8** associated with the development of the Mukondeleli WEF would be avoided. The No-Go Alternative has the following implications:

- In terms of agriculture, the no-go alternative considers impacts that will occur to the agricultural environment in the absence of the proposed development. There are no agricultural impacts of the no-go alternative.
- The development offers an additional income source to agriculture, without excluding agriculture from the land. Therefore, the negative agricultural impact of the no-go alternative is more significant than that of the development, and so, purely from an agricultural impact perspective, the proposed development is the preferred alternative between the development and the no-go. In addition, the no-go option would prevent the proposed development from contributing to the environmental, social and economic benefits associated with the development of renewable energy in South Africa.
- In terms of Aquatic Biodiversity, the area around the WEF is already altered, large sections of the layout of the WEF are situated in agricultural fields and previously disturbed areas. Considering the no-go alternative for the WEF would either be that the infrastructure be placed in other areas which might be green field areas or due to the limited energy generation capacity South Africa is facing the use of other forms of energy such as coal or nuclear power. The environmental footprint of coal fired power stations are far greater than that of WEF
- The advantages of the no-go alternative would be that there will be less disturbance to the aquatic ecosystems than with the proposed WEF. An advantage of the proposed WEF would be that adherence to the mitigation measures and the EMPr will be monitored, and corrective measures will be taken where required
- From an avifaunal perspective, the 'no-go' alternative will result in the current *status quo* being maintained. The 'no-go' option would eliminate any additional impact on the ecological integrity of the proposed WEF development site, as far as avifauna is concerned.
- The No-Go Alternative would also mean that no vegetation will be removed or disturbed during the development of the WEF. No impact on the CBA 1 and 2 on site, and no impact on the natural grassland.
- No birds will be impacted upon, either through the loss of their habitat by clearing of vegetation which can result in displacement, or bird mortality due to collisions with wind turbines and medium overhead powerlines, or electrocution on the medium voltage overhead powerlines.
- No bats will be impacted upon either through the loss of foraging habitat due to vegetation clearing, roost destruction, or bat mortalities by colliding with turbine blades or by suffering barotrauma during foraging activities, or during migration.
- If the 'No-Go' option is implemented, the area would thus retain its visual character and sense of place and no visual impacts would be experienced by any locally occurring receptors.
- No potential heritage artefacts or potential palaeontological resources will be impacted on.
- No noise impacts during the construction phase or during the operational phase when wind turbines are rotating.
- No additional traffic to the project area as a result of the construction phase.

Based on the Social Impact Assessment, the primary goal of the Project is to supplement South Africa's energy and assist to improve energy security. In addition, it will also reduce the country's reliance on coal as an energy source. This represents a positive social benefit to assist in addressing the current energy supply constraints. The project also aims to reduce the carbon footprint associated with energy generation. As indicated above, energy supply constraints and the associated load shedding have had a significant impact on the economic development of the South African economy. South Africa also relies on coal-powered energy to meet more than 90% of its energy needs. South Africa is therefore one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions.

The No-Go Alternative would represent a lost opportunity for South Africa to improve energy security and supplement its current energy needs with clean, renewable energy. Given South Africa's current energy security challenges and its position as one of the highest per capita producers of carbon emissions in the world, this would represent a significant negative social cost.

10.6 RECOMMENDATIONS

The following key aspects are recommended to be included as conditions of authorisation:

- The layout submitted in the final EIR are not finalised. The final layout must be submitted to the MDARDLEA for approval prior to construction;
- The site-specific EMPr submitted with the final EIR should not be approved. The EMPr must be updated to include the final layout map once finalised and approved by MDARDLEA.
- The mitigation measures included in the EMPr must be adhered to;
- A pre-construction walkdown must be undertaken by the biodiversity, heritage and avifauna specialists in order to provide input with regards to micro-siting of structures and infrastructure in preparation of the final Layout;
- MK11, MK24, MK26, MK28, MK36, MK37 & MK39 must be microsited prior to approval of final layout such that the site can be groundtruthed and any sensitive areas are avoided;
- The Wind Energy Structure currently located either within a wetland or within the buffer of a wetland should be moved into nearby impacted areas like agricultural fields;
- Recommendations for the layout as provided by the relevant specialists must be implemented as far as possible;
- The final EMPr must form part of all contractual documents with contractors during construction and operational phases of the project. Furthermore, a dedicated Environmental Control Officer (ECO) must be appointed to ensure compliance to all EA conditions and EMPr commitments throughout the construction phase;
- Appropriate permits in terms of the Mpumalanga Natura Conservation Act (No. 10 of 1998) must be obtained before commencement of construction; and
- Where required, water use authorisation under NWA is to be obtained from the DWS prior to construction.

The following recommendations are made in respect of the proposed Project:

- A geotechnical site investigation must be undertaken to provide detailed geotechnical information for the design of the proposed structures and roads;
- No new residential dwellings will be developed within areas enveloped by the 42 dBA noise level contour;
- Structures located within the 45 dBA noise level contour should not be used for residential use;
- Alternative layouts should be considered where the current footprints encroach into wetlands or wetland buffer zones;
- It is recommended that monitoring in terms of wetland PES as well as biomonitoring be conducted to consider the cumulative impacts of the proposed Vhuvhili SEF, Mukondeleli WEF as well as the gridline solution (subject to separate applications);
- Monitoring should be conducted in both the construction and operational phases of the project;
- It is imperative that an AIS plant management plan be developed for the proposed Mukondeleli WEF prior to the construction phase;
- Clearing and/treatment of these species occurs prior to any construction activities which will curb the spread of AIS plants due to the disturbance events caused by construction;
- A pre-construction survey needs to be undertaken on all unploughed sections of the final layout;
- The likely graveyard alongside turbine MK-24 must be buffered by a minimum of 50 m unless the site is checked and confirmed not to be a graveyard;
- No stones may be removed from any archaeological site;
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution; and
- The developer should liaise with the affected landowners to ensure that the final layout minimises the impact on productive crop land.

- In the event where the mitigation measures to prevent the collisions fails and mortalities of avifauna and bats do occur, then the developer should engage with the MTPA to determine what the biodiversity offset should be.

10.7 IMPACT STATEMENT

The overall objective of the EIA is to provide sufficient information to enable informed decision-making by the authorities. This was undertaken through consideration of the proposed project components, identification of the aspects and sources of potential impacts and subsequent provision of mitigation measures.

In assessing the environmental feasibility of the Mukondeleli WEF, the requirements of all relevant legislation have been considered. The identification and development of appropriate management and mitigation measures that should be implemented in order to minimise potentially significant impacts associated with the project, has been informed by best practice principles, past experience and the relevant legislation (where applicable).

The EIA process has found that the proposed project will involve activities which will lead to a number of direct and indirect negative impacts on the biophysical and socio-economic environment. These impacts were found to vary in terms of their consequence and probability. Positive impacts are limited to the creation of employment opportunities and other socio-economic benefits as a result of the multiplier effect. This includes the potential to improve energy security in South Africa, increase the generation of renewable energy and reduce the reliance on coal powered energy to meet the country's electricity demand. Positive impacts also include the potential recovery, removal and placement of fossils in a recognised institution (if uncovered).

Mitigation measures have been developed where applicable for the above aspects and are presented within the EMPr (**Appendix I**). The mitigation measures are necessary to ensure that the project is planned, constructed and operated in an environmentally responsible manner. It is imperative that all impact mitigation recommendations contained in the EMPr, of which the environmental impact assessment took cognisance, are legally enforced.

It is the opinion of WSP that the information contained in this document (read in conjunction with the final scoping report) is sufficient for the MDARDLEA to make an informed decision for the environmental authorisation being applied for in respect of this project. The findings of this S&EIR process and associated Specialist studies conclude that there are no fatal flaws associated with the proposed development. Negative environmental impacts associated with the proposed Mukondeleli WEF can be mitigated to acceptable levels. It is therefore the opinion of the EAP that the project can proceed, and that all the listed mitigation measures and recommendations are considered by the MDARDLEA.

EA AUTHORISATION PERIOD

Appendix 1(3)(1)(q) of the NEMA EIA Regulations 2014, as amended requires "where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised" must be included in the EIA Report.

The EA is required to be valid for a period of 10 years from the date of issuance of the EA. This is considered a reasonable period to allow the Applicant time to conduct relevant internal processes which can only begin after issuance of the EA.

FINALISATION OF THE EMPR AND LAYOUT

It is important to note that the EMPr (**Appendix I**) and project layout included in this EIR are not final and although included in this EIR, these are not submitted for approval at this stage. Subsequent to the decision-making phase, if environmental authorisation is granted for the Mukondeleli WEF, the EMPr will have to be amended to include measures as dictated by the final layout map and micro-siting, including the requirements of the EA. The amended EMPr and final layout subjected to micro-siting will be submitted to the MDARDLEA for review and approval following detailed design.

11 CONCLUSION

ENERTRAG South Africa is proposing the development of an area of approximately 3600ha, with a maximum export capacity of up to 300MW. The proposed Mukondeleli WEF is located approximately 8km south of Secunda in the Gert Sibande District Municipality and the GMM Local Municipality, near the town of Secunda, in the Mpumalanga Province of South Africa**.**

This S&EIR process considered the biophysical location of the proposed development, as well as a feasibility assessment by the proponent, which *inter alia* served to identify site options that would be optimal for energy production and grid interconnection. As discussed previously, the purpose of the proposed Mukondeleli WEF is to contribute to the national energy targets of diversification of energy supply and the promotion of clean energy. The project will also aid in overcoming the national power shortages that are currently faced in the country. The Project will be the first large-scale wind energy facilities being developed in Mpumalanga. Other socio-economic benefits would result from the proposed project, including the increase of energy supply, employment opportunities and local economic development.

The anticipated environmental and social impacts associated with the proposed Mukondeleli WEF have been identified and assessed by the various specialists. The initial layout consisted of 54 turbine positions for the Mukondeleli WEF, which was considered and assessed by the Specialists during the Scoping Phase to ensure any development constraints and environmental sensitivities can be avoided. Based on the Specialist findings, a revised layout was developed to avoid sensitive features and buffer areas and mitigate against overall impact. The revised layout consisting of 42 turbines positions (current layout) was taken forward for further Specialist assessment during the EIA Phase (this report).

Based on the findings of the impact assessment and specialist studies, the proposed project is considered to have an overall **Low** to **Moderate** negative environmental impact and an overall **Low** to **Moderate** positive socio-economic impact, with the implementation of the relative mitigation measures. All of the specialists have recommended that the proposed project receive EA if the recommended mitigation measures are implemented.

In consideration of the findings of the S&EIR Process, as well as the national, provincial and local strategic requirements to support sustainable development whilst promoting socio-economic development, it is the opinion of the EAP that the proposed project will make a positive contribution towards socio-economic development in the Gert Sibande District Municipality in addition to national benefits in terms of renewable energy generation. It is recommended that the project receive EA in terms of the EIA Regulations (as amended), provided that the outlined mitigation measures of this S&EIR process are implemented effectively.

The draft EIR (this report) was made available for public review from **12 January 2023** to **13 February 2023**. All I&APs on the database (included in the SER (**Appendix D** of the EIR) were notified of the release of the draft EIR, EMPr and specialist reports for a period of 30 days.

All issues and comments submitted to WSP during the public review period of the draft EIR have been incorporated in the CRR (**Appendix D** of the EIR (i.e. SER)). The Final EIR will be submitted to the MDARDLEA, as the competent authority, for decision-making.

As of 6 December 2022 a total of 9 projects have been successfully registered with Infrastructure South Africa (ISA). Projects registered with ISA received their SIP letters immediately after GN2835 was published in December 2022. One of the projects registered included the Sasol HyShift Project in Secunda, Mpumalanga.

The Mukondeleli WEF feeds into the broader HyShift Project through the generation of renewable energy.

Therefore, the MDARDLEA have been requested to consider reducing their decision making timeframe to 57 days as per the timeframes outlined in the Infrastructure Development Act, as amended (Act 23 of 2014

If you have any further enquiries, please feel free to contact:

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