PROPOSED CONSTRUCTION OF THE EMVELO WIND ENERGY FACILITY AND ITS ASSOCIATED GRID INFRASTRUCTURE, NEAR ERMELO, MPUMALANGA PROVINCE, SOUTH AFRICA



AVIFAUNAL SPECIALIST ASSESSMENT REPORT

MAY 2025

AFRIAVIAN ENVIRONMENTAL

1. EXECUTIVE SUMMARY

Respective Special Purpose Vehicles (SPVs) are proposing the development of a commercial wind farm cluster that is expected to comprise two separate Wind Energy Facilities (WEFs) namely, the Sheepmoor WEF (up to 240 MW) and the Emvelo WEF (up to 240 MW). Each WEF will apply for its own grid connection route to connect to the newly proposed Camden B substation. The proposed development sites are located east of Ermelo and falls within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province.

It is intended that these projects would be bid in upcoming bidding windows of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the aim of evacuating the generated power from the WEFs into the National Eskom Grid. This will aid in the diversification and stabilisation of the country's electricity supply in line with the objectives of the Integrated Resource Plan (IRP).

This report serves as the **Avifaunal Specialist Study** for the proposed **Emvelo WEF**.

The Emvelo WEF is proposed to comprise up to 22 turbines with a maximum output capacity of up to 240 MW. The WEF will be located on ten (10) land parcels and will have an anticipated lifespan of up to 25 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed permanent turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation. It is proposed that an up 132 kV on-site substation complex and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km in length (within a 300 m assessment corridor) that traverses thirty-five (35) land parcels, be constructed to connect the proposed WEF to the newly proposed Camden B substation. Four alternative powerline routings have been proposed, namely OHL Preferred, OHL Alternative 1, OHL Alternative 2 and OHL Alternative 3.

According to the Southern African Bird Atlas Project (SABAP2), a total of 253 bird species could potentially occur in the Broader Area where the proposed Emvelo WEF and associated gird connection infrastructure are located. Of the 253 species, 38 species are classified as priority species for wind energy developments. Of the wind energy development priority species in the Broader Area, 32 have been recorded during the pre-construction monitoring. Of the 253 species, 76 are considered powerline sensitive species of which 57 have been recorded during the pre-construction monitoring.

1.1 Summary of Findings

1.1.3 Wind Energy Facility

The proposed Emvelo WEF will 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 33 kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33 kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

1.1.3.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

A measure of displacement will inevitably take place for all priority species as a result of disturbance from construction activities during the construction phase. This will primarily affect ground-nesting species in the remaining high-quality grassland, wetlands, and wetland fringes. However, this impact could be extended to tree and cliff nesting species breeding in or directly adjacent to the project boundary. The project boundary is in close proximity to a Martial Eagle (Endangered) nest- and roost sites. In addition, the Southern Bald Ibises (Vulnerable) that roost and breed adjacent to the Emvelo WEF project site could face a disruption of their reproductive cycle. Some species could recolonise the area after the completion of construction. However, as a result of habitat fragmentation and operational turbines causing disturbance, other species could only partially return to their previous habitat, resulting in lower densities than before. In summary, the following species could be impacted by disturbance during the construction phase: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Black Sparrowhawk, Black-winged Kite, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Sensitive Species 23, Spotted Eagle-Owl, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **Medium** pre- and post-mitigation.

1.1.3.2 Displacement due to habitat transformation in the construction phase.

The construction of additional roads will result in further habitat fragmentation; however, the site already has many existing access roads, most of which will be upgraded and utilised for the wind farm development. It is noted that some of the roads to be upgraded will infringe on the habitat classified as very high sensitivity through habitat suitability modelling; however, these infringements will mostly be along the edges of these grassland patches. This, together with the disturbance of the operating turbines, could influence the density of several species. This is the case for larger terrestrial species that utilise the remaining natural grassland, wetlands, and wetland fringes as breeding habitat, and also for smaller, range-restricted species for which the area is considered to provide suitable habitat. It is not expected that priority species will be permanently displaced from the development site, but densities may be reduced. In summary, the following terrestrial species and raptors are likely to be most affected by habitat transformation: African Grass Owl (recorded during dedicated wetland surveys), Black-winged Lapwing, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Secretarybird, Sensitive Species 23, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **Medium** pre- and post-mitigation.

1.1.3.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed WEF will pose a collision risk to several priority species which could regularly occur at the site. Species exposed to this risk are large terrestrial species, occasional long-distance fliers, i.e., bustards, cranes, storks, Southern Bald Ibis, and Secretarybird, although bustards and cranes generally seem to be less vulnerable to turbine collisions than originally anticipated (Ralston-Paton & Camagu 2019). Small passerines may also be vulnerable during display flight activities. Soaring priority species such as Cape Vulture and a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collisions. The regularly occurring priority species that could be at risk of collisions with the turbines are the following: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Amur Falcon, Black Sparrowhawk, Black-winged Kite, Black-winged Lapwing, Black-winged Pratincole, Blue Crane, Common Buzzard, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Sensitive Species 23, Spotted Eagle-Owl, White Stork, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **High** pre-mitigation and **Medium** post-mitigation.

1.1.3.4 Electrocution on the 33 kV MV overhead lines (if any) in the operational phase.

The following priority species are potentially vulnerable to electrocution on the 33 kV overhead lines (if any): African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Amur Falcon, Black Sparrowhawk, Black-winged Kite, Common Buzzard, Grey Crowned Crane, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Southern Bald Ibis and Spotted Eagle-Owl. The overall impact significance is rated as **Medium** pre-mitigation and **Low** post-mitigation.

1.1.3.5 Collisions with the 33 kV MV overhead lines (if any) in the operational phase.

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines may have to run above ground for technical reasons. These overhead lines could pose a collision risk to priority avifauna, depending on where those lines are located. Priority species potentially at risk are African Grass Owl (recorded during dedicated wetland surveys), Blue Crane, Denham's Bustard, Grey Crowned Crane, Marsh Owl, Secretarybird, Southern Bald Ibis, Spotted Eagle-Owl, White Stork, and White-bellied Bustard. The overall impact significance is rated as **Medium** pre-mitigation and **Low** post-mitigation.

1.1.3.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact significance is likely to be similar in nature to the construction phase.

1.1.3.7 Cumulative Impacts.

Considering the other three renewable energy (RE) (specifically wind) projects currently proposed within the 35 km radius, the maximum number of turbines including those proposed for the proposed Emvelo WEF, totals 133 in similar habitat around the proposed project. The Emvelo WEF's turbines constitute about 18% of the total number of planned turbines in the area and as such poses a **moderate to high** cumulative impact. Furthermore, these planned WEFs including the Emvelo WEF constitutes about 7% of the total area of similar habitat available to birds in the 35 km radius around the project. As such, the cumulative impact of these planned WEF projects at the time of writing is considered **moderate** as far as the creation of high-risk zones are concerned within the area contained in the 35 km radius. Finally, the contribution of the Emvelo WEF, which footprint comprises about 19% of the total land parcel area designated for RE developments in the 35 km radius, to the cumulative impact of all the RE facilities collectively is therefore **moderate to low** as far as potential displacement of priority species due to habitat transformation is concerned. Furthermore, the contribution of the Emvelo WEF and its associated electrical grid infrastructure (i.e., 132 kV OHL connection to the proposed Camden Substation) to the cumulative impact of all the RE facilities and their associated electrical grid infrastructure collectively is therefore considered moderate as far as potential displacement of priority species due to habitat transformation as well as potential risk of collision and electrocution is concerned.

Table 1 summarises the expected impacts of the proposed Emvelo WEF and proposed mitigation measures per impact.

Table 1: Overall Impact Significance for the WEF (Pre- and Post-Mitigation). Refer to Section 6.3 for detailed Impact Analysis Tables.

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No construction should take place in the All-Infrastructure Exclusion Zones as indicated in Section 6.5 of this report of this report unless existing roads are to be upgraded. (4) No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Medium
Construction: Displacement due to habitat transformation	Medium	(1) Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. (4) No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report.	Medium
Operational: Collisions with the turbines	High	(1) No turbines (including the rotor swept area) should be located in Turbine Exclusion Zones as indicated in Section 6.5 and Figure 35 of this report. (2) Diurnal and nocturnal Automated Shut Down on Demand (SDoD) (camera and radar) to accommodate low light conditions and night flying species, with Observer-led SDoD as additional mitigation, as well as diurnal proactive curtailment based on environmental and weather conditions conducive to bird flight activity must be fully implemented on	Medium

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		all authorised wind turbines located in both 'high risk zones' and 'medium risk zones' throughout the lifespan of the proposed WEF. Analysis of Martial Eagle tracking data has revealed strong correlations between flight activity and variables such as time of day, wind speed, and temperature. These correlations will be further refined prior to the WEF becoming operational – also see Section 5.8.7.1 for more information. • SDoD and radar technology must be in operation at the onset of commercial operation date (COD). • SDoD success must be monitored throughout the lifetime of the WEF, where monitoring data during operation will continuously inform the SDoD needs for each turbine. • The SDoD programme must be developed and included in the approved EMPr, post-EA (should such EA be granted) during the detailed design phase prior to construction. Specific details of the SDoD programme will be included in a comprehensive Biodiversity Management Plan (BMP) which will be developed and implemented prior to the commercial operational date of the WEF. (3) **Sensitive Species 23:** All authorised wind turbines located within the modelled medium risk zone traversing Species 23 habitat connectivity corridors (see Section 6.5 and Figure 32) must implement dynamic, real-time nocturnal curtailment i.e., from dawn to dusk for the duration of the summer season. The following turbines are affected: WTGs 5, 13, 15, 19, 20, 23 and 25. • Dynamic real-time habitat mapping and assessment for the species will need to be conducted every 7-14 days (semi-monthly) from October onward, using the latest satellite imagery, supplemented with on-site weather station rainfall and soil moisture data. This near real-time, dynamic modelling will generate a **habitat suitability index** by integrating rainfall (water	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		levels), wetland saturation, and vegetation state. Vegetation state will consider both structural components influenced by grazing and burning, as well as seasonal productivity measured through remotely sensed habitat suitability time-series analysis. Note that the satellite imagery is updated weekly, therefore the frequency of checking these datasets cannot be increased; however, the proposed mitigation strategy prescribes the onsite implementing of hydrometric equipment that would measure the ambient conditions (such as soil moisture, temperature, etc.) on an hourly basis. Therefore, changes in the local weather parameters will be detected much more frequently than at a 7-14 day interval. Also, wetland monitoring at the onset of spring / summer will be conducted more frequently, and regional rainfall patterns will also be monitored in order to determine when conditions become or are likely to become suitable for the species. Structural assessments will be conducted using drone-derived Digital Terrain Model (DTMs), while productivity trends will be monitored across the growing season to capture phenological and productivity changes. When the dynamic habitat suitability index indicates favourable habitat conditions following the onset of late spring-early summer (October) rainfall, wind turbines located in the medium risk mitigation zone must be curtailed at night (from dusk until dawn) for the duration of the summer season. Habitat condition thresholds (favourable/unfavourable) derived from the dynamic habitat suitability index has been calibrated using observed species presence-absence datasets. This habitat condition tracking tool can be deployed in near real time and will issue notifications to the designated avifaunal specialist if favourable conditions are triggered via an online webapp.	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		(4) **Live-bird monitoring and carcass searches** should be implemented in the operational phase to assess collision rates, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al. 2015). Given the sensitivity of the site, live-bird monitoring should be conducted for at least the first 5 years of operation and be reassessed thereafter to determine the continued frequency of such monitoring as informed by a site-specific Biodiversity Management Plan. Carcass searches must be conducted annually for the lifespan of the facility to assess collision rates. (5) **All authorised wind turbines** must have at least **one blade painted according to a CAA approved pattern** to reduce the risk of raptor collisions (Blade Patterning Guidelines 2024). See **Appendix 12**. (6) Fatality thresholds must be monitored on an annual basis for the lifespan of the WEF. The ratio of predicted annual fatalities (based on Collision Risk Modelling (CRM) values that take the effectiveness of avoidance and mitigation measures into account) to allowable Potential Biological Removals (PBR) is expressed as a **percentage annual fatality threshold for each priority species per site**, which serves as a practical trigger for additional mitigation. If operational monitoring indicates that annual fatalities are approaching or exceeding PBR-based thresholds, this will trigger an immediate review and escalation of mitigation measures, such as extending curtailment periods or adjusting SDOD protocols. This framework ensures that mitigation is responsive, data-informed, and conservation-aligned, with threshold exceedance serving as a clear and proactive management trigger. (7) Additional mitigation measures, when required during operations, must be implemented timeously in accordance with the practicality and associated ease of implementation. **All revised mitigation measures should be implemented within a time period of maximum six (6) months.**	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Operational: Electrocutions on the 33 kV MV network	Medium	(1) Underground cabling must be used as much as is practically possible. (2) If the use of overhead lines is unavoidable due to technical reasons (or other environmental constraints e.g. water courses), the Avifaunal Specialist must be consulted timeously to ensure that a bird-friendly pylon design is used, and that appropriate mitigation is implemented pro-actively for complicated pylon structures e.g., insulation of live components to prevent electrocutions on terminal structures and pylon transformers. (3) Monthly inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to search for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).	Low
Operational: Collisions with the 33 kV MV network	Medium	Bird flight diverters (design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings) should be installed on all the overhead line sections for the full length directly associated with the proposed WEF according to the applicable Eskom standard at the time.	Low
Decommissioning: Displacement due to disturbance	Medium	(1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No off-road driving should be allowed. (4) No dismantling activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Medium
Cumulative Impacts	High	As above	Medium

1.1.4 Grid Connection Components

The proposed Emvelo WEF 132 kV grid connection will 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.
- Collisions with the overhead lines in the operational phase.
- Mortality due to electrocutions on the proposed grid connection infrastructure in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

1.1.4.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

Construction activities could impact birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although this is often impractical to implement due to tight construction schedules. Powerline-sensitive species which are potentially most vulnerable to displacement due to disturbance are mostly ground-nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl, and White-bellied Bustard. The overall impact significance is rated as **Medium** pre-mitigation and **Low** post-mitigation.

1.1.4.2 Displacement due to habitat transformation in the construction phase.

During the construction of overhead powerlines (OHL), service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. These activities could impact birds breeding, foraging, and roosting in, or in close proximity to the proposed OHL grid connection, when the habitat is transformed. Relevant to this development, very little mitigation can be applied to reduce this impact as the total permanent transformation of the natural habitat within the construction footprint of the on-site substation is unavoidable. In the case of the OHL, the direct habitat transformation is limited to the on-site substation and pylon/tower footprints and the narrow access road/track underneath the proposed OHL. The loss of habitat in the substation footprint (1.5 ha will cover a small percentage of the habitat that regularly supports powerline sensitive species, and the resultant impact is likely to be minimal. Powerline sensitive species which are potentially most vulnerable to displacement due to habitat transformation are mostly ground-nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl and White-bellied Bustard. The overall impact significance is rated as **Medium** pre-mitigation, and it will decrease to **Low** post-mitigation.

1.1.4.3 Collisions with the overhead line (OHL) in the operational phase.

The up to 132 kV OHL could pose a collision risk to virtually all powerline-sensitive avifauna, depending on where the spans are located. Several factors are thought to influence avian collisions, including the manoeuvrability of the birds, topography, weather conditions, powerline configuration, and visual capacity. Species potentially at risk are African Darter, African Grass Owl (recorded during dedicated wetland surveys), African Sacred Ibis, African Spoonbill, Black-bellied Bustard, Black-headed Heron, Blue Crane, Cape Shoveler, Cape Vulture, Denham's Bustard, Egyptian Goose, Glossy Ibis, Great Egret, Greater Flamingo, Grey Crowned

Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Little Grebe, Marsh Owl, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Sensitive Species 23, Spotted Eagle-Owl, Spur-winged Goose, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, Yellow-billed Duck and other sensitive wetland species. The overall impact significance is rated as **High** pre-mitigation, and it will decrease to **Medium** post-mitigation.

1.1.4.4 Mortality due to electrocutions on the proposed grid connection infrastructure in the operational phase

Electrocution refers to the scenario where a bird is perched, or attempts to perch, on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pylon/tower design. Should the proposed OHL be constructed using a 132 kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification due to their size and gregarious nature is the Cape Vulture. The overall impact significance is rated as **medium** pre-mitigation, and it will decrease to **low** post-mitigation.

Electrocutions within the proposed on-site substation are possible; however, the likelihood of this impact on the more sensitive Species of Conservation Concern (SCC) is remote, as these species are unlikely to regularly utilise the infrastructure within the on-site substation station for perching or roosting. Powerline sensitive species that are more vulnerable to electrocutions are medium-sized raptors, corvids, owls, and certain species of waterbirds. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, and Yellow-billed Kite. The overall impact significance is rated as **Low** pre- and post-mitigation.

1.1.4.5 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact significance is likely to be similar to that during the construction phase.

1.1.4.6 Cumulative Impacts.

There are several existing high voltage (HV) powerlines in the 35 km radius around the proposed Grid Connection Project, of which about 300 km worth of OHL is contained in the 35 km radius. The sum total of all the existing and planned HV lines in the 35 km radius amounts to an estimated 383 km, of which the proposed Emvelo WEF Grid Connection will constitute 30 km, or about 8%. The contribution of the Emvelo WEF Grid Connection to the cumulative impact of all the grid connections and existing HV lines is thus low. However, the combined contribution of all the grid connections to the cumulative impact of the HV lines in the 35 km radius, which is mainly collision mortality of priority species with the powerlines is high. The cumulative collision impact of all the grid connections and existing HV lines in the 35 km radius is assessed to be **High** pre-mitigation and **Medium** post-mitigation.

Table 18**2** summarises the expected impacts of the proposed grid connection and proposed mitigation measures per impact.

Table 2: Overall Impact Significance for the Grid Connection (Pre- and Post-Mitigation). Refer to Section 6.4 for detailed Impact Analysis Tables.

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No construction should take place in the All-Infrastructure Exclusion Zones as indicated in Section 6.5 of this report of this report unless existing roads are to be upgraded. (4) No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Low
Construction: Displacement due to habitat transformation	Medium	(1) Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. (4) No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report.	Low
Operational: Electrocutions on the grid connection infrastructure	Medium	(1) A bird-friendly pylon design should be used. (2) Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles must be implemented.	Low
Operational: Electrocutions on infrastructure in the substation complex.	Low	Monitor the electrocution mortality in the substation complex. Apply mitigation if electrocution happens regularly.	Low

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Operational: Collisions with the overhead 132 kV grid connection	High	(1) Mitigation in the form of Bird Flight Diverters on the OHL is required. The entire length of the OHL should be fitted with Eskom approved Bird Flight Diverters. Design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings. (2) The operational monitoring programme must include regular monitoring (i.e. quarterly) of the powerlines for collision mortalities.	Medium
Decommissioning: Displacement due to disturbance	Medium	(1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No off-road driving should be allowed. (4) No dismantling activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Low
Cumulative Impacts	High	As above	Medium

1.2 Conclusions

1.2.1 Wind Energy Facility

The proposed Emvelo WEF is expected to have high and medium impacts on avifauna pre-mitigation, but through the implementation of appropriate mitigation measures the impact significance could be reduced to an **overall medium and low risk**. Based on the proposed revised 22-turbine site layout plan, it is strongly recommended that the affected turbines – as indicated in Section 6.5 below - be micro-sited or removed to avoid the recommended avifaunal no-go areas and turbine exclusion zones, including the rotor-swept areas. For detailed information on the delineation of the respective exclusion zones, please refer to Section 6.5 below.

1.2.2 Grid Connection Components

The proposed Emvelo WEF Grid Connection will have a moderate impact significance on avifauna pre-mitigation which, in most instances, could be reduced to an overall low impact significance through the implementation of appropriate mitigation. From an avifaunal perspective, OHL Alternatives 1 and 2 are least preferred as they have the longest span and therefore pose a higher collision risk to birds. The Preferred OHL Alternative is preferred over OHL Alternative 3 as it avoids the 2.5 km No Disturbance Buffer around the Martial Eagle nest (coordinates provided on request).

In conclusion, the proposed WEF development and its associated electrical grid infrastructure is supported by this Specialist, on the condition that the implementation of compulsory mitigation measures as recommended in this report are strictly adhered to.

2. ENVIRONMENTAL SENSITIVITIES

According to the Animal Species Theme on the DFFE Screening Tool, the proposed WEF Project Site and the associated Grid Connection Project Area of Influence (PAOI) are classified as having a **Medium to High** sensitivity. The Medium and High sensitivity rating for avifauna is due to the possible occurrence of several Species of Conservation Concern (SCC) namely: Grey Crowned Crane (Globally and Regionally Endangered), Martial Eagle (Globally and Regionally Endangered), Southern Bald Ibis (Globally and Regionally Vulnerable), White-bellied Bustard (Regionally Vulnerable), Secretarybird (Globally Endangered and Regionally Vulnerable) and African Grass Owl (Regionally Vulnerable).

A **High** sensitivity classification for the WEF Project Site and the Grid Connection PAOI was confirmed during the on-site surveys. The following SCC were recorded on site:

- African Grass Owl (Regionally Vulnerable)
- African Marsh Harrier (Regionally Endangered)
- Denham's Bustard (Globally Near Threatened, Regionally Vulnerable)
- Secretarybird (Globally Endangered, Regionally Vulnerable)
- White-bellied Bustard (Regionally Vulnerable)
- Blue Crane (Globally Vulnerable, Regionally Near Threatened)
- Grey Crowned Crane (Globally and Regionally Endangered)
- Martial Eagle (Globally and Regionally Endangered)
- Lanner Falcon (Regionally Vulnerable)
- Greater Flamingo (Regionally Near Threatened)
- Sensitive Species 23 (Regionally and Globally Critically Endangered)
- Southern Bald Ibis (Regionally and Globally Vulnerable)
- Cape Vulture (Globally Vulnerable and Regionally Endangered)
- Yellow-breasted Pipit (Regionally and Globally Vulnerable)

Specialist Sensitivity Analysis and Verification

The following avifaunal sensitivities were identified in and near the WEF Project Site and the Grid Connection PAOI (Refer to **Section 6.5 and 6.6** for full details on the various buffer zones):

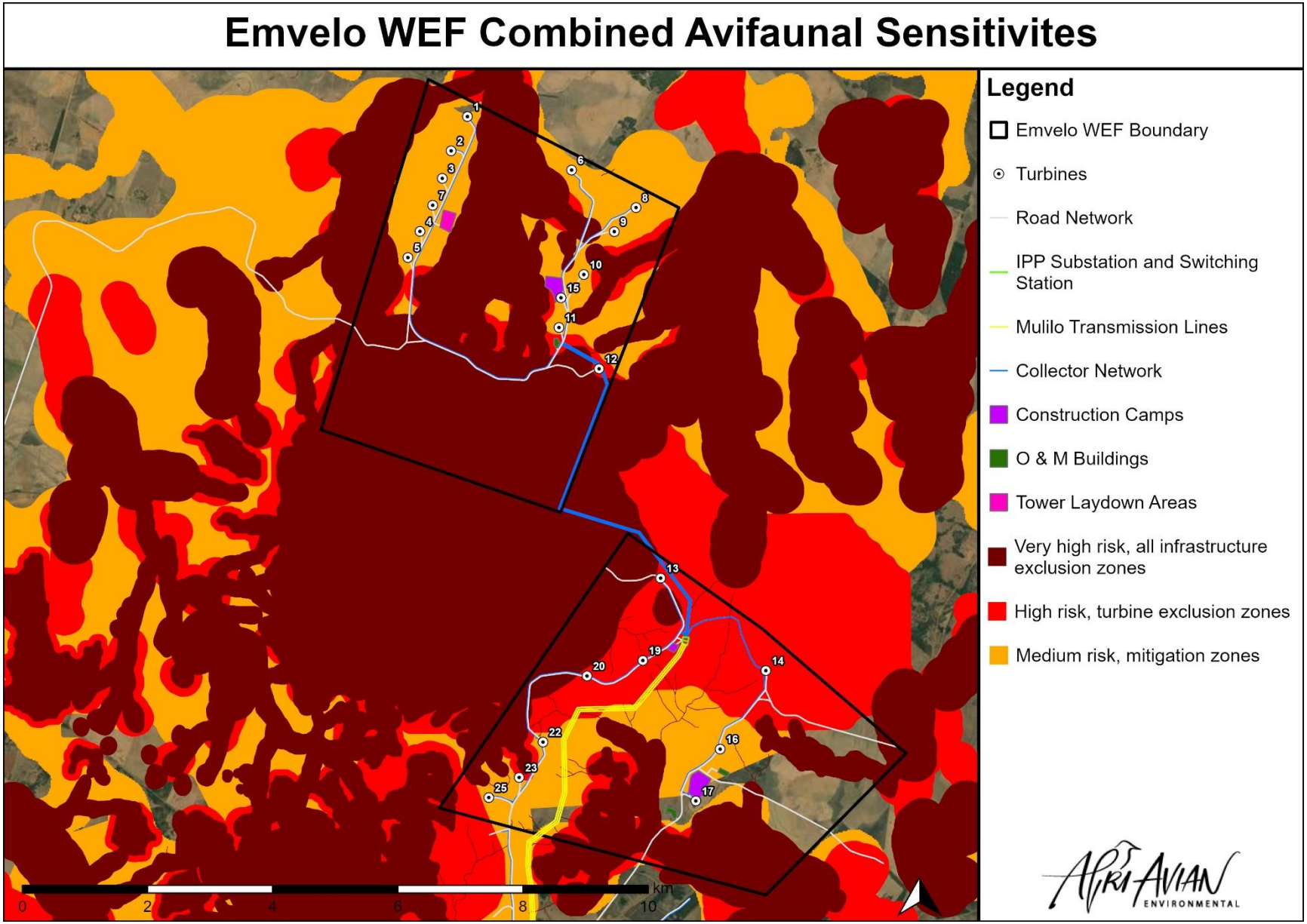


Figure (i): Combined Avifaunal Sensitivities identified for the Emvelo WEF Project.

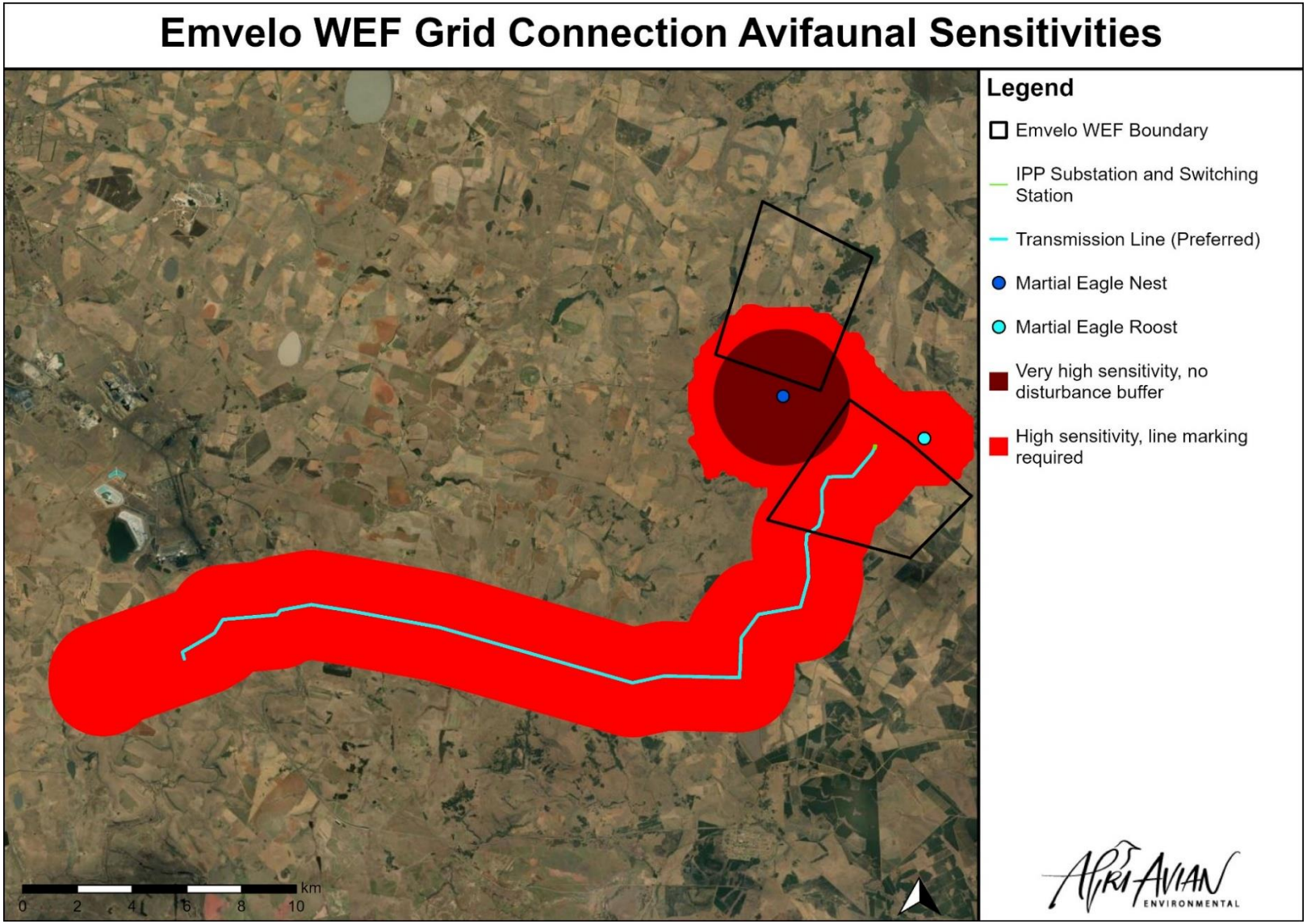


Figure (ii): Combined Avifaunal Sensitivities identified for the Emvelo Grid Connection. NOTE: Due to the large amount of wetlands/drainage lines and natural grasslands in the area it is recommended that the entire OHL be fitted with Bird Flight Diverters and a bird-friendly pylon design must be used for the OHL to minimise the electrocution risk.

PROTOCOLS FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON AVIFAUNAL SPECIES BY ONSHORE WIND ENERGY GENERATION FACILITIES WHERE THE ELECTRICITY OUTPUT IS 20 MEGAWATTS OR MORE & THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL ANIMAL SPECIES (GOVERNMENT GAZETTE NO 43855, 30 OCTOBER 2020)

Report Content Requirements	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 13
c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 1 & 2
(cA) an indication of the quality and age of base data used for the specialist report;	Sections 1 & 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 5 & 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Appendices 10 & 11
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Sections 1 & 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
g) an identification of any areas to be avoided, including buffers;	Section 6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Section 6
k) any mitigation measures for inclusion in the EMPr;	Sections 6.5 & 6.6, Appendices 7 & 8
l) any conditions for inclusion in the environmental authorisation;	Sections 6.5 & 6.6, Appendices 7 & 8

m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Sections 6.5 & 6.6, Appendices 7 & 8
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
q) any other information requested by the competent authority.	Not applicable
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	All sections

Error! Reference source not found.
1. EXECUTIVE SUMMARY II
1.1 Summary of Findings ii

1.2 Conclusions xiv
2. ENVIRONMENTAL SENSITIVITIES XIV
1. INTRODUCTION 25
1.1 Terms of Reference 25
1.2 Specialist Credentials 25
1.3 Assessment Methodology 25
2. ASSUMPTIONS AND LIMITATIONS 27
3. TECHNICAL DESCRIPTION 28
3.1 Project Location 28
3.2 Project Description 32
3.3 Layout Alternatives 33
4. LEGAL REQUIREMENT AND GUIDELINES 37
4.1 Agreements and Conventions 37
4.2 National Legislation 38
4.3 Provincial Legislation 39
4.4 Best Practice Guidelines 39
5. DESCRIPTION OF THE RECEIVING ENVIRONMENT 39
5.1 Natural Environment 39
5.2 Modified Environment 40
5.3 Key Biodiversity Areas (KBAs) 40
5.4 The DFFE National Screening Tool 42
5.5 National Protected Areas 45
5.6 Site Ecological Importance 45
5.7 Avifauna in the Broader Area 47
5.8 Results of Pre-Construction Bird Monitoring 59
6. SPECIALIST FINDINGS AND ASSESSMENT OF IMPACTS 81
6.1 Wind Energy Facility (WEF) 81
6.2 Grid Connection Components 89
6.3 The Identification and Assessment of Potential Impacts: Wind Energy Facility 94
6.4 The Identification and Assessment of Potential Impacts: Grid Components 99
6.5 The Identification of Environmental Sensitivities: Wind Energy Facility 102
6.6 The Identification of Environmental Sensitivities: Grid Components 110
6.7 Cumulative Impacts 111
6.8 Conditions for inclusion in the EMPr: WEF 115
6.9 Conditions for inclusion in the EMPr: Grid Connection Components 115
7. COMPARATIVE ASSESSMENT OF ALTERNATIVES 115
7.1 Wind Energy Facility 115
7.2 Grid Components 115
7.3 No-Go Alternative 115

8. CONCLUSION AND SUMMARY 116
8.1 Summary of Findings 116
8.2 Conclusions 128
8.3 Conditions for inclusion in the Environmental Authorisation 128
9. ENVIRONMENTAL SENSITIVITIES 128
10. POST CONSTRUCTION MONITORING PROGRAMME 131
11. REFERENCES 131
APPENDIX 1: TERMS OF REFERENCE 136
APPENDIX 2: SPECIALIST CV 137
APPENDIX 3: PRE-CONSTRUCTION MONITORING PROTOCOL 145
APPENDIX 4: BIRD HABITAT 149
APPENDIX 5: SABAP2 SPECIES LIST FOR THE BROADER AREA 151
SPECIES RECORDED DURING PRE-CONSTRUCTION MONITORING 158
APPENDIX 6: ASSESSMENT CRITERIA 163
APPENDIX 7: ENVIRONMENTAL MANAGEMENT PLAN FOR THE WEF 166
APPENDIX 8: ENVIRONMENTAL MANAGEMENT PLAN FOR THE GRID CONNECTION 181
APPENDIX 9: OPERATIONAL MONITORING PLAN WEF 186
APPENDIX 10: SITE SENSITIVITY VERIFICATION WEF 190
APPENDIX 11: SITE SENSITIVITY VERIFICATION GRID CONNECTION 194
APPENDIX 12: BLADE PATTERNING GUIDELINES 197
APPENDIX 13: SPECIALIST DECLARATION OF INDEPENDENCE 201
APPENDIX 14: ESTIMATED ANNUAL FATALITY THRESHOLDS 204
APPENDIX 15: POTENTIAL BIOLOGICAL REMOVAL METHODOLOGY 205

LIST OF TABLES

Table 1: Overall Impact Significance for the WEF (Pre- and Post-Mitigation). Refer to Section 6.3 for detailed Impact Analysis Tables. v
Table 2: Overall Impact Significance for the Grid Connection (Pre- and Post-Mitigation). Refer to Section 6.4 for detailed Impact Analysis Tables. xii
Table 3: The number of SABAP2 lists completed for the Broader Area 26
Table 4: Agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna. 37
Table 5: Wind Energy Priority Species Recorded in The Broader Area. 49
Table 6: Powerline Sensitive Species Recorded in The Broader Area. 52
Table 7: The Results of The Walk and Drive Transects. 60
Table 8: Results of Focal Point Surveys 63
Table 9: Incidental records (actual counts) of priority species made during the seasonal surveys (seven surveys) at the Mulilo WEF Cluster (Emvelo and Sheepmoor WEFs). 63
Table 10: Rating of impacts: Construction Phase 94
Table 11: Rating of impacts: Operational Phase 96
Table 12: Rating of impacts: Decommissioning Phase 98
Table 13: Rating of impacts: Construction Phase 99
Table 14: Rating of impacts: Operational Phase 100
Table 15: Rating of impacts: Decommissioning Phase 101
Table 16: Rating of Cumulative Impacts: WEF 113
Table 17: Rating of Cumulative Impacts: Grid Connection Components 114
Table 18: Overall Impact Significance for the proposed Emvelo WEF (Pre- and Post-Mitigation) 119
Table 19: Overall Impact Significance for the Grid Connection (Pre- and Post-Mitigation) 126

LIST OF FIGURES

Figure 1: Project Location within Broader Area of 12 SABAP2 Pentads. 27
Figure 2: Regional Context Map showing the location of the proposed Mulilo WEF Cluster and its associated grid connection east of Ermelo. 29
Figure 3: Map showing the Preferred Route Alignment for the Proposed 132 kV Overhead Power Line (in light blue) and the Avifaunal PAOI for the grid connection corridor (indicated in dark blue). 31
Figure 4: The final proposed Site Layout Plan of the Emvelo WEF. 34
Figure 5: Proposed layout alternatives for the Emvelo WEF Grid Connection. 36
Figure 6: Key Biodiversity Areas in the vicinity of the proposed Emvelo WEF Project site. 41
Figure 7: The full extent of the Chrissie Pans KBA in relation to the proposed Emvelo WEF site. 41
Figure 8: The Biodiversity elements triggering the KBA criteria as it relates to the Chrissie Pans Key Biodiversity Area. 42
Figure 9: The classification of the Emvelo WEF Project Site according to the Animal Species Theme in the DFFE National Screening Tool. 43
Figure 10: The classification of the Emvelo WEF Project Site according to the Vulture Species Theme in the DFFE National Screening Tool. 44
Figure 11: The National Web-Based Environmental Screening Tool map of the Grid PAOI, indicating sensitivities for the Animal Species Theme. 45
Figure 12: The location of the Martial Eagle nest and roost sites indicating a 2.5 km no-go buffer for all infrastructure around the nest site. 58
Figure 13: Index of kilometric abundance of priority species recorded at the WEF and control site during drive transect surveys (seven surveys). 61
Figure 14: Index of kilometric abundance of priority species recorded at the WEF during walk transect surveys (seven surveys). 61
Figure 15: The location of priority species recorded at the proposed Emvelo WEF through transect counts and incidental sightings. 62
Figure 16: Recorded Flight Times (in Hours: Minutes: Seconds) and Flight Altitudes (High/Medium/Low) of Priority Species (during the first seven surveys, excluding the additional five surveys conducted as part of the Martial Eagle monitoring). 65
Figure 17: Recorded flight lines of priority species in and near the Emvelo WEF Project Site (based on data recorded from seven surveys). 68
Figure 18: Recorded flight lines for Martial Eagle during the additional five surveys (V1 to V5) in and near the Emvelo WEF Project Site. 69
Figure 19: Recorded flight lines of all other priority species (excluding Martial Eagle) during the additional five surveys (V1 to V5) in and near the Emvelo WEF Project Site. 70
Figure 20: Recorded Flight Times (in Hours: Minutes: Seconds) and Flight Altitudes of Priority Species including Martial Eagle. 73
Figure 21: Total distance travelled by the adult female Martial Eagle by hour of day. 75
Figure 22: Proportion of time spent by the tracked Martial Eagles (ME) within varied distance bands from the nest site. Orange – Adult female ME (Amsterdam); Blue – Adult male ME (Verkykerskop); Green – Juvenile ME (April 2024 to May 2025). 75
Figure 23: Total distance travelled by the adult female Martial Eagle across months of the year. 76
Figure 24: Total distance travelled by the adult female Martial Eagle across varied temperature classes. 76
Figure 25: Total distance travelled by the adult female Martial Eagle across varied wind speed classes. 77
Figure 26: Collision risk modelling predicted fatalities for Sensitive Species 23 and the Yellow-breasted Pipit with two estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with avoidance of core habitats (blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year. 79
Figure 27: Collision risk modelling predicted fatalities for non-threatened priority species with two estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with stringent mitigation (Automated SDoD and proactive curtailment) for all authorised turbines located in high and medium risk zones (blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year. 80
Figure 28: Collision risk modelling predicted fatalities for threatened priority species with four estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with avoidance of very high and high-risk zones but no

additional mitigation (dark blue); 3) revised WEF layout with both avoidance of very high and high-risk zones and stringent mitigation for Martial Eagle and Southern Bald Ibis (mitigation = compulsory Automated SDoD and diurnal proactive curtailment) (blue); and 4) revised WEF layout with stringent mitigation (mitigation = compulsory Automated SDoD and diurnal proactive curtailment) (light blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year. 81
Figure 29: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data) 91
Figure 30: Buffer zones around the Martial Eagle nest and roost. 104
Figure 31: Aquatic buffer zones from an avifaunal perspective. 105
Figure 32: Recommended buffer zones around suitable Sensitive Species 23 habitat. 106
Figure 33: No-Go Zones around Yellow-breasted Pipit Habitat. 107
Figure 34: Proposed shaped turbine exclusion zones and medium sensitivity zones around Southern Bald Ibis colonies/habitat. 108
Figure 35: Combined avifaunal sensitivity map for the proposed Emvelo WEF. 109
Figure 36: Avifaunal Sensitivities identified for the Emvelo Grid Connection. NOTE: Due to the large amount of wetlands/drainage lines and natural grasslands in the area it is recommended that the entire OHL be fitted with Bird Flight Diverters. And a bird-friendly pylon design must be used for the OHL to minimize the electrocution risk. 111
Figure 37: Renewable energy projects within a 50 km radius of the proposed Emvelo WEF. 112
Figure 38: Proposed renewable energy projects within a 35 km radius around the proposed Emvelo WEF. 114
Figure 39: Avifaunal Sensitivities identified for the Emvelo WEF Project. 130
Figure 40: Avifaunal Sensitivities identified for the Emvelo Grid Connection. 130

LIST OF APPENDICES

Appendix 1: Terms of Reference
Appendix 2: Specialist CV
Appendix 3: Pre-Construction Monitoring Protocol
Appendix 4: Bird Habitat
Appendix 5: Species List for the Broader Area
Appendix 6: Assessment Criteria
Appendix 7: Environmental Management Plan - WEF
Appendix 8: Environmental Management Plan - Grid Connection
Appendix 9: Operational Monitoring Plan WEF
Appendix 10: Site Sensitivity Verification WEF
Appendix 11: Site Sensitivity Verification Grid Connection
Appendix 12: Blade Patterning Guidelines
Appendix 13: Specialist Declaration of Independence
Appendix 14: Estimated Annual Fatality Thresholds
Appendix 15: Potential Biological Removal Methodology

GLOSSARY OF TERMS

Definitions	
Broader Area	A consolidated data set for a total of 12 pentads where the project sites are located.
Powerline Priority Species	Priority species were defined as species which could potentially be impacted by power line collisions or electrocutions, based on specific morphological and/or behavioural characteristics[1]. Priority species were further subdivided into raptors, waterbirds, terrestrial birds, and corvids.
Wind Priority Species	Priority species for wind energy development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief et al. 2012).

LIST OF ABBREVIATIONS

BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BLSA	BirdLife South Africa
DFFE	Department of Forestry, Fisheries and the Environment
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
HV	High Voltage
IBA	Important Bird Area
IKA	Index of Kilometric Abundance
IUCN	International Union for Conservation of Nature
kV	Kilovolt
MV	Medium Voltage
NEMA	National Environmental Management Act (Act 107 of 1998, as amended)
OHL	Overhead line
PAOI	Project Area of Influence
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SABAP1	First Southern African Bird Atlas Project
SABAP2	Second Southern African Bird Atlas Project
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African Biodiversity Institute
SAPAD	South Africa Protected Areas Database
SCC	Species of Conservation Concern
WEF	Wind Energy Facility

[1] Other species were also considered in the case of potential displacement due to disturbance associated with the construction of the grid.

1. INTRODUCTION

Respective Special Purpose Vehicles (SPVs) are proposing the development of a commercial wind farm cluster that is expected to comprise two separate Wind Energy Facilities (WEFs) namely, the Sheepmoor WEF (up to 240 MW) and the Emvelo WEF (up to 240 MW). Each WEF will apply for its own grid connection route to connect to the newly proposed Camden B substation. The proposed development sites are located east of Ermelo and falls within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province. It is intended that these projects would be bid in the seventh bidding window of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the aim of evacuating the generated power from the WEFs into the National Eskom Grid. This will aid in the diversification and stabilisation of the country's electricity supply in line with the objectives of the Integrated Resource Plan (IRP).

This report serves as the **Avifaunal Specialist Study** for the proposed **Emvelo WEF**.

The Emvelo WEF is proposed to comprise up to 22 turbines with a maximum output capacity of up to 240 MW. The WEF will be located on ten (10) land parcels and will have an anticipated lifespan of up to 25 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed permanent turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation. It is proposed that an up 132 kV on-site substation complex and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km in length (within a 300 m assessment corridor) that traverses thirty-five (35) land parcels, be constructed to connect the proposed WEF to the newly proposed Camden B substation. Four alternative powerline routings have been proposed, namely OHL Preferred, OHL Alternative 1, OHL Alternative 2 and OHL Alternative 3.

According to the Southern African Bird Atlas Project (SABAP2) a total of 253 bird species could potentially occur in the Broader Area where the proposed Emvelo WEF and Gird Connection Infrastructure are located. Of the 253 species, 38 species are classified as priority species for wind energy developments. Of the wind energy development priority species in the Broader Area, 32 (84%) have been recorded during the pre-construction monitoring. Of the 253 species, 76 are considered power line sensitive species and 57 (75%) of the power line sensitive species have been recorded during the pre-construction monitoring.

1.1 Terms of Reference

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts;
- Give a considered opinion whether the project is fatally flawed from an avifaunal perspective; and
- If not fatally flawed, recommend mitigation measures to reduce the expected impacts.

For the general Terms of Reference for all specialist reports, please see **Appendix 1.**

1.2 Specialist Credentials

Please see **Appendix 2** for Specialist CVs.

1.3 Assessment Methodology

The following methods and sources were used to compile this report:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), to ascertain which species occur within the **Broader Area** i.e. within a block consisting of 12 pentads (**Table 3**, **Figure 1**). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 9 km. From 2007 to date, a total of 179 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 218 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2022.2) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF Project Site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2023) was used in order to view the Broader Area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind energy developments were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the WEF and Grid connection sites.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the sites were the results of a pre-construction programme conducted over four seasons (2022–2023) at the proposed Mulilo WEF Cluster (Emvelo WEF and Sheepmoor WEF project sites). The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **Appendix 3** for a detailed explanation of the monitoring methods).
- Information gained from pre-construction monitoring at four potential wind farm sites in close proximity to the proposed Emvelo WEF site, namely Ujekamanzi WEFs 1–2 and Camden WEFs 1–2 also assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.

Table 3: The number of SABAP2 lists completed for the Broader Area

Pentad	Full protocol lists	Ad hoc protocol lists
2630_3005	43	11
2630_3010	58	15
2630_3015	26	17
2630_3020	7	10
2635_3005	26	44
2635_3010	29	5
2635_3015	23	8
2635_3020	18	1
2640_3005	29	14
2640_3010	7	32

Pentad	Full protocol lists	Ad hoc protocol lists
2640_3015	15	36
2640_3020	4	25
Total	**285**	**218**

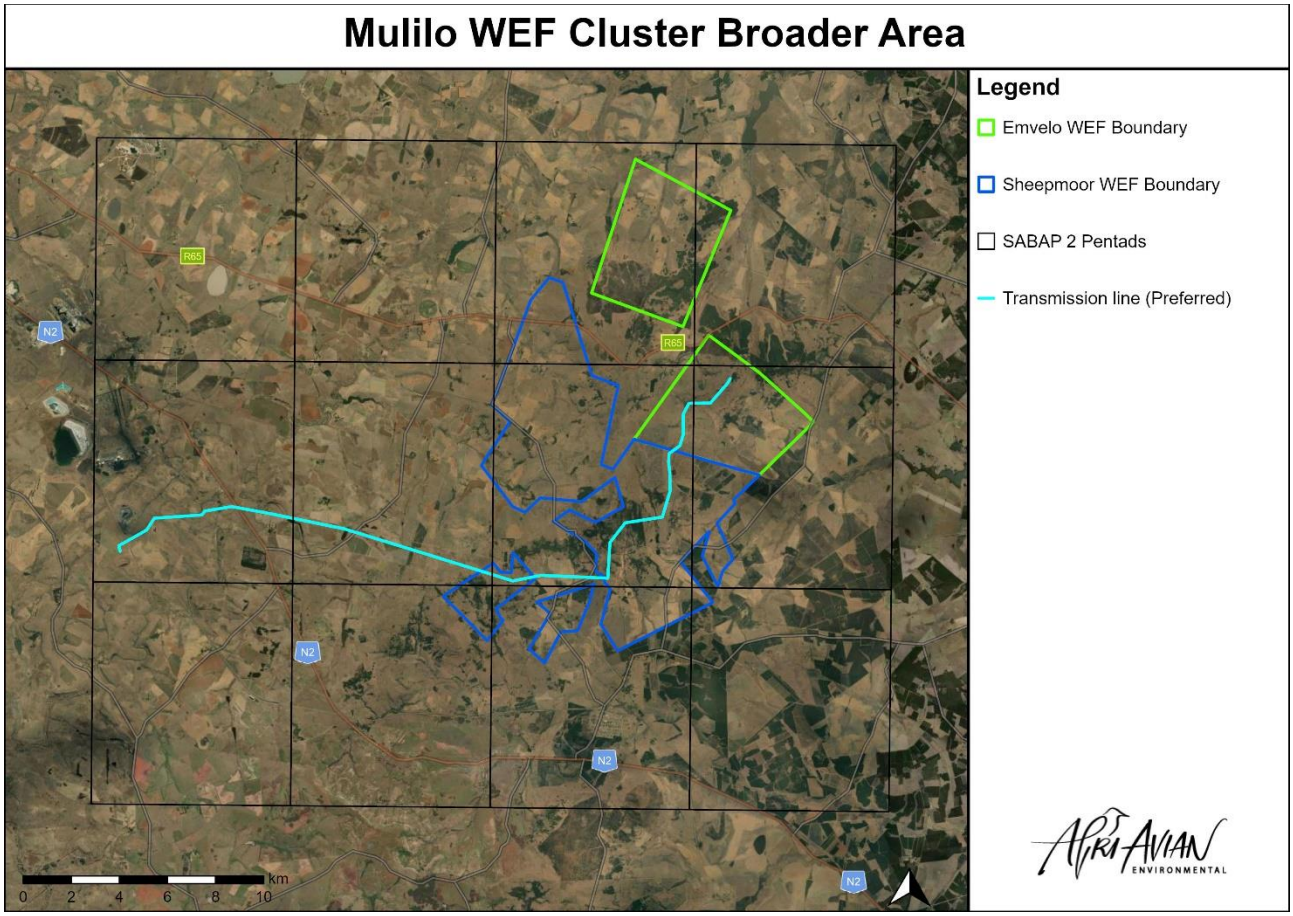


Figure 1: Project Location within Broader Area of 12 SABAP2 Pentads.

2. ASSUMPTIONS AND LIMITATIONS

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 which 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 conducted over four seasons.
- Conclusions in this study are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- To date, only one peer-reviewed scientific paper has been published on the impacts that wind farms have on birds in South Africa (Perold *et al*. 2020). 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: “in order 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.”

- According to the specifications received from the proponent, the 33 kV medium-voltage lines will be buried next to the roads where practically feasible. It was therefore assumed that there could be 33 kV overhead lines which could pose an electrocution risk to priority species.
- **Priority species for wind energy developments** were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).
- Priority species for powerline developments (i.e., **powerline sensitive species**) were defined as species which could potentially be impacted by powerline collisions or electrocutions, based on specific morphological and/or behavioural characteristics. Species classes which fall under these categories are raptors, large terrestrial birds, waterbirds, and crows.
- The **Project Area of Influence (PAOI)** from an avifaunal perspective for the proposed 132 kV grid connection was assumed to be a 2 km buffer area around the proposed alignments. The 300 m assessment corridor falls within this buffer area.

3. TECHNICAL DESCRIPTION

3.1 Project Location

Respective Special Purpose Vehicles (SPVs) are proposing the development of a commercial wind farm cluster, the Mulilo WEF Cluster, that is expected to comprise two separate Wind Energy Facilities (WEFs) namely, the Sheepmoor WEF (up to 240 MW) and the Emvelo WEF (up to 240 MW). Each WEF will apply for its own grid connection route to connect to the newly proposed Camden B substation, via 132 kV overhead transmission powerlines of approximately 20–32 km in length.

The proposed WEF development sites are located east of Ermelo and falls within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province (**Error! Reference source not found.**).

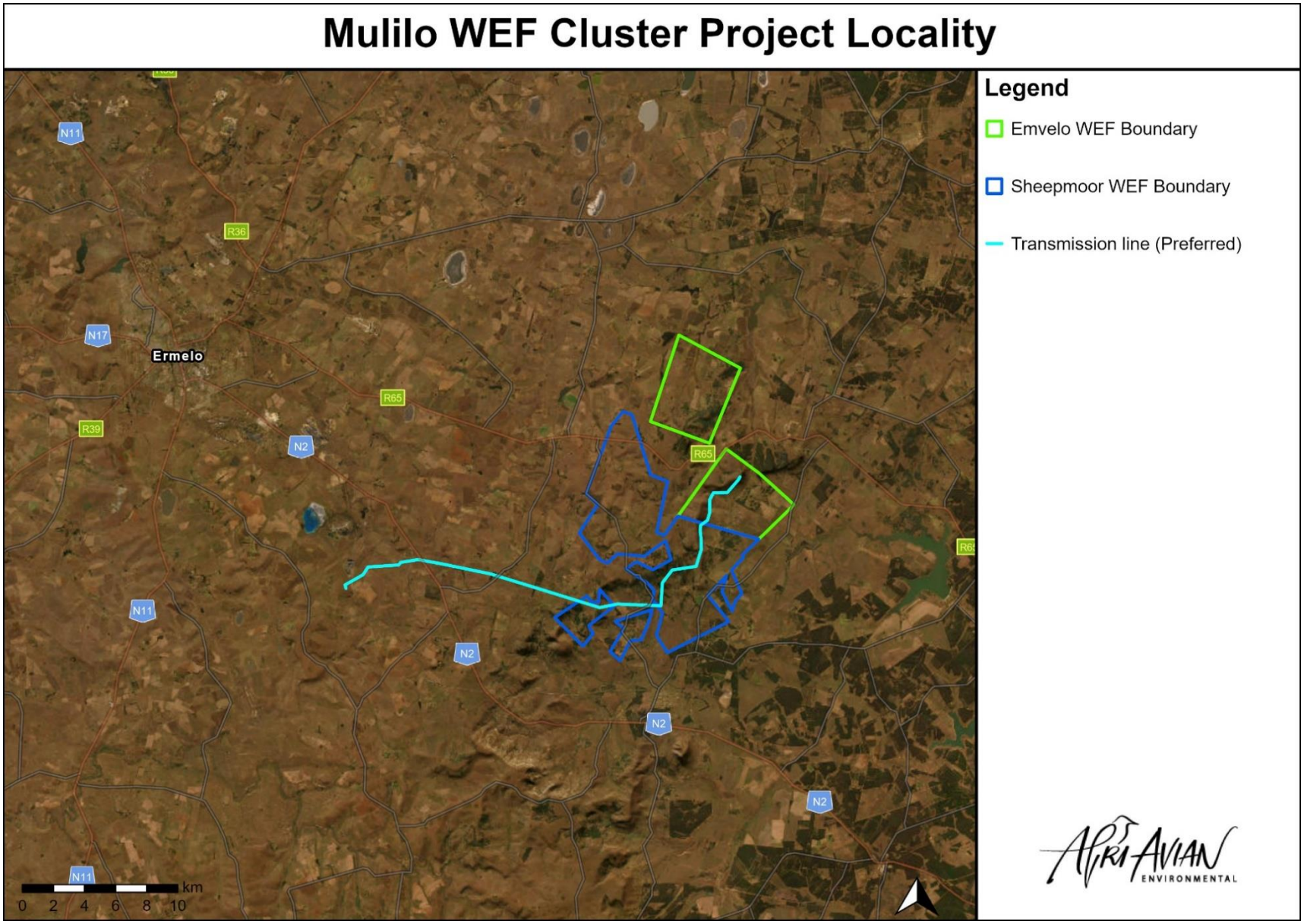


Figure 2: Regional Context Map showing the location of the proposed Mulilo WEF Cluster and its associated grid connection east of Ermelo.

3.1.1 WEF

The **Emvelo WEF** project site as shown on the locality map above (**Figure 2**) comprises approximately 4654 hectares (ha) in extent and incorporates the following farm portions:

Emvelo WEF			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
Rozina Elizabeth De Villiers	Schimmelhoek	272	1
Wiek Cloete Trust	Schimmelhoek	272	2
Wiek Cloete Trust	Schimmelhoek	272	5
DC Geldenhuys Family Trust	Remainder of the Farm Schiedam No. 274	274	RE
Randell's Ranch Trust (Philip Randall)	Portion 2 of the Farm Schiedam No. 274	274	2

3.1.2 Grid Connection

It is proposed that an on-site substation complex with a capacity of up to 132 kV and an up to 132 kV Overhead Powerline (OHL) of approximately 30 km in length, traversing thirty-five (35) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation. The preferred 132kV OHL route alignment and Project Area of Influence (PAOI) are shown in **Figure 3.**

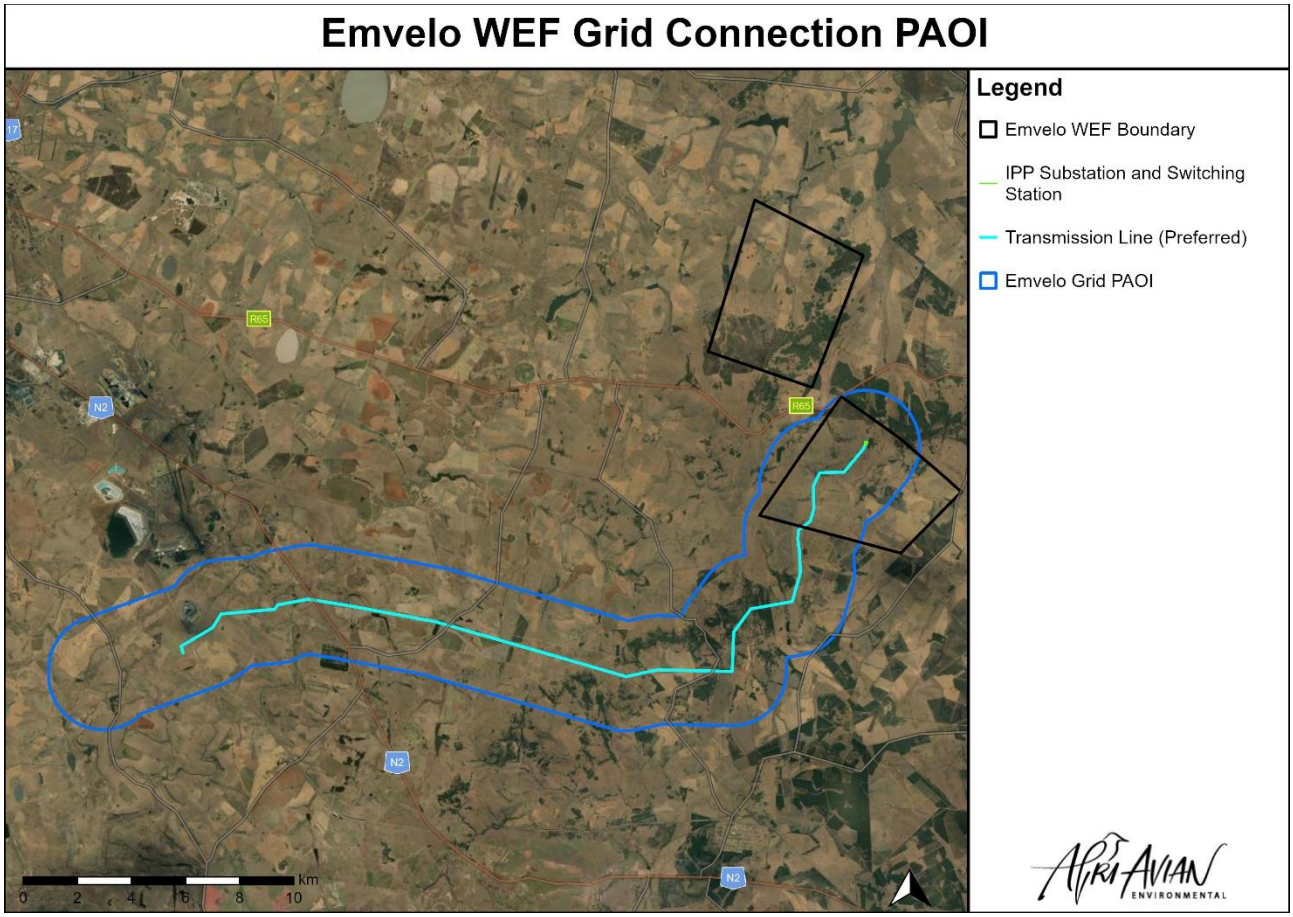


Figure 3: Map showing the Preferred Route Alignment for the Proposed 132 kV Overhead Power Line (in light blue) and the Avifaunal PAOI for the grid connection corridor (indicated in dark blue).

Emvelo WEF Grid Connection			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
DC Geldenhuys Family Trust	Remainder of the Farm Schiedam No. 274	274	RE
Randell's Ranch Trust (Philip Randall)	Schiedam	274	2
Antonette Swart	Remainder Portion 1 of the Farm Schiedam No. 274	274	1
Henry Goodwin Geldenhuys	Portion 6 of the Farm Schiedam No. 274	274	6
Loufried Testamentere Trust	Portion 5 of the Farm Schiedam No. 274	274	5
Johan Saaiman Trust	Portion 9 of the Farm Waaihoek No. 286	286	9
Johannes Stephanus Roberts	Remainder Portion 6 of the Farm Waaihoek No. 286	286	6
Johannes Stephanus Roberts	Remainder Portion 13 of the Farm Waaihoek No. 286	286	13
Johannes Stephanus Roberts	Remainder Portion 2 of the Farm Waaihoek No. 286	286	2

Emvelo WEF Grid Connection			
Freddie Van Oudtshoorn Trust	Portion 11 of Farm Waaihoek No. 286	286	11
Josua Meyer Trust	Waaihoek	286	3
Josua Meyer Trust	Waaihoek	286	12
Josua Meyer Trust	Waaihoek	286	4
Tallyprops 7 Pty Ltd (Pieter Langenhoven)	Remainder Portion 8 of the Farm Windhoek No. 291	291	8
	Onverwacht	287	RE
National Government of SA	Zwartwater	288	6
National Government of SA	Zwartwater	288	1
Dream World Inv 450 Pty Ltd	Weltevreden	289	10
Dream World Inv 450 Pty Ltd	Weltevreden	289	11
Dream World Inv 450 Pty Ltd	Weltevreden	289	6
Van Der Merwe Broers Trust	Weltevreden	289	RE/3
National Government of SA	Witpunt	267	RE/7
National Government of SA	Mooiplaats	290	7
National Government of SA	Mooiplaats	290	8
Eglin Inv No 44 Pty Ltd	Mooiplaats	290	RE/1
Eglin Inv No 44 Pty Ltd	Mooiplaats	290	RE/9

3.2 Project Description

The Emvelo WEF is proposed to comprise up to 22 turbines with a maximum output capacity of up to 240 MW. The WEF will be located on ten (10) land parcels and will have an anticipated lifespan of 20–25 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design.

It is proposed that an on-site substation with a capacity up to 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing thirty-five (35) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation.

The proposed technical details of the proposed Emvelo WEF are presented in the table below:

Developer / Applicant	**Emvelo Wind Energy Facility (Pty) LTD**
DFFE Reference	14/12/16/3/3/2/2611
WEF Generation Capacity	Up to 240 MW
Site Access	Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3 m width for underground 33 kV reticulation.
Number of Turbines	Up to 22

Hub Height from ground level	Up to 150 m
Blade Length	Up to 91 m
Rotor Diameter	Up to 182 m
Length of internal roads	To be confirmed
Width of internal roads	Up to 12 m during construction, to be rehabilitated to up to 9 m.
On-site substation capacity	Up to 132 kV
Proximity to grid connection	Approximately 30 km
Grid Connection Capacity	Up to 132 kV
Temporary turbine construction laydown and storage areas.	Crane platforms and hardstand laydown areas up to a total of 40 ha (Up to 1 ha per turbine)
Permanent footprint area dimensions, including roads, turbine hardstand areas, O&M buildings, and battery pad.	O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha
Operations and maintenance buildings (O&M building) with parking area	Up to 1 ha
Height of fencing	Up to 2.8 m
Type of fencing	Where site offices are required, temporary screen fencing is used to screen offices from the wider landscape.

It is intended that the proposed Emvelo WEF be bid in upcoming bidding windows of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the aim of evacuating the generated power from the WEFs into the National Eskom Grid. This will aid in the diversification and stabilisation of the country's electricity supply in line with the objectives of the Integrated Resource Plan (IRP).

3.3 Layout Alternatives

3.3.1 Wind Energy Facility

The final layout is assessed as part of the EIA Phase. The proposed WEF layout is shown in **Figure 4** below.

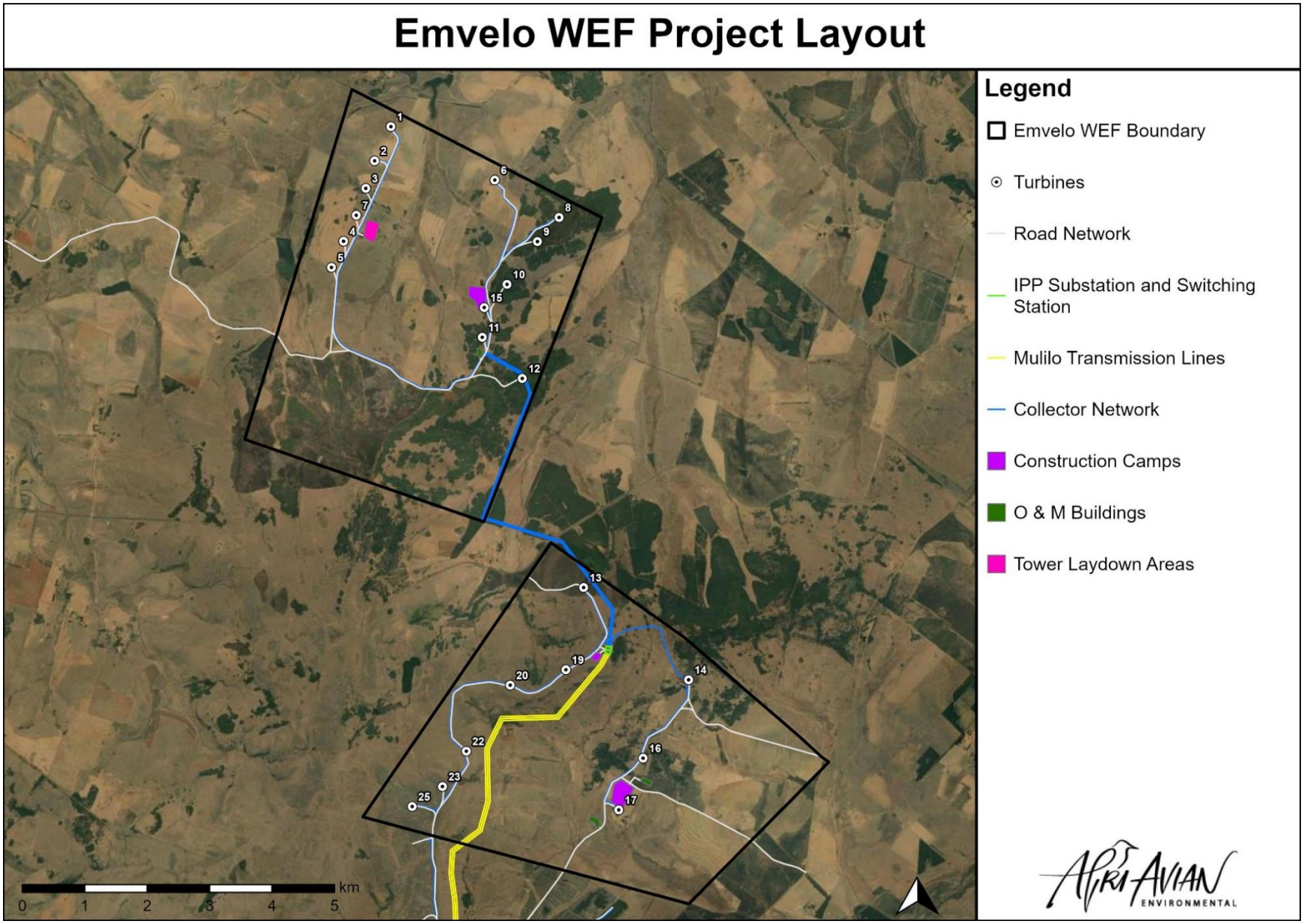


Figure 4: The final proposed Site Layout Plan of the Emvelo WEF.

3.3.2 Grid Components

The grid connection infrastructure proposal connecting the proposed Emvelo WEF to the newly proposed Camden B Substation includes four (4) transmission line route alignment alternatives (**Figure 5**), each within a 300 m wide assessment corridor (150 m on either side of the proposed powerline). These alternatives have been considered and assessed as part of the EIA Phase and will be amended or refined to avoid identified environmental sensitivities.

The four options are:

- 132kV OHL Preferred – 32.9 km
- 132kV OHL Alternative 1 – 33.5 km
- 132kV OHL Alternative 2 – 35.2 km
- 132kV OHL Alternative 3 – 35.9 km

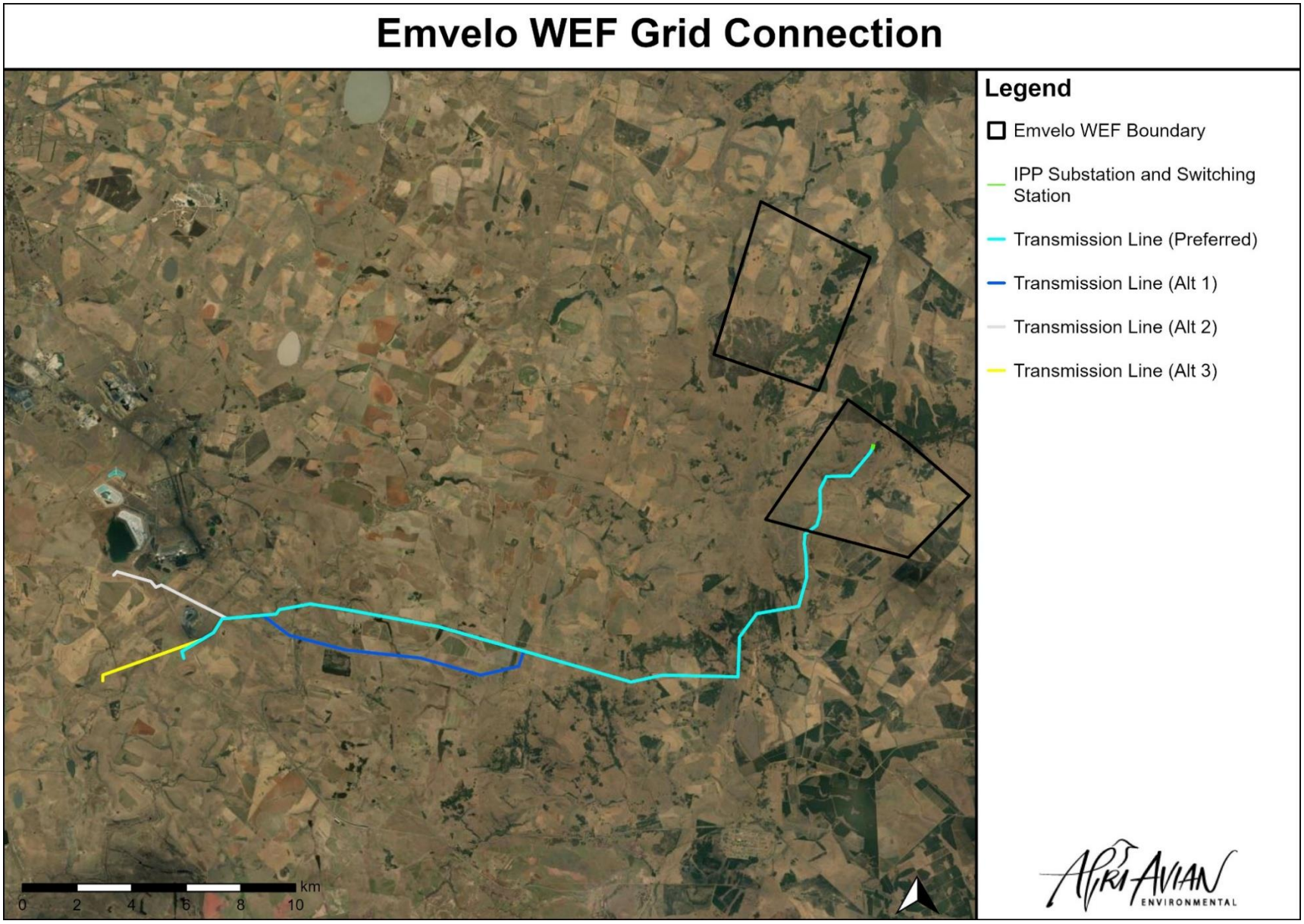


Figure 5: Proposed layout alternatives for the Emvelo WEF Grid Connection.

3.3.3 No-go Alternative

The ‘no-go’ alternative is the option of not undertaking the proposed WEF and / or Grid Connection Infrastructure projects. Hence, if the ‘no-go’ option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed projects on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

4. LEGAL REQUIREMENT AND GUIDELINES

4.1 Agreements and Conventions

Table 4 below lists agreements and conventions which South Africa is party to, and which is directly relevant to the conservation of avifauna (BirdLife International 2020).

Table 4: Agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna.

Convention	Description	Geographic Scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland, and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna,	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global

(CITES), Washington DC, 1973		
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

4.2 National Legislation

4.2.3 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –
(a) to an environment that is not harmful to their health or well-being; and
(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
(i) prevent pollution and ecological degradation;
(ii) promote conservation; and
(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

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

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out several guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally, and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. 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) is applicable in the case of powerline developments. In the case of wind energy developments, the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species where the output is 20MW or more (Government Gazette No 43110, 20 March 2020) is applicable.

4.2.5 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act 10 of 2004 read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

4.3 Provincial Legislation

4.3.1 Mpumalanga Nature Conservation Act 10 of 1998

The current legislation applicable to the conservation of fauna and flora in the province is the Mpumalanga Nature Conservation Act 10 of 1998. It consolidated and amended the laws relating to nature conservation within the province and provides for matters connected therewith. All birds are classified as Protected Game (Section 4 (1) (b)), except those listed in Schedule 3, which are classified as Ordinary Game (Section 4 (1)(c)).

4.4 Best Practice Guidelines

The South African “Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa” (Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011) are followed for this study. This document was published by the Endangered Wildlife Trust (EWT) and Birdlife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1 Natural Environment

The proposed Emvelo WEF and Grid Connection Project Site is situated in the Grassland Biome, in the Mesic Highveld Grassland Bioregion (Mucina & Rutherford 2006). The proposed site is comprised of undulating grassland plains, with small, scattered patches of dolerite outcrops in areas, low hills, pan depressions and drainage lines with associated wetland areas. Vegetation on site consists predominantly of Wakkerstroom Montane Grassland and Eastern Highveld Grassland. Wakkerstroom Montane Grassland comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* (ouhout) thickets occurring along steep, mainly east-facing slopes, and drainage areas (Mucina & Rutherford 2006). Eastern Highveld Grassland vegetation is comprised of a short, closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn (Mucina & Rutherford 2006). The black wattle, *Acacia mearnsii* is an aggressive invader of riparian areas. Stands of alien *Eucalyptus* and *Pinus* species are scattered throughout the proposed development area.

Ermelo has a temperate climate. January is the warmest month with a maximum temperature of 24.4 C°. June and July are the coldest months, with a minimum temperature of 0.2 C°. The driest month is June with an average of 3 mm of precipitation. Most of the precipitation falls in December, averaging 151 mm. The average annual precipitation is around 756 mm (Climate – data.org 2021). The topography in the project area is characterised by gentle undulating plains. The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. The livestock in the study area is a combination of mostly sheep and cattle, with a few horses.

The natural environment within the project area is impacted by anthropogenic disturbance. Overgrazing of grassland and wetland vegetation, especially during the dry season, causes degraded veld conditions and excessive trampling of wetlands. This is exacerbated by the intensified frequency with which grassland and wetland vegetation is burned, especially during the dry season. Additionally, the proliferation of alien plant infestation in the broader landscape, as well as the complete transformation of indigenous vegetation to crop fields for agriculture further contributes towards the overall habitat deterioration in the region.

5.2 Modified Environment

Whilst the distribution and abundance of the bird species in the Broader Area are mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine the few external modifications to the environment that have relevance for birds.

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the Broader Area:

- **Surface Water:** The WEF Project Site and Grid Connection PAOI contains several man-made sources of surface water such as ground dams and boreholes. These sources of water are important for birds for drinking and bathing.
- **Alien Trees:** There are clumps and stands of alien trees throughout the WEF Project Site and Grid Connection PAOI. Alien trees could attract a variety of bird species for the purposes of nesting and roosting.
- **Agriculture:** The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. Birds could be attracted to these areas in search of food.

Appendix 4 provides a photographic record of the habitat at the Project Site.

5.3 Key Biodiversity Areas (KBAs)

Key Biodiversity Areas (KBA's) are 'sites that contribute significantly to the global persistence of biodiversity', which means they are the most important places in the world for species and their habitats – whether these be in terrestrial, freshwater, estuarine or marine ecosystem.

The Global Standard for the Identification of Key Biodiversity Areas, published in 2016, sets out internationally agreed scientific criteria for the identification of KBAs worldwide. Sites qualify as global KBAs if they meet the specific standardised criteria and quantitative thresholds focused on one or more of five trigger aspects:

1. Threatened biodiversity
2. Geographically restricted biodiversity
3. Ecological integrity
4. Biological processes
5. Irreplaceability through quantitative analysis

The Project Site (Emvelo WEF & Grid Connection) overlaps with one Key Biodiversity Area (KBA), namely the Chrissie Pans KBA (**Figure 6 and Figure 7**).

This KBA qualifies as a Key Biodiversity Area of international significance that meets the thresholds for three (3) criteria described in the Global Standard for the Identification of KBAs. Based on current available information, the Chrissie Pans KBA meets criterion A1 due to the presence of significant proportions of the global populations of six (6) threatened species of which two (2) are bird species (**Figure 8**). Note that both the Blue Crane and the Southern Bald Ibis have been recorded on or near the Emvelo WEF Project site. The Chrissie Pans KBA regularly holds two (2) individual geographically restricted species, therefore meeting criterion B1 as well. A quantitative analysis of irreplaceability indicates that the KBA is 100% irreplaceable for the global persistence of one (1) species, therefore meeting criterion E. The KBA holds a significant proportion of the global extent of one (1) threatened ecosystem (meeting criterion A2).

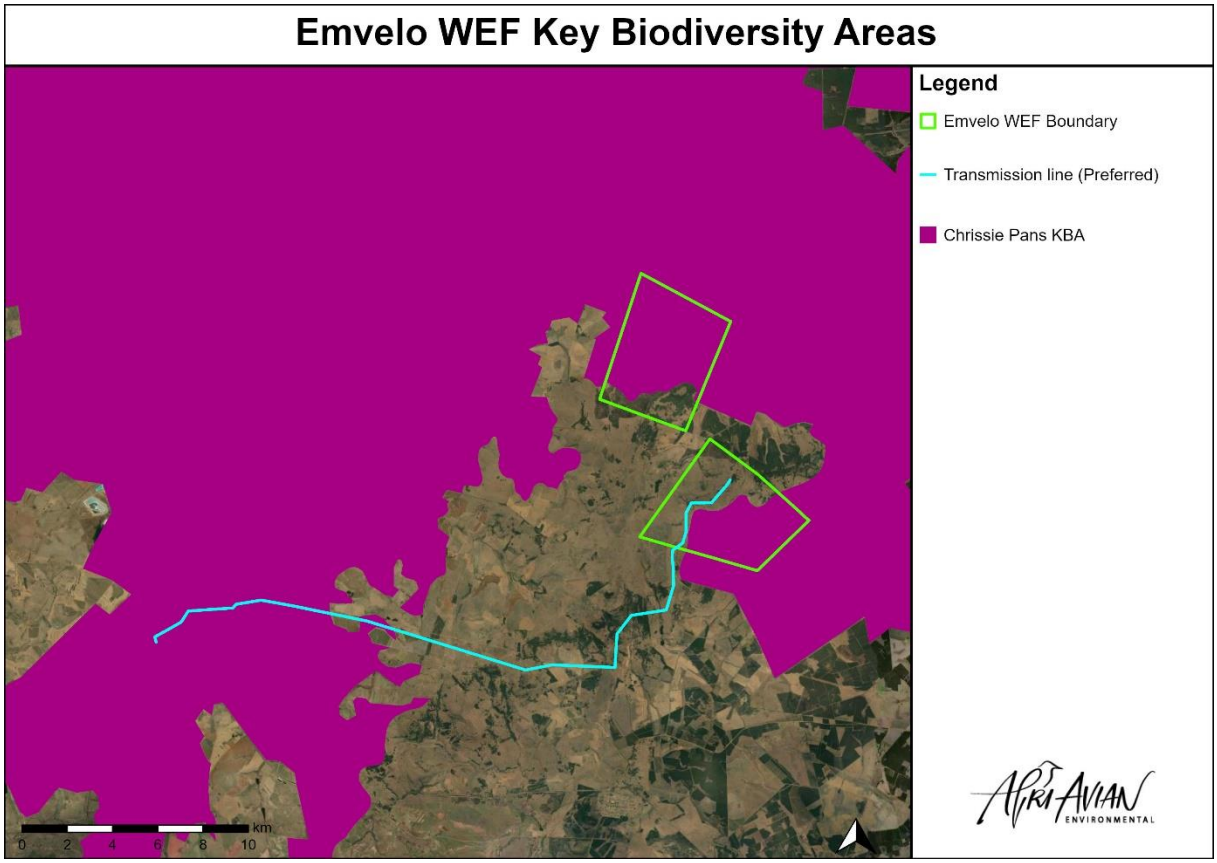


Figure 6: Key Biodiversity Areas in the vicinity of the proposed Emvelo WEF Project site.

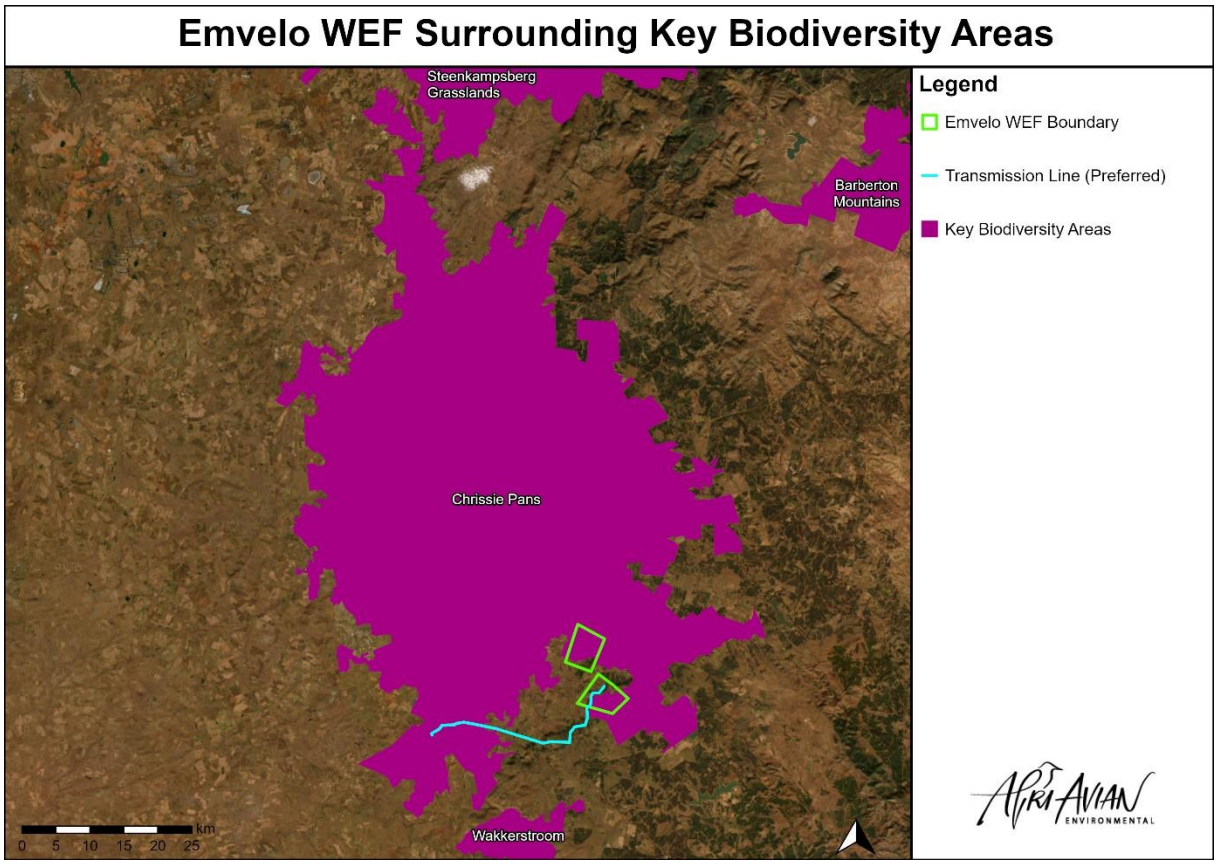


Figure 7: The full extent of the Chrissie Pans KBA in relation to the proposed Emvelo WEF site.

Biodiversity elements triggering KBA criteria

Search:

Taxonomic group	Scientific name	Common name	IUCN Red List category	Year	KBA criteria
Aves	*Anthropoides paradiseus*	Blue Crane	VU	2024	A1d
Aves	*Geronticus calvus*	Southern Bald Ibis	VU	2024	A1b
Caryophyllales	*Khadia carolinensis*		VU	2024	A1b, B1
Gentianales	*Aspidoglossum xanthosphaerum*		VU	2024	A1b, B1
Mammalia	*Redunca fulvorufula*	Mountain Reedbuck	EN	2024	A1c

Figure 8: The Biodiversity elements triggering the KBA criteria as it relates to the Chrissie Pans Key Biodiversity Area.

5.4 The DFFE National Screening Tool

5.4.1 Wind Energy Facility

The WEF Project Site and immediate environment is classified as **Medium** and **High Sensitivity** for bird species according to the Animal Species Theme (**Figure 9**). The Medium and/or High sensitivity classification is linked to the potential occurrence of Denham's Bustard *Neotis denhami* (Globally Near-Threatened and Regionally Vulnerable), Secretarybird *Sagittarius serpentarius* (Globally Endangered and Regionally Vulnerable), Southern Bald Ibis *Geronticus calvus* (Globally and Regionally Vulnerable), African Grass Owl *Tyto capensis* (Regionally Vulnerable), Grey-crowned Crane *Balearica regulorum* (Globally and Regionally Endangered), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable).

The Project Site contains confirmed habitat for Species of Conservation Concern (SCC), primarily for Southern Bald Ibis, Yellow-breasted Pipit, and Secretarybird (Globally Endangered and Regionally Vulnerable), 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, GN 1150 of 30 October 2020).

According to the Screening Tool, the WEF Project Site and immediate environment is classified as Medium and Low Sensitivity for vultures according to the Vulture Species Theme (**Figure 10**). The Medium sensitivity is due to the Project Site possibly affecting an area with between 5%–10% of the vulture population, according to the Screening Tool. During the pre-construction monitoring 48 minutes of Cape Vulture flights were recorded at medium height (i.e., within rotor-swept height). The passage rate for Cape Vultures after 756 hours of monitoring was 0.06 birds per day which amounts to about one Cape Vulture every two weeks. According to the Cervantes Population Utilization Distribution outputs the Emvelo WEF Project Site is rated Low sensitivity for Cape Vulture (Cervantes et al 2023).

Fourteen (14) wind energy development priority SCC have been recorded during the on-site field surveys. The recorded species are listed in the table below (NT = Near Threatened, VU = Vulnerable, EN = Endangered):

Species name	Scientific name	Global Conservation Status	Regional Conservation Status
African Grass Owl	*Tyto capensis*	-	VU
African Marsh Harrier	*Circus ranivorus*	-	EN
Blue Crane	*Grus paradisea*	VU	NT
Cape Vulture	*Gyps coprotheres*	VU	EN
Denham's Bustard	*Neotis denhami*	NT	VU
Greater Flamingo	*Phoenicopterus roseus*	-	NT
Grey Crowned Crane	*Balearica regulorum*	EN	EN
Lanner Falcon	*Falco biarmicus*	-	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Secretarybird	*Sagittarius serpentarius*	EN	VU
Sensitive Species 23	*n/a*	CR	CR
Southern Bald Ibis	*Geronticus calvus*	VU	VU
White-bellied Bustard	*Eupodotis senegalensis*	-	VU
Yellow-breasted Pipit	*Anthus chloris*	VU	VU

Based on the available SABAP2 data, the Site Sensitivity Verification survey, and the integrated pre-construction monitoring surveys conducted at the WEF Project Site, a classification of **High Sensitivity** for avifauna (for the **Animal Species Theme**) is confirmed for the Emvelo WEF and a classification of **Low Sensitivity** is substantiated for the **Vulture Species Theme** based on the low passage rate recorded during the site surveys.

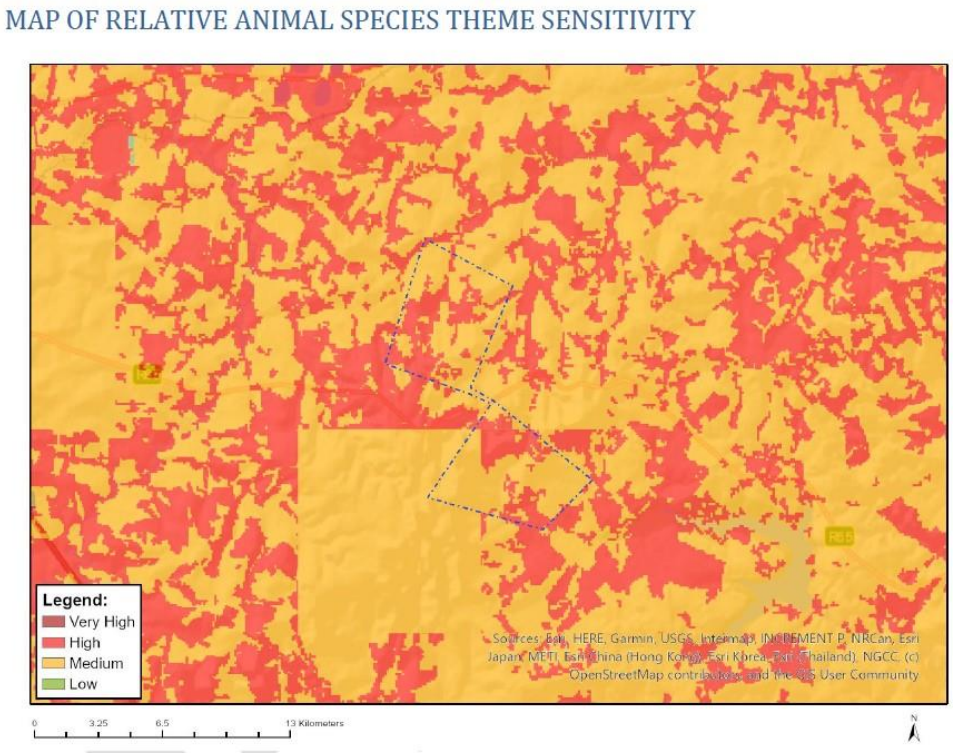


Figure 9: The classification of the Emvelo WEF Project Site according to the Animal Species Theme in the DFFE National Screening Tool.

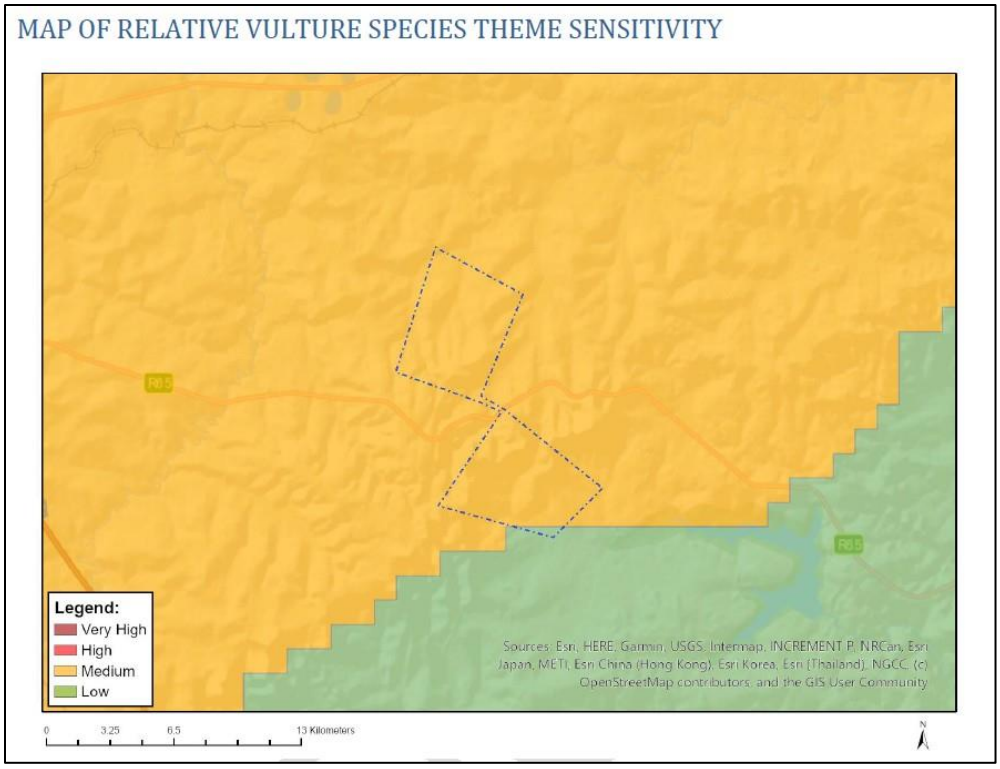


Figure 10: The classification of the Emvelo WEF Project Site according to the Vulture Species Theme in the DFFE National Screening Tool.

5.4.2 Grid Components

According to the DFFE National Screening Tool, the habitat within the Grid Connection PAOI is classified as **Medium** and **High sensitivity** for birds according to the Animal Species Theme (**Figure 11**). The Medium and/or High sensitivity classification is linked to the potential occurrence of Denham's Bustard *Neotis denhami* (Globally Near-Threatened and Regionally Vulnerable), Secretarybird *Sagittarius serpentarius* (Globally Endangered and Regionally Vulnerable), Southern Bald Ibis *Geronticus calvus* (Globally and Regionally Vulnerable), Grey-crowned Crane *Balearica regulorum* (Globally and Regionally Endangered), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable). The PAOI contains confirmed habitat for SCC, primarily for Southern Bald Ibis and Secretarybird (Globally Endangered and Regionally Vulnerable), 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, GN 1150 of 30 October 2020).

Twelve (12) power line-sensitive SCC have been recorded during the on-site field surveys. The recorded species are listed in the table below (NT = Near Threatened, VU = Vulnerable, EN = Endangered):

Species name	Scientific name	Global Conservation Status	Regional Conservation Status
African Marsh Harrier	*Circus ranivorus*	-	EN
Blue Crane	*Grus paradisea*	VU	NT
Cape Vulture	*Gyps coprotheres*	VU	EN
Denham's Bustard	*Neotis denhami*	NT	VU
Greater Flamingo	*Phoenicopterus roseus*	-	NT

Species name	Scientific name	Global Conservation Status	Regional Conservation Status
Grey Crowned Crane	*Balearica regulorum*	EN	EN
Lanner Falcon	*Falco biarmicus*	-	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Secretarybird	*Sagittarius serpentarius*	EN	VU
Sensitive Species 23	*n/a*	CR	CR
Southern Bald Ibis	*Geronticus calvus*	VU	VU
White-bellied Bustard	*Eupodotis senegalensis*	-	VU

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the Project Site thus far, the classification of **High Sensitivity** for avifauna is supported for the Emvelo WEF Grid Connection PAOI. See **Appendix 11** for the Site Sensitivity Verification Report.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

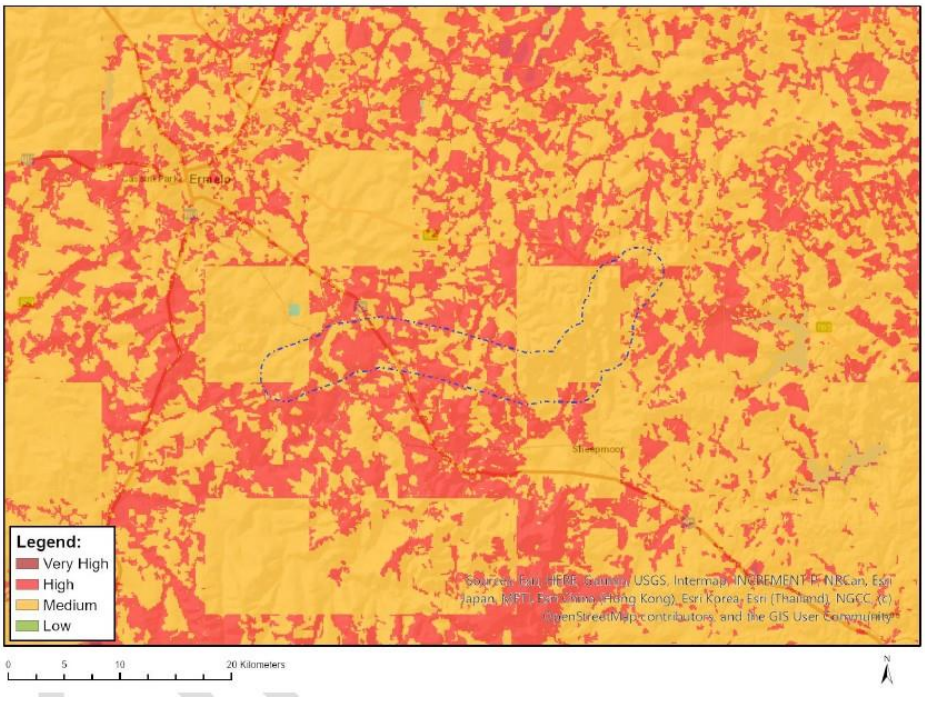


Figure 11: The National Web-Based Environmental Screening Tool map of the Grid PAOI, indicating sensitivities for the Animal Species Theme.

5.5 National Protected Areas

The closest protected area to the proposed development is the Nooitgedacht Dam Nature Reserve (70 km). The avifauna in this protected area is not expected to be impacted by the proposed development due to the distance from the WEF and Grid project sites.

5.6 Site Ecological Importance

The Animal Species Protocol require specialists to identify:

- the nature and the extent of the potential impact of the proposed development on SCC occurring on the proposed project site;
- the potential impact of the proposed development on the habitat of the SCC; and
- any alternative development footprints within the preferred development site which would be of 'low' sensitivity as identified by the Screening Tool and verified through the site sensitivity verification.

In order to spatially identify the different areas of importance for a species for a proposed development site and to facilitate transparent and comparable reporting of the potential impacts of development, a standardised metric, **Site Ecological Importance (SEI)** has been developed for identifying site-based ecological importance for species, in relation to a proposed project with a specific footprint/ project areas of influence (PAOI) and suite of anticipated activities. It allows for rapid spatial inspection and evaluation of impacts of proposed developments within the context of on-site habitats and Species of Conservation Concern (SCC) and also facilitates integration of inputs from different specialist studies. This process is necessary because the Screening Tool evaluates 'environmental sensitivity' at a larger scale than that of a proposed development site and frequently includes modelled data that require field verification.

This assessment relies on the data collected during the necessary specialist surveys to provide a current evaluation of the on-site habitat conditions. This assessment does not replace the output of the Screening Tool but is more specific to the proposed development footprint/PAOI and proposed project activities. Where the site-specific assessment produces lower or higher SEI classification than the 'environmental sensitivity' output of the Screening Tool for that particular site, it is the responsibility of the specialist to provide a clear and defensible justification for the difference.

The **SEI is considered to be a function of** the **biodiversity importance (BI)** of the receptor (e.g., species of conservation concern, the vegetation/fauna community or habitat type present on the site) **and** its resilience to impacts (**receptor resilience [RR]**) as follows: **SEI = BI + RR**

BI in turn is a **function of conservation importance (CI)** and the **functional integrity (FI)** of the receptor as follows: **BI = CI + FI**

The different habitat types within the Project Site have been delineated and identified based on observations during the field assessment and available satellite imagery. These habitat types have been assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of SCC and their ecosystem processes. There are two main natural habitat types within the Project Site to evaluate for SEI. These habitats are 1) grassland and 2) wetlands (with their associated drainage lines).

1) Grassland Habitat within the Project Site

Given the confirmed presence of and confirmed available habitat for several avifaunal SCC the **CI** of the grassland habitat within the Emvelo WEF Project Site is rated as **High**. The **FI** is rated as **Medium** due to moderate habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches.

Therefore, the **Biodiversity Importance** of the grassland habitat within the Emvelo WEF Project Site is rated as **Medium** (as per the matrix below):

Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

Biodiversity Importance		Conservation Importance				
		Very high	High	Medium	Low	Very low
Functional Integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (the habitat on site). The **RR** is rated as **Medium** as the intact grassland habitats will very likely recover slowly (~ will take more than 10 years to recover). **With a Medium BI and a Medium RR, the SEI of the grassland habitat is rated as Medium.**

In terms of the species assessment guidelines, the implications for the Medium SEI rating for suitable SCC habitat at the site indicates that the following general measures are considered appropriate for these areas – "*Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities".*

2) Wetland Habitat within the Project Site

Given the confirmed presence of and confirmed available habitat for several Avifaunal SCC the **CI** of the wetland habitat within the Emvelo WEF Project Site is rated as **High**. The **FI** is rated as **High** due to good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches.

Therefore, the **Biodiversity Importance** of the wetland habitat within the Emvelo WEF Project Site is rated as **High**. The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (the habitat on site). The **RR** is rated as **Medium** as the intact wetland habitats will very likely recover slowly (~ will take more than 10 years to recover). **With a High BI and a Medium RR, the SEI of the wetland habitat is rated as High.**

In terms of the species assessment guidelines, the implications for the High SEI rating for suitable SCC habitat at the site indicates that the following general measures are considered appropriate for these areas – "*Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities*".

5.7 Avifauna in the Broader Area

According to the Southern African Bird Atlas Project (SABAP2), a total of 253 bird species could potentially occur in the Broader Area where the proposed Emvelo WEF and Gird Connection Infrastructure are located. Of the 253 species, 38 species are classified as priority species for wind energy developments. The wind priority species include all species of conservation concern and although a few IBA trigger species are not included in this list the exclusion areas recommended for other similar species included as priority species offer adequate protection for these additional (particularly wetland associated) species. Of the wind energy development priority species in the Broader Area, 32 have been recorded during the pre-construction monitoring. Of the 253 species, 76 are considered powerline sensitive species of which 57 have been recorded during the pre-construction monitoring.

Table 5 and

ame	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Collision With Turbines	Displacement - Habitat Transformation	Displacement - Disturbance
n Eagle	*Haliaeetus vocifer*	7,26	0,92	-	-	x	M			x	x		x		x
rier-Hawk	*Polyboroides typus*	15,64	2,29	-	-	x	H		x		x		x		x
rsh Harrier	*Circus ranivorus*	4,47	0,46	-	EN	x	M	x		x	x		x		x
n	*Falco amurensis*	26,26	9,63	-	-	x	H	x	x		x	x	x		
er	*Circus maurus*	0,00	0,46	EN	EN		L	x			x		x		x
rowhawk	*Accipiter melanoleucus*	15,08	1,38	-	-	x	M		x		x		x		x
d Bustard	*Lissotis melanogaster*	4,47	0,00	-	-	x	M	x				x	x	x	x
ted Snake Eagle	*Circaetus pectoralis*	4,47	0,46	-	-	x	M		x		x		x		x
ed Buttonquail	*Turnix nanus*	2,79	0,00	-	EN		L	x		x				x	x
ed Kite	*Elanus caeruleus*	65,92	14,22	-	-	x	H	x	x		x		x		x
ed Lapwing	*Vanellus melanopterus*	21,23	1,38	-	-	x	H	x		x		x	x	x	
	Grus paradisea	12,85	0,46	VU	NT	x	M	x		x	x	x	x	x	x
an	*Eupodotis caerulescens*	0,56	0,00	NT	LC		L	x					x	x	x
ke Eagle	*Circaetus cinereus*	2,79	0,00	-	-	x	M		x		x		x		x
ed Chat	*Campicoloides bifasciatus*	7,82	0,00	-	-	x	M	x						x	x
e-Owl	*Bubo capensis*	-	-	-	-	x	M	x	x	x		x	x	x	x
re	*Gyps coprotheres*	3,35	0,00	VU	EN	x	M	x			x		x		x
uzzard	*Buteo buteo*	39,11	16,97	-	-	x	H	x	x		x	x	x		
Bustard	*Neotis denhami*	5,03	0,00	NT	VU	x	M	x				x	x	x	x
zard	*Buteo trizonatus*	-	-	NT	LC	x	M		x	x	x		x	x	x
mingo	*Phoenicopterus roseus*	1,68	0,00	-	NT	x	M			x	x		x		
ned Crane	*Balearica regulorum*	15,64	0,46	EN	EN	x	H	x			x		x	x	x
d Francolin	*Scleroptila afra*	15,08	0,00	-	-	x	M	x				x	x	x	x
zard	*Buteo rufofuscus*	32,40	8,72	-	-	x	H	x	x		x	x	x		x
con	*Falco biarmicus*	12,85	0,46	-	VU	x	M	x			x		x		x
mingo	*Phoeniconaias minor*	1,12	0,00	NT	NT		L			x	x		x		
d Eagle	*Lophaetus occipitalis*	13,97	14,22	-	-	x	M		x		x		x		x
	Asio capensis	1,68	0,46	-	-	x	M	x		x	x		x	x	x
le	*Polemaetus bellicosus*	5,59	0,00	EN	EN	x	M	x	x		x		x		x
ack Korhaan	*Afrotis afraoides*	0,56	0,00	-	-		L	x				x	x	x	x
asted Sparrowhawk	*Accipiter rufiventris*	1,68	0,00	-	-	x	M		x		x		x		x
rd	*Sagittarius serpentarius*	24,02	2,29	EN	VU	x	H	x					x	x	x
ald Ibis	*Geronticus calvus*	26,82	4,13	VU	VU	x	H	x			x	x	x		x

ame	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Collision With Turbines	Displacement - Habitat Transformation	Displacement - Disturbance
gle-Owl	*Bubo africanus*	11,73	1,38	-	-	x	M		x	x			x		x
sprey	*Pandion haliaetus*	0,56	0,00	-	-		L				x		x		x
k	*Ciconia ciconia*	10,61	2,29	-	-	x	M	x		x	x	x	x		
ed Bustard	*Eupodotis senegalensis*	12,29	0,00	-	VU	x	H	x				x	x	x	x
asted Pipit	*Anthus chloris*	1,12	0,00	VU	VU	x	M	x					x	x	x

Table 6 below list all the priority species and the possible impact on the respective species by the proposed WEF and Grid Connection.

LC = Least Concern
NT = Near Threatened
VU = Vulnerable
EN = Endangered

H = High
M = Medium
L = Low

Table 5: Wind Energy Priority Species Recorded in The Broader Area.

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Collision With Turbines	Displacement - Habitat Transformation	Displacement - Disturbance	Electrocution MV Network	Collision MV Network
African Fish Eagle	*Haliaeetus vocifer*	7,26	0,92	-	-	x	M			x	x		x		x	x	
African Harrier-Hawk	*Polyboroides typus*	15,64	2,29	-	-	x	H		x		x		x		x	x	
African Marsh Harrier	*Circus ranivorus*	4,47	0,46	-	EN	x	M	x		x	x		x		x	x	
Amur Falcon	*Falco amurensis*	26,26	9,63	-	-	x	H	x	x		x	x	x			x	
Black Harrier	*Circus maurus*	0,00	0,46	EN	EN		L	x			x		x		x	x	x
Black Sparrowhawk	*Accipiter melanoleucus*	15,08	1,38	-	-	x	M		x		x		x		x	x	
Black-bellied Bustard	*Lissotis melanogaster*	4,47	0,00	-	-	x	M	x				x	x	x	x		x
Black-chested Snake Eagle	*Circaetus pectoralis*	4,47	0,46	-	-	x	M		x		x		x		x	x	
Black-rumped Buttonquail	*Turnix nanus*	2,79	0,00	-	EN		L	x		x				x	x		
Black-winged Kite	*Elanus caeruleus*	65,92	14,22	-	-	x	H	x	x		x		x		x	x	
Black-winged Lapwing	*Vanellus melanopterus*	21,23	1,38	-	-	x	H	x		x		x	x	x			
Blue Crane	*Grus paradisea*	12,85	0,46	VU	NT	x	M	x		x	x	x	x	x	x		x
Blue Korhaan	*Eupodotis caerulescens*	0,56	0,00	NT	LC		L	x					x	x	x		x
Brown Snake Eagle	*Circaetus cinereus*	2,79	0,00	-	-	x	M		x		x		x		x	x	
Buff-streaked Chat	*Campicoloides bifasciatus*	7,82	0,00	-	-	x	M	x						x	x		

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Collision With Turbines	Displacement - Habitat Transformation	Displacement - Disturbance	Electrocution MV Network	Collision MV Network
Cape Eagle-Owl	*Bubo capensis*	-[2]	-	-	-	x	M	x	x	x		x	x	x	x	x	x
Cape Vulture	*Gyps coprotheres*	3,35	0,00	VU	EN	x	M	x			x		x		x	x	x
Common Buzzard	*Buteo buteo*	39,11	16,97	-	-	x	H	x	x		x	x	x			x	x
Denham's Bustard	*Neotis denhami*	5,03	0,00	NT	VU	x	M	x				x	x	x	x		x
Forest Buzzard	*Buteo trizonatus*	-	-	NT	LC	x	M		x	x	x		x	x	x	x	x
Greater Flamingo	*Phoenicopterus roseus*	1,68	0,00	-	NT	x	M			x	x		x				x
Grey Crowned Crane	*Balearica regulorum*	15,64	0,46	EN	EN	x	H	x			x		x	x	x	x	x
Grey-winged Francolin	*Scleroptila afra*	15,08	0,00	-	-	x	M	x				x	x	x	x		
Jackal Buzzard	*Buteo rufofuscus*	32,40	8,72	-	-	x	H	x	x		x	x	x		x	x	
Lanner Falcon	*Falco biarmicus*	12,85	0,46	-	VU	x	M	x			x		x		x	x	
Lesser Flamingo	*Phoeniconaias minor*	1,12	0,00	NT	NT		L			x	x		x				x
Long-crested Eagle	*Lophaetus occipitalis*	13,97	14,22	-	-	x	M		x		x		x		x	x	
Marsh Owl	*Asio capensis*	1,68	0,46	-	-	x	M	x		x	x		x	x	x	x	x
Martial Eagle	*Polemaetus bellicosus*	5,59	0,00	EN	EN	x	M	x	x		x		x		x	x	
Northern Black Korhaan	*Afrotis afraoides*	0,56	0,00	-	-		L	x				x	x	x	x		x
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	1,68	0,00	-	-	x	M		x		x		x		x	x	

[2] No Reporting Rate as this species was recorded during monitoring only and not through SABAP2.

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Collision With Turbines	Displacement - Habitat Transformation	Displacement - Disturbance	Electrocution MV Network	Collision MV Network
Secretarybird	*Sagittarius serpentarius*	24,02	2,29	EN	VU	x	H	x					x	x	x		x
Southern Bald Ibis	*Geronticus calvus*	26,82	4,13	VU	VU	x	H	x			x	x	x		x	x	x
Spotted Eagle-Owl	*Bubo africanus*	11,73	1,38	-	-	x	M		x	x			x		x	x	x
Western Osprey	*Pandion haliaetus*	0,56	0,00	-	-		L				x		x		x	x	
White Stork	*Ciconia ciconia*	10,61	2,29	-	-	x	M	x		x	x	x	x				x
White-bellied Bustard	*Eupodotis senegalensis*	12,29	0,00	-	VU	x	H	x				x	x	x	x		x
Yellow-breasted Pipit	*Anthus chloris*	1,12	0,00	VU	VU	x	M	x					x	x	x		

Table 6: Powerline Sensitive Species Recorded in The Broader Area.

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Power line - Electrocution HV	Power line - Collision
African Black Duck	*Anas sparsa*	4,47	0,00	-	-		L			x	x			x
African Darter	*Anhinga rufa*	14,53	3,21	-	-	x	M			x	x			x
African Fish Eagle	*Haliaeetus vocifer*	7,26	0,92	-	-	x	M			x	x			
African Goshawk	*Accipiter tachiro*	0,56	0,00	-	-	x	M		x					
African Harrier-Hawk	*Polyboroides typus*	15,64	2,29	-	-	x	H		x		x			
African Marsh Harrier	*Circus ranivorus*	4,47	0,46	-	EN	x	M	x		x	x			
African Sacred Ibis	*Threskiornis aethiopicus*	37,43	5,50	-	-	x	H			x	x	x		x
African Spoonbill	*Platalea alba*	22,91	1,83	-	-	x	H			x	x			x
African Swamphen	*Porphyrio madagascariensis*	6,15	2,75	-	-		M			x	x			
Amur Falcon	*Falco amurensis*	26,26	9,63	-	-	x	H	x	x		x	x		
Black Harrier	*Circus maurus*	0,00	0,46	EN	EN		L	x			x			
Black Heron	*Egretta ardesiaca*	0,56	0,00	-	-		L			x	x			x
Black Sparrowhawk	*Accipiter melanoleucus*	15,08	1,38	-	-	x	M		x		x			
Black-bellied Bustard	*Lissotis melanogaster*	4,47	0,00	-	-	x	M	x				x		x
Black-chested Snake Eagle	*Circaetus pectoralis*	4,47	0,46	-	-	x	M		x		x			
Black-headed Heron	*Ardea melanocephala*	50,28	2,75	-	-	x	H	x		x	x	x		x
Black-necked Grebe	*Podiceps nigricollis*	0,56	0,46	-	-		L			x	x			x
Black-winged Kite	*Elanus caeruleus*	65,92	14,22	-	-	x	H	x	x		x			
Blue Crane	*Grus paradisea*	12,85	0,46	VU	NT	x	M	x		x	x	x		x

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Power line - Electrocution HV	Power line - Collision
Blue Korhaan	*Eupodotis caerulescens*	0,56	0,00	NT	LC		L	x						x
Blue-billed Teal	*Spatula hottentota*	0,56	0,00	-	-		L			x	x			x
Brown Snake Eagle	*Circaetus cinereus*	2,79	0,00	-	-	x	M		x		x			
Cape Crow	*Corvus capensis*	12,85	0,00	-	-		M	x	x			x		
Cape Eagle-Owl	*Bubo capensis*	-	-	-	-	x	M	x	x	x		x		x
Cape Shoveler	*Spatula smithii*	15,08	0,46	-	-	x	H			x	x			x
Cape Teal	*Anas capensis*	0,56	0,00	-	-		L			x	x			x
Cape Vulture	*Gyps coprotheres*	3,35	0,00	VU	EN	x	M	x			x		x	x
Common Buzzard	*Buteo buteo*	39,11	16,97	-	-	x	H	x	x		x	x		
Common Moorhen	*Gallinula chloropus*	29,61	4,13	-	-	x	H			x	x			
Denham's Bustard	*Neotis denhami*	5,03	0,00	NT	VU	x	M	x				x		x
Egyptian Goose	*Alopochen aegyptiaca*	69,27	9,63	-	-	x	H	x		x	x	x		x
Forest Buzzard	*Buteo trizonatus*	-	-	NT	LC	x	M		x	x	x			x
Fulvous Whistling Duck	*Dendrocygna bicolor*	0,00	0,46	-	-		L			x	x			x
Glossy Ibis	*Plegadis falcinellus*	4,47	0,92	-	-	x	M			x	x			x
Goliath Heron	*Ardea goliath*	1,68	0,00	-	-		L			x	x			x
Great Egret	*Ardea alba*	8,94	1,38	-	-	x	M			x	x			x
Greater Flamingo	*Phoenicopterus roseus*	1,68	0,00	-	NT	x	M			x	x			x
Grey Crowned Crane	*Balearica regulorum*	15,64	0,46	EN	EN	x	H	x		x	x	x		x
Grey Heron	*Ardea cinerea*	20,67	1,83	-	-	x	H			x	x			x

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Power line - Electrocution HV	Power line - Collision
Hadada Ibis	*Bostrychia hagedash*	83,24	12,84	-	-	x	H	x		x	x	x		x
Hamerkop	*Scopus umbretta*	16,76	0,46	-	-	x	H			x	x			x
Helmeted Guineafowl	*Numida meleagris*	54,19	3,67	-	-	x	H	x	x	x	x	x		
Intermediate Egret	*Ardea intermedia*	16,76	1,83	-	-	x	H			x	x			x
Jackal Buzzard	*Buteo rufofuscus*	32,40	8,72	-	-	x	H	x	x		x	x		
Lanner Falcon	*Falco biarmicus*	12,85	0,46	-	VU	x	M	x			x			
Lesser Flamingo	*Phoeniconaias minor*	1,12	0,00	NT	NT		L			x	x			x
Little Egret	*Egretta garzetta*	1,68	0,92	-	-		L			x	x			x
Little Grebe	*Tachybaptus ruficollis*	51,96	5,96	-	-	x	H			x	x			x
Long-crested Eagle	*Lophaetus occipitalis*	13,97	14,22	-	-	x	M		x		x			
Marsh Owl	*Asio capensis*	1,68	0,46	-	-	x	M	x		x	x	x		x
Martial Eagle	*Polemaetus bellicosus*	5,59	0,00	EN	EN	x	M	x	x		x	x		
Northern Black Korhaan	*Afrotis afraoides*	0,56	0,00	-	-		L	x				x		x
Pied Crow	*Corvus albus*	11,73	3,67	-	-	x	M	x	x	x	x	x		
Purple Heron	*Ardea purpurea*	10,06	0,00	-	-	x	M			x	x			x
Red-billed Teal	*Anas erythrorhyncha*	21,79	2,29	-	-	x	H			x	x			x
Red-knobbed Coot	*Fulica cristata*	58,10	8,26	-	-	x	H			x	x			x
Reed Cormorant	*Microcarbo africanus*	56,98	6,88	-	-	x	H			x	x			x
Rock Kestrel	*Falco rupicolus*	7,26	0,92	-	-		M	x	x			x		
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	1,68	0,00	-	-	x	M		x		x			

Species Name	Scientific Name	Full Protocol	Ad Hoc Protocol	Global Conservation Status	Regional Conservation Status	Recorded During Monitoring	Likelihood Of Regular Occurrence	Grassland	Woodland & Alien Trees	Drainage Lines & Wetlands	Dams	Agriculture	Power line - Electrocution HV	Power line - Collision
Secretarybird	*Sagittarius serpentarius*	24,02	2,29	EN	VU	x	H	x						x
Sensitive Species 23	*n/a*	-	-		CR	x	M			x				x
South African Shelduck	*Tadorna cana*	30,73	4,59	-	-	x	H			x	x			x
Southern Bald Ibis	*Geronticus calvus*	26,82	4,13	VU	VU	x	H	x						x
Southern Pochard	*Netta erythrophthalma*	3,91	0,00	-	-	x	L			x	x			x
Spotted Eagle-Owl	*Bubo africanus*	11,73	1,38	-	-	x	M		x	x				x
Spur-winged Goose	*Plectropterus gambensis*	57,54	5,50	-	-	x	H	x		x	x	x		x
Squacco Heron	*Ardeola ralloides*	1,12	0,00	-	-		L			x	x			x
Western Barn Owl	*Tyto alba*	5,03	0,92	-	-		M	x	x			x		x
Western Cattle Egret	*Bubulcus ibis*	34,08	6,88	-	-	x	H	x		x	x	x		x
Western Osprey	*Pandion haliaetus*	0,56	0,00	-	-		L				x			
White Stork	*Ciconia ciconia*	10,61	2,29	-	-	x	M			x	x			x
White-backed Duck	*Thalassornis leuconotus*	5,59	0,46	-	-	x	M			x	x			x
White-bellied Bustard	*Eupodotis senegalensis*	12,29	0,00	-	VU	x	H	x				x		x
White-breasted Cormorant	*Phalacrocorax lucidus*	8,94	1,38	-	-	x	M			x	x			x
White-faced Whistling Duck	*Dendrocygna viduata*	1,68	0,00	-	-		L			x	x			x
Yellow-billed Duck	*Anas undulata*	60,89	6,88	-	-	x	H			x	x			x
Yellow-billed Kite	*Milvus aegyptius*	3,91	0,46	-	-	x	M	x	x	x	x	x		

5.7.1 Summary of Key Species of Conservation Concern that were recorded on the Project Site

African Marsh Harrier *Circus ranivorus* (Regionally Endangered)

This species is dependent on permanent wetlands, both inland and coastal, for breeding, feeding, and roosting. It also hunts over drier floodplains, grasslands, croplands, and Fynbos, where it preys mainly on small rodents (Simmons 2005). The primary threat faced by this species is loss and degradation of its sensitive wetland habitats, brought about by drainage or damming for development and agriculture (Monadjem et al. 2003), as well as pollution. The decrease in the regional population of African Marsh Harrier is believed to be sufficiently rapid to satisfy the thresholds for regionally Endangered under the population trend criterion A2 (>50 % decline over a 24-year period (three generations)). African Marsh Harriers would be vulnerable to collisions with turbine blades as well as displacement due to habitat loss and disturbance displacement.

African Marsh Harriers were recorded at the Emvelo WEF Project site, with several flight lines at medium height recorded in the vicinity of Vantage Point (VP) 12 over the adjacent wetland habitat areas.

Blue Crane *Anthropoides paradiseus* (Globally Vulnerable, Regionally Near Threatened)

The national bird of South Africa, the Blue Crane is mostly found in the country, with a small population (less than 1%) also occurring in Namibia. Blue Cranes typically inhabit dry grasslands and open grassland areas, as well as agricultural landscapes. They usually roost communally during the winter non-breeding season in wetlands or dams (with concentrated movements in and out of the roosts during crepuscular periods - early morning / later afternoon) and are subject to seasonal movements. Blue Cranes are at risk of colliding with powerlines and also face the threat of turbine collisions. Additionally, they are vulnerable to displacement due to habitat loss and disturbance, which could impact their population.

At least one pair of Blue Crane was recorded in the spring and summer months (visit one and visit four) at the Emvelo Project site.

Greater Flamingo *Phoenicopterus roseus* (Regionally Near Threatened)

In South Africa the Greater Flamingo mainly occurs in the central and south-western regions. It generally prefers coastal mudflats, inland dams, sewage treatment works, small temporary pans, and river mouths, while it exclusively breeds at recently flooded, large eutrophic shallow salt pans (Hockey et al. 2005). The southern African population of Greater Flamingo has undergone declines of >40% over the past three generations. Unfortunately, there are no data to support similar trends within the regional population, although it is suspected to be approaching the 30% threshold, qualifying this species as regionally Near Threatened. The population declines are largely due to lowering water tables at major breeding sites as well as collisions with powerlines. Collisions with wind turbines have also become a threat.

While Greater Flamingo was not recorded specifically at the Emvelo Project site, there were observations made at the adjoining Sheepmoor Project site and in the Broader Area. Flamingos are known to regularly commute between pans as foraging conditions change.

Grey Crowned Crane *Balearica regulorum* (Globally and Regionally Endangered)

The regional population of Grey Crowned Crane has undergone a continuous decline of >30% over the past 45 years (three generation period). Grey Crowned Cranes require mixed wetland-grassland habitats (Hockey et al. 2005). They typically nest within or on the edges of wetlands, while foraging in wetlands, nearby grasslands, and croplands. The primary threat to the species in South Africa is the widespread degradation and loss of breeding habitats, most often caused by the draining or damming of wetlands (Taylor et al. 2015) Powerlines

pose a collision hazard to young birds and adults. Other threats include disturbance at nesting areas and entanglement in fences.

At least one pair of Grey Crowned Crane was recorded in the spring and summer months (visit one and visit four) at the Emvelo Project site. Grey Crowned Cranes were also regularly recorded at a large wetland area in a valley east of vantage point 12.

Lanner Falcon *Falco biarmicus* (Regionally Vulnerable)

The Lanner Falcon (Regionally Vulnerable) is widely distributed across Africa, the Arabian Peninsula, and the Western Palearctic (Ferguson-Lees & Christie 2001). Within the southern African region, it is found throughout South Africa, Lesotho, and Swaziland, though in low densities, with the highest concentrations recorded in the Western Cape and KwaZulu-Natal. Lanner Falcons mostly occur in open grassland, cleared woodlands and agricultural areas. Breeding pairs tend to favour cliffs as nesting and roosting sites; however, they will also use alternative structures such as trees, pylons and buildings (Hockey et al. 2005). Within the PAOI they would use the powerline in the west and could potentially hunt over the entire area.

The main threat to the Lanner Falcon is habitat loss and transformation within the Grassland Biome, driven by urbanization, agriculture, and afforestation. These changes have led to a decline in preferred prey species and reduced foraging opportunities (Barnes & Jenkins 2000).

Lanner Falcons have been recorded during pre-construction monitoring at the Emvelo WEF Project Site. These birds of prey hunt assorted (usually avian) prey in variable habitats across the landscape. Several flight lines for Lanner Falcon were recorded, particularly during visit 3.

Martial Eagle *Polemaetus bellicosus* (Globally Near Threatened and Regionally Endangered)

The regionally Endangered Martial Eagle occurs in much of sub-Saharan Africa. In southern Africa, it is widespread but uncommon, generally preferring flat, open woodland, such as savanna, forest edges and drainage woodland in shrubland. It may move into open farmland with stands of trees. Within the PAOI, they would utilize the existing powerline in the west and potentially cover the entire area for hunting.

Barnes (2000) identifies human activities outside protected areas as the primary drivers of Martial Eagle population decline. Key threats include direct persecution through shooting and trapping by small-stock farmers, indirect poisoning, drowning in sheer-walled farm reservoirs, loss of natural prey due to habitat degradation, nest site disturbance, and electrocution on electricity pylons. The process of rangeland modification and degradation (primarily by overgrazing) affects eagle populations, at least indirectly by influencing the distribution, abundance, and accessibility of prey (Taylor et al. 2015).

During the pre-construction monitoring period, an active Martial Eagle nest has been identified situated in close proximity to the Emvelo Wind Energy Facility (WEF) project site (see **Figure 12**). To enhance understanding of the spatial movement patterns of this species, seasonal surveys were completed and followed by additional dedicated surveys specifically focused on the Martial Eagle (refer to section 5.8). The flight risk model and sensitivity zonation for Martial Eagle were developed using a combination of tracking data, focused field observations, and high-resolution environmental predictor variables. This approach resulted in a comprehensive dataset of flight paths (see **Figure 17**). While most observations recorded a single Martial Eagle, several flights of a pair of Martial Eagles were also recorded. Martial Eagles are known to be winter season breeders that sometimes breed biennially (Kemp et al, 2020).

See **Figure 12** below for the location of the Martial Eagle nest buffered by a 2.5 km All Infrastructure Exclusion Zone, as well as the location of a recently confirmed roost site located southeast of the Martial Eagle nest. Refer to Section 5.8.7.1 of the updated Avifaunal Specialist Report for additional information on Martial Eagle tracking data considered in this study.

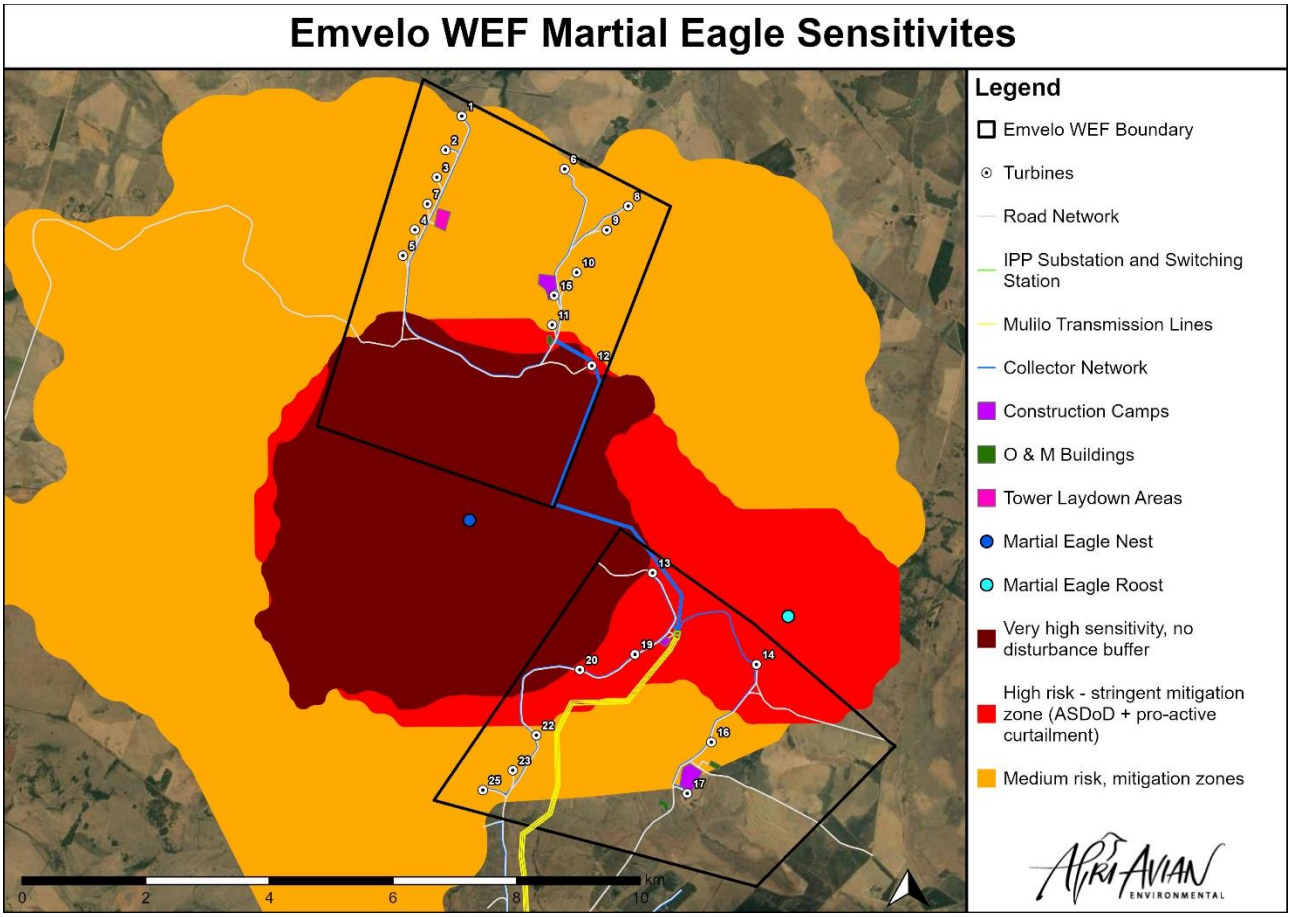


Figure 12: The location of the Martial Eagle nest and roost sites indicating a 2.5 km no-go buffer for all infrastructure around the nest site.

Secretarybird *Sagittarius serpentarius* (Globally Endangered, Regionally Vulnerable)

The Secretarybird is not considered migratory, but it does move around in response to changes in rainfall, grassland conditions, and fires. This iconic species prefers open grassland and scrub environments, and it can also be found in the savannah biome. Recently uplisted to Endangered, Secretarybird numbers are declining across its range largely due to anthropogenic changes in land use as a result of cultivation and urbanization that results in habitat loss and disturbance. Secretarybirds use the tops of low trees, often preferring flat-topped thorn trees for nesting and roosting. They may nest at any time of year when food is abundant. Secretarybirds may be impacted by habitat destruction, disturbance, displacement, and collisions with turbine blades, powerlines, and fences.

Secretarybirds were observed during all pre-construction surveys at the Emvelo WEF project site, albeit in low numbers, with most sightings involving individual birds. It is important to note that their breeding patterns may vary; they can breed in an area for several years but may subsequently be absent or present in much-reduced numbers (Kemp et al., 2020).

Southern Bald Ibis *Geronticus calvus* (Regionally Vulnerable)

The Southern Bald Ibis satisfies the population criterion for regionally Vulnerable (population size estimated to number <10 000 mature individuals and a predicted continuing decline of >10% in three generations). Southern Bald Ibis are found mostly in high-altitude grasslands, although they are known to use mid-altitude and coastal grasslands, including artificial grassland such as sports fields, golf courses and irrigated meadows (Manry 1985). For breeding, the species requires cliffs with suitable ledges, generally above water. Apart from the

modified grasslands mentioned above, the species also uses old maize fields, croplands, firebreaks and open spaces in towns when foraging. The Southern Bald Ibis is threatened by poachers taking eggs and young from breeding ledges, by pesticides and poisoning and, in certain areas, by habitat destruction and degradation caused by open-cast mining, urban development and largescale commercial farming (Collar et al. 1994, Barnes 2000). Southern Bald Ibises may be impacted by habitat destruction, disturbance displacement, and collisions with turbine blades and power lines.

Southern Bald Ibis were regularly observed during pre-construction monitoring, and flocks occasionally in excess of 50 birds were recorded at the Emvelo WEF Project Site. Further, extensive flight hours in the rotor blade zone have also been recorded on site. Several Southern Bald Ibis colonies and roosts are present in the Broader Area.

5.8 Results of Pre-Construction Bird Monitoring

The objective of the pre-construction monitoring at the proposed Emvelo WEF was to gather baseline data over a minimum period of four seasons (up to eight surveys) on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the proposed WEF site and at a suitable control site, to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species to assess the potential collision risk with the turbines and associated powerline infrastructure.

The Guidelines require a minimum of four surveys over a period of a year (12 months) covering four seasons. Pre-construction monitoring conducted by a team of onsite monitors resulted in data collection at the Emvelo WEF site as well as a Control Site and includes a dataset covering a period of approximately 18 months during the following time envelopes:

- 21 February–03 March 2022
- 21–27 April 2022
- 01–16 June 2022
- 06–21 October 2022
- 14–17 January 2023 (Transect counts only)
- 05–09 May 2023
- 28–30 June 2023
- 22–26 August 2023

Additional Vantage Point and Transect Count monitoring was conducted near the identified Martial Eagle nest to gain a better understanding of their flight behaviour adding approximately five more months to the dataset. These additional surveys were done to cover the expanded WEF and EGI development footprints as well as additional targeted Martial Eagle monitoring (with GPS tracking data spanning a period of more than 12 months i.e., April 2024 to May 2025) during which time all other bird species were also recorded across the entire project site. The five additional surveys were conducted during the following time envelopes:

- 17–22 October 2023
- 15–23 November 2023
- 30 November–05 December 2023
- 17–22 January 2024
- 14–20 February 2024

In addition, from December 2024 to February 2025 additional targeted wetland surveys were conducted with special focus on the Sensitive Species 23 to gain a better understanding of the species' habitat preferences and movement patterns, and again all other bird species were also recorded across the entire project site during this time.

Collectively, this totals to a combined 26 months' worth of avifaunal monitoring data recorded on and around the proposed development site. Therefore, the specialist's findings, assignment of buffer / exclusion zones, models and recommendations are based on avifaunal data collected over a period of more than two years.

Table 7 as well as **Figure 13 and Figure 14** below present the results of the pre-construction monitoring conducted at the WEF site and control area.

During April/May 2024 one adult and one juvenile bird of the pair nesting adjacent to the site was fitted with tracking devices by the Endangered Wildlife Trust in order to better understand the movement patterns of Martial eagles in the landscape. The tracking data was made available to AfriAvian by the proponent and used to better understand the spatial use of the landscape by the eagles. The tracking data is being used to further develop a stringent mitigation strategy which will involve the diurnal proactive curtailment of turbines in high risk mitigation zones around the nest during periods when the eagles are likely to be flying. See section 5.8.7.1 for more information.

5.8.1 Transects

The results of the transect counts after seven surveys are presented in **Table 7**, for a detailed species list of avifauna recorded on site refer to **Appendix 5**:

Table 7: The Results of The Walk and Drive Transects.

TURBINE SITE	
Species Composition	**Number**
All Species	180
Priority Species	19 (11%)
Non-Priority Species	161
Total Count	
Drive Transects	10 583
Walk Transects	8095
Total	18 678
CONTROL SITE	
Species Composition	**Number**
All Species	110
Priority Species	9 (8%)
Non-Priority Species	101
Total Count	
Drive Transects	3309
Walk Transects	1870
Total	5179

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transects across four seasons and seven surveys (**Figure 13 and Figure 14**).

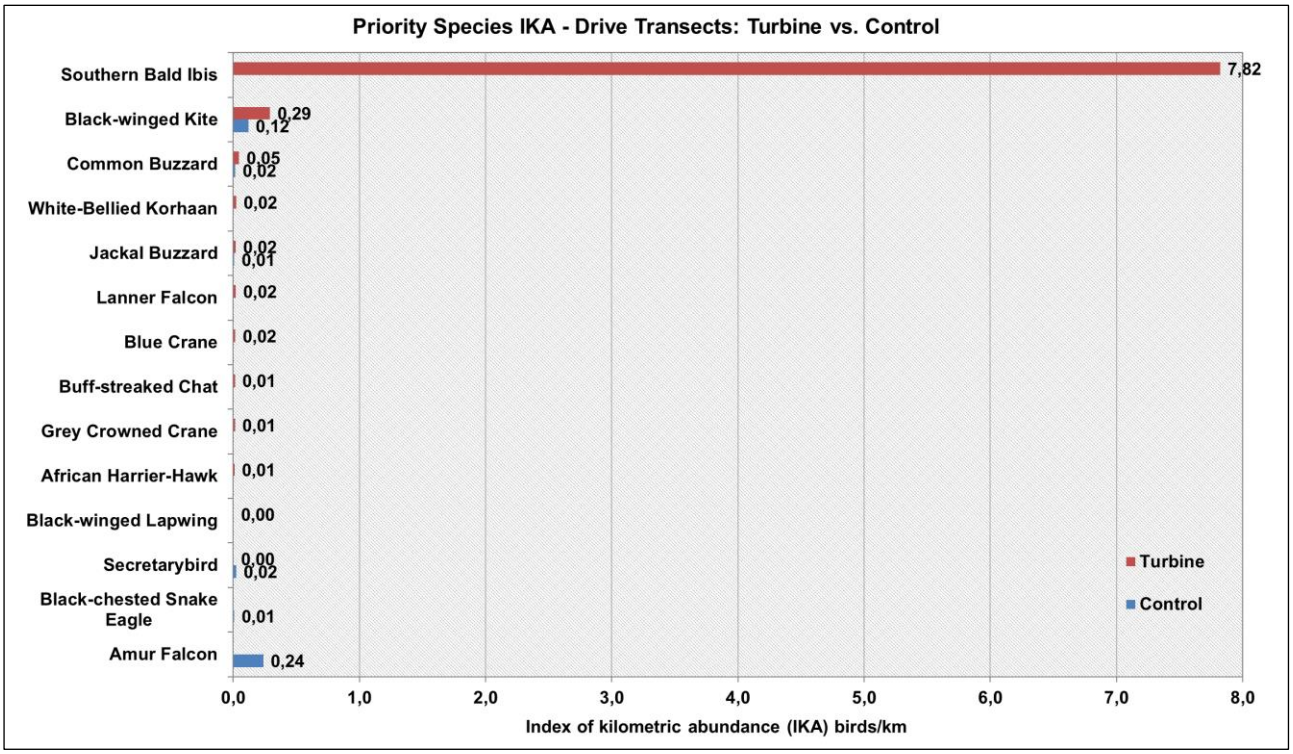


Figure 13: Index of kilometric abundance of priority species recorded at the WEF and control site during drive transect surveys (seven surveys).

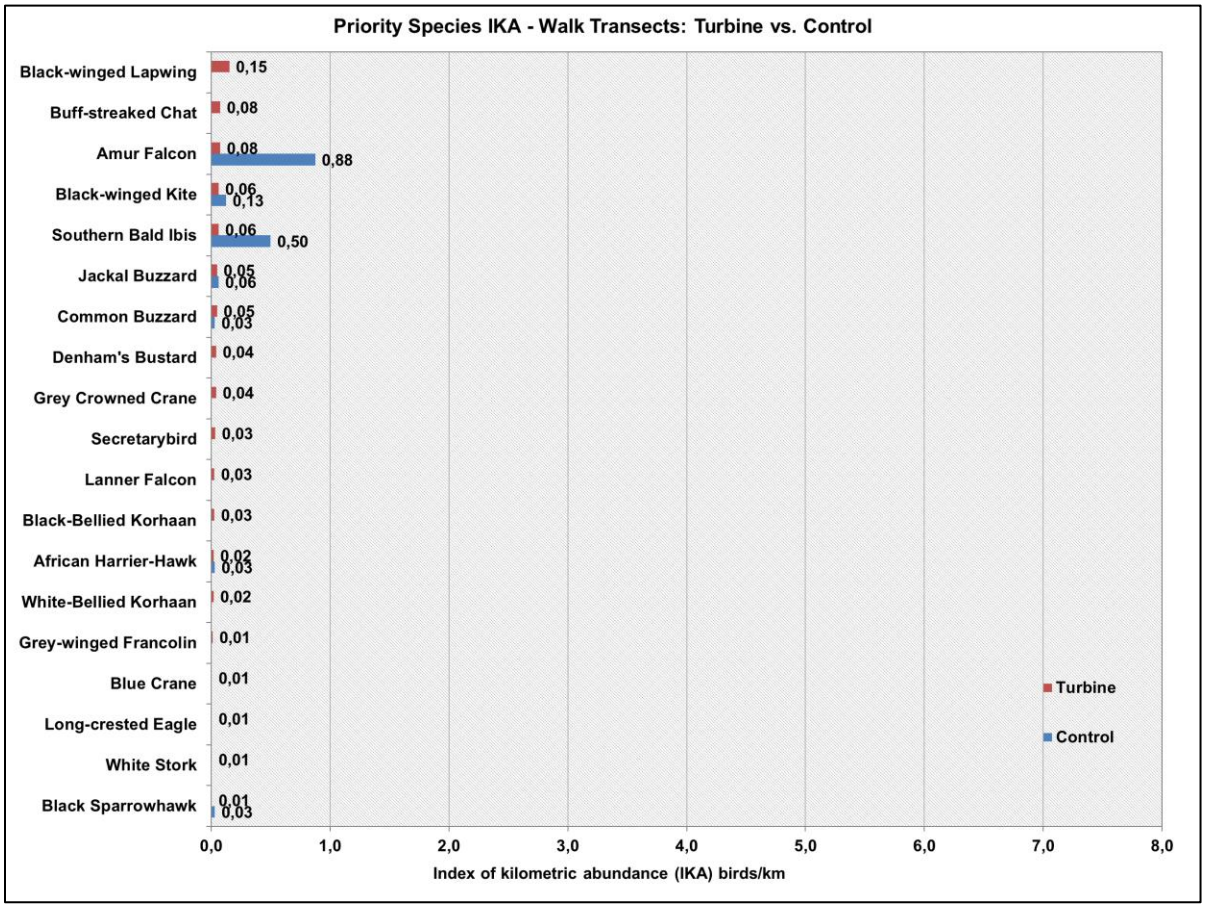


Figure 14: Index of kilometric abundance of priority species recorded at the WEF during walk transect surveys (seven surveys).

Figure 15 below shows the spatial distribution of the priority species recorded during transect counts and incidental sightings over all monitoring surveys.

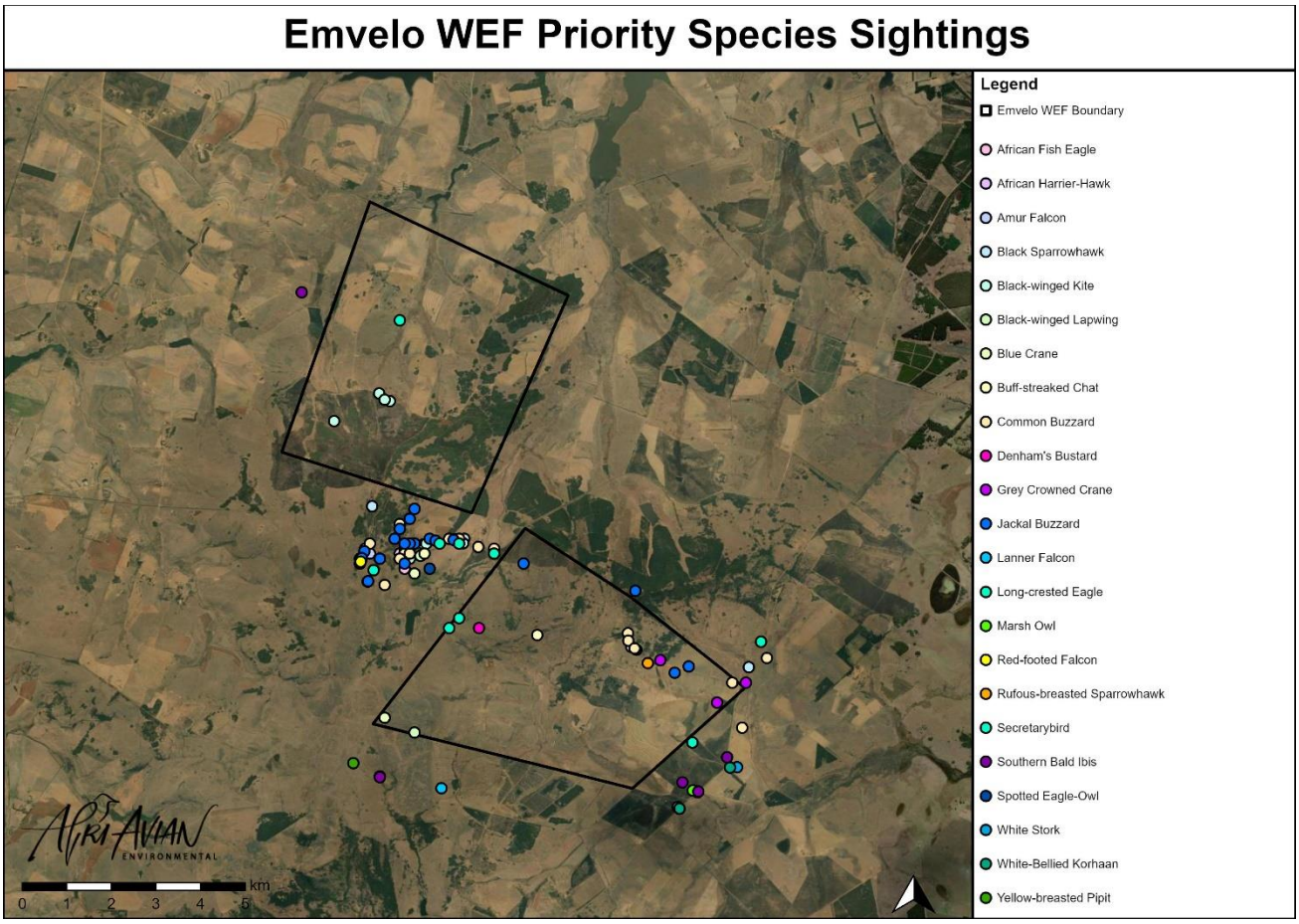


Figure 15: The location of priority species recorded at the proposed Emvelo WEF through transect counts and incidental sightings.

5.8.2 Focal Points

Three focal points (FP) of bird activity were identified:

- FP1: A large farm dam in a drainage line. This FP was surveyed once during each survey.
- FP2: Southern Bald Ibis colony (26°37'20.82" South, 30°18'36.43" East)
- FP3: Southern Bald Ibis colony (26°38'28.47" South, 30°17'37.67" East)

- A Martial Eagle nest was discovered towards the end of the initial pre-construction monitoring campaign and subsequent additional monitoring effort was devoted to the nest area to better understand the flight risk of the eagles around the nest. Based on extended GPS tracking data recorded over a period of 12 months and analysed in May 2025, this tracking data indicated the concentrated activity of the Martial Eagles (i.e., up to 20% of flight time spent) at a location situated approximately 6 km southeast of the known nest site, which at the time of assessment is confirmed to be a roost based on the amount of time the tracked birds spent at this site, specifically during the summer months (November to March). A site inspection conducted in mid-May 2025 however confirmed the absence of an alternate nest at this location. Refer to Section 5.7.1 above for a brief description of the location of the Martial Eagle nest and roost in relation to the Project Site. Also refer to Sections 5.8.5 and 5.8.7 below for more information on flight risk modelling and additional monitoring undertaken for the Martial Eagle.

See Figure 1 in **Appendix 3** for the location of the focal points.

Table 8: Results of Focal Point Surveys

Focal Points	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
	Priority Species Recorded						
FP1	Southern Bald Ibis (SBI), Grey Crowned Crane Roost	No Priority Species	Southern Bald Ibis	Southern Bald Ibis	47 SBIs seen	36 SBIs seen	2 SBIs seen and Black Sparrowhawk seen hunting in area
FP2: SBI Colony	NA	NA	NA	Southern Bald Ibis (nesting with chicks), Long-crested Eagle, African Harrier Hawk and African Goshawk	No Priority Species	More than 8 SBI seen, no nests or remnants of nests seen	8 SBIs and Lanner Falcon seen
FP3: SBI Colony	NA	NA	NA	Southern Bald Ibis (2 confirmed active nests), Buff-streaked Chat, Jackal Buzzard and Denham's Bustard	No SBIs, no nests and no whitewash seen. Long-Crested Eagle flew past	3 SBI nests with guano, 1 Jackal Buzzard seen, and 1 Cape Eagle-Owl heard	No SBIs, nests nor remnants seen

5.8.3 Incidental Counts

Table 9 provides an overview of the incidental sightings of priority species during the four seasonal surveys.

Table 9: Incidental records (actual counts) of priority species made during the seasonal surveys (seven surveys) at the Mulilo WEF Cluster (Emvelo and Sheepmoor WEFs).

Priority Species – Incidental Sightings		S1	S2	S3	S4	S5	S6	S7	Total
Southern Bald Ibis	*Geronticus calvus*	70	28	0	24	3	0	1	126
Black-winged Kite	*Elanus caeruleus*	6	3	8	18	5	2	2	44
Common Buzzard	*Buteo buteo*	12	0	0	18	0	0	0	30
Black-winged Lapwing	*Vanellus melanopterus*	4	1	0	11	0	3	9	28
Jackal Buzzard	*Buteo rufofuscus*	5	5	2	4	4	0	3	23
Grey-winged Francolin	*Scleroptila afra*	0	0	0	1	1	18	0	20
Grey Crowned Crane	*Balearica regulorum*	12	2	0	4	0	0	0	18
Spotted Eagle-Owl	*Bubo africanus*	1	5	3	4	1	1	2	17
White Stork	*Ciconia ciconia*	0	0	0	16	0	0	0	16
Secretarybird	*Sagittarius serpentarius*	0	7	1	1	6	0	0	15
Long-crested Eagle	*Lophaetus occipitalis*	7	2	0	2	2	0	0	13
Amur Falcon	*Falco amurensis*	6	0	0	1	0	0	0	7
Yellow-breasted Pipit	*Anthus chloris*	0	0	0	7	0	0	0	7
Lanner Falcon	*Falco biarmicus*	2	3	0	0	0	1	0	6
Black Sparrowhawk	*Accipiter melanoleucus*	0	3	0	1	0	0	1	5

Priority Species – Incidental Sightings		S1	S2	S3	S4	S5	S6	S7	Total
Buff-streaked Chat	*Campicoloides bifasciatus*	0	0	0	3	0	0	2	5
African Harrier-Hawk	*Polyboroides typus*	0	0	1	2	0	1	0	4
Denham's Bustard	*Neotis denhami*	0	0	0	3	1	0	0	4
Marsh Owl	*Asio capensis*	0	1	3	0	0	0	0	4
Blue Crane	*Grus paradisea*	0	0	0	3	0	0	0	3
African Marsh Harrier	*Circus ranivorus*	0	0	0	2	0	0	0	2
Forest Buzzard	*Buteo trizonatus*	0	0	0	0	0	0	2	2
White-bellied Korhaan	*Eupodotis senegalensis*	2	0	0	0	0	0	0	2
African Fish Eagle	*Haliaeetus vocifer*	0	0	0	1	0	0	0	1
Brown Snake Eagle	*Circaetus cinereus*	1	0	0	0	0	0	0	1
Martial Eagle	*Polemaetus bellicosus*	0	1	0	0	0	0	0	1
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	0	0	0	1	0	0	0	1

See **Appendix 5** for a list of all species recorded during the pre-construction monitoring.

5.8.4 Vantage Point Observations

A total of 583 hours of Vantage Point watches were completed at nine (9) vantage points, at the Amsterdam WEF Cluster (Emvelo and Sheepmoor WEFs), to record flight patterns of priority species. In the seven (7) sampling periods, the duration of priority species flights amounted to 22 hours, 19 minutes, and 34 seconds. A total of 488 individual flights were recorded. The passage rate for priority species was 0.83 birds/hour[3]. This amounts to about 11 birds per day.[4] See **Figure 16** below for the duration of flights for each priority species[5].

5.8.4.1 Vantage Point Viewsheds

For the Emvelo WEF, only four (4) out of the originally proposed 24 turbine locations fell outside the 2 km radii of the vantage point surveys, whereas for the Sheepmoor WEF, only four (4) out of the originally proposed 29 turbine locations were located outside the 2 km radii of the vantage point surveys. Therefore, the total site area surveyed during pre-construction bird monitoring covered about 105 km^2 out of the approximately 143 km^2, translating to about 73% reporting coverage of the entire Amsterdam WEF Cluster area.

Some factors influenced the reporting coverage through vantage point surveys such as i) the development footprint for each WEF kept changing during the pre-construction monitoring period, and ii) additional land was added to the project area mid-way through the pre-construction monitoring period. As a result, additional effort was made to include additional surveys in the area in general beyond the first year of pre-construction monitoring as well as the recording of additional flight data of all incidental observations supports the slightly below average reporting coverage via vantage point surveys.

[3] A distinction was drawn between passages and flights. A passage may consist of several flights e.g. every time an individual bird changes height or mode of flight, this was recorded as an individual flight, although it still forms part of the same passage.

[4] Assuming 13 hours daylight averaged over all four seasons.

[5] Flight duration was calculated by multiplying the flight time with the number of individuals in the flight e.g. if the flight time was 30 seconds and it contained two individuals, the flight duration was 30 seconds x 2 = 60 seconds.

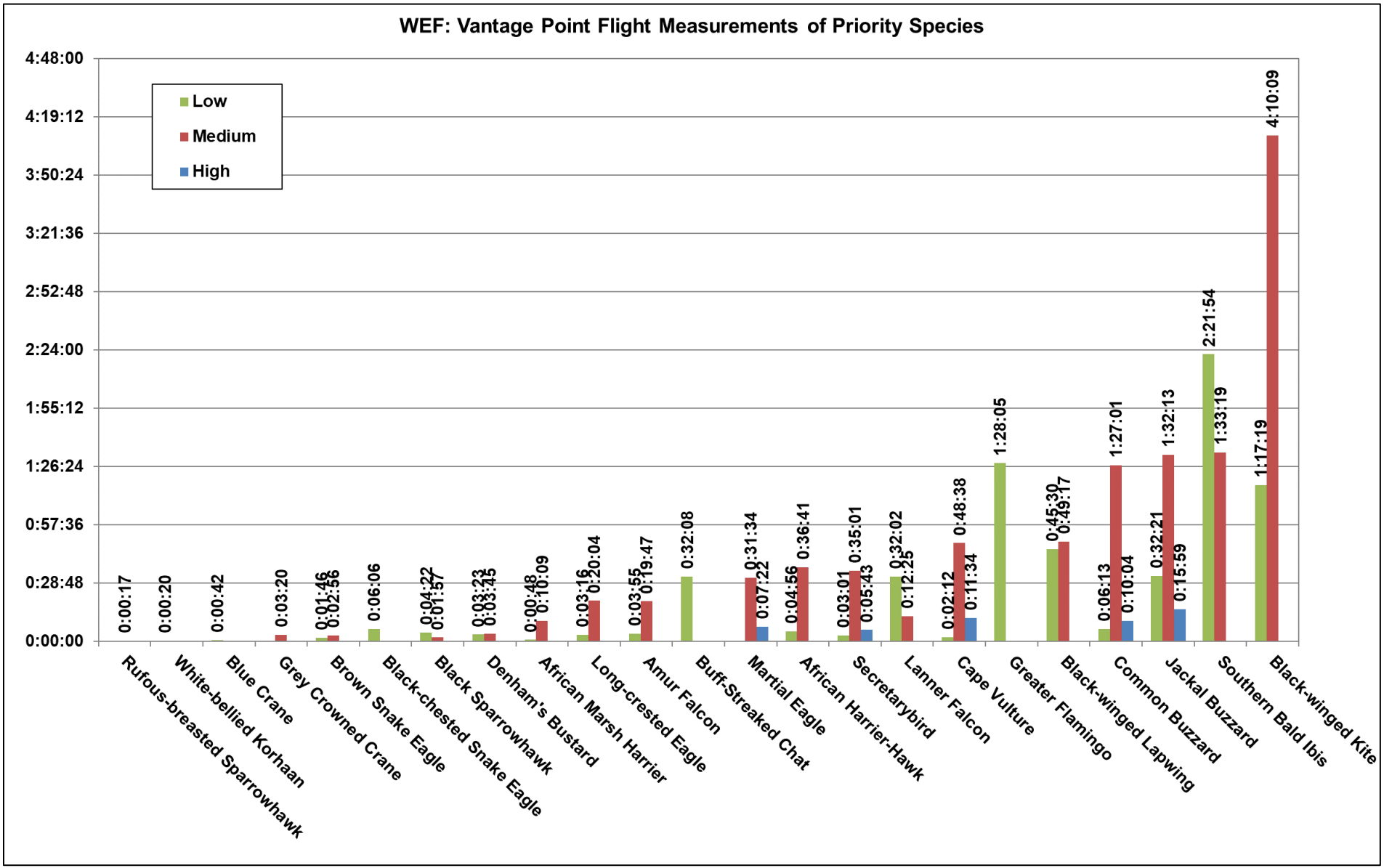


Figure 16: Recorded Flight Times (in Hours: Minutes: Seconds) and Flight Altitudes (High/Medium/Low) of Priority Species (during the first seven surveys, excluding the additional five surveys conducted as part of the Martial Eagle monitoring).

5.8.5 Flight Risk Modelling

Due to the discovery of a Martial Eagle nest located adjacent to the proposed Emvelo WEF project footprints, extensive additional monitoring was performed to collect flight data of the two adult eagles and the one juvenile in the area. A total of 37 hours, 34 minutes and 11 seconds of direct Martial Eagle flight time was recorded during an additional 60 hours of focussed observation time conducted in the area near and around the nest. The extensive dataset of Martial Eagle flight data (collected during vantage point observations and obtained from the GPS tracking data), was used to develop and refine a flight risk model. GPS tracking data being generated within the PAOI by two tracked adults was used to further validate and refine the associated flight risk model. Refer to Section 5.8.7 below for more information on additional Martial Eagle monitoring undertaken.

We scripted and used R and python workflows to prepare, pre-process and analyse all predictor variables. Predictors variables represented various facets of topography, drainage, and vegetation productivity. Topographical features included ruggedness, drainage, TWI, and topographical relief, whilst aspects of vegetation productivity were derived from remote sensing indices. We utilised an Artificial Neural Network (ANN) predictive modelling workflow to train and develop the flight risk model (FRM). ANNs are capable of learning complex patterns and relationships in data, making them suitable for a wide range of classification problems. The modelling workflow included data partitioning, model training, optimization of algorithms and hyperparameters, and model testing and validation.

Model training indicated that topographical features related to slope and terrain ruggedness were positively associated with flight risk. Areas with undulating slopes, wide gorges, and valleys—particularly gentler landforms such as back-slopes, foot-slopes, toe-slopes, and terraces or floodplains—were linked to higher flight risk. The presence and density of perch structures, including linear power infrastructure and woody vegetation, also contributed to increased risk. Among all variables, distance from the nest was the strongest predictor of flight risk, followed by proximity to perch sites, and then topographical characteristics.

The raw predictive FRM surface was further processed to derive two risk classes (or zones), namely high and medium risk zones around the nest (Section 6.5). The risk zones were derived by the quantity of observed high risk flights being accommodated by each respective risk envelope. The High Risk zone (i.e., Turbine Exclusion Zone) encompassed approximately 79 km^2, which is very comparable to the area covered by a 5 km circular buffer (78.5 km^2) as recommended by BirdLife South Africa and EWT. However, based on the Martial Eagle tracking and observation data which is showing that approximately 75% of recorded flight activity occurred within 3 km of the nest, a more precautionary Very High Risk zone (about 31 km²) was delineated as a no-go buffer around the Martial Eagle nest, within which no disturbance is allowed (i.e., All Infrastructure Exclusion Zone), while the High Risk zone (i.e., Turbine Exclusion Zone) was revised and slightly expanded to also include the Martial Eagle roost that was confirmed on site. Consequently, the Medium Risk zone (about 148 km²) now incorporates a more stringent mitigation regime than conventional practice, including both automated Shutdown-on-Demand (SDOD) and dynamic (proactive) diurnal curtailment during periods of expected eagle activity.

Subsequently, following from the expansion of the High Risk zone to include the Martial Eagle roost, note that proposed WTGs 12, 13, 14, 19 and 20 are now located within the High-Risk zone i.e., no turbines allowed. Although these five turbines will also be subject to the stringent mitigation regime that is compulsory for all authorised turbines located in the Medium Risk zone, it is strongly recommended that that these affected turbine positions be reconsidered post-EA (should such EA be granted) during the detailed design phase, prior to construction.

5.8.6 Spatial Distribution of Flights Over the Turbine Area

Flight lines of priority species were recorded during Vantage Point watches to determine the flight activity and distribution of flight across the WEF site. The results after seven (7) surveys are presented in **Figure 17**.

Additional monitoring (another five surveys) was conducted to gather additional data on the flight activity and distribution of flight across the WEF site, with particular focus given to Martial Eagles due to the active nest near the Project Site. The results after the additional five (5) surveys are presented in **Figure 18** and **Figure 19**.

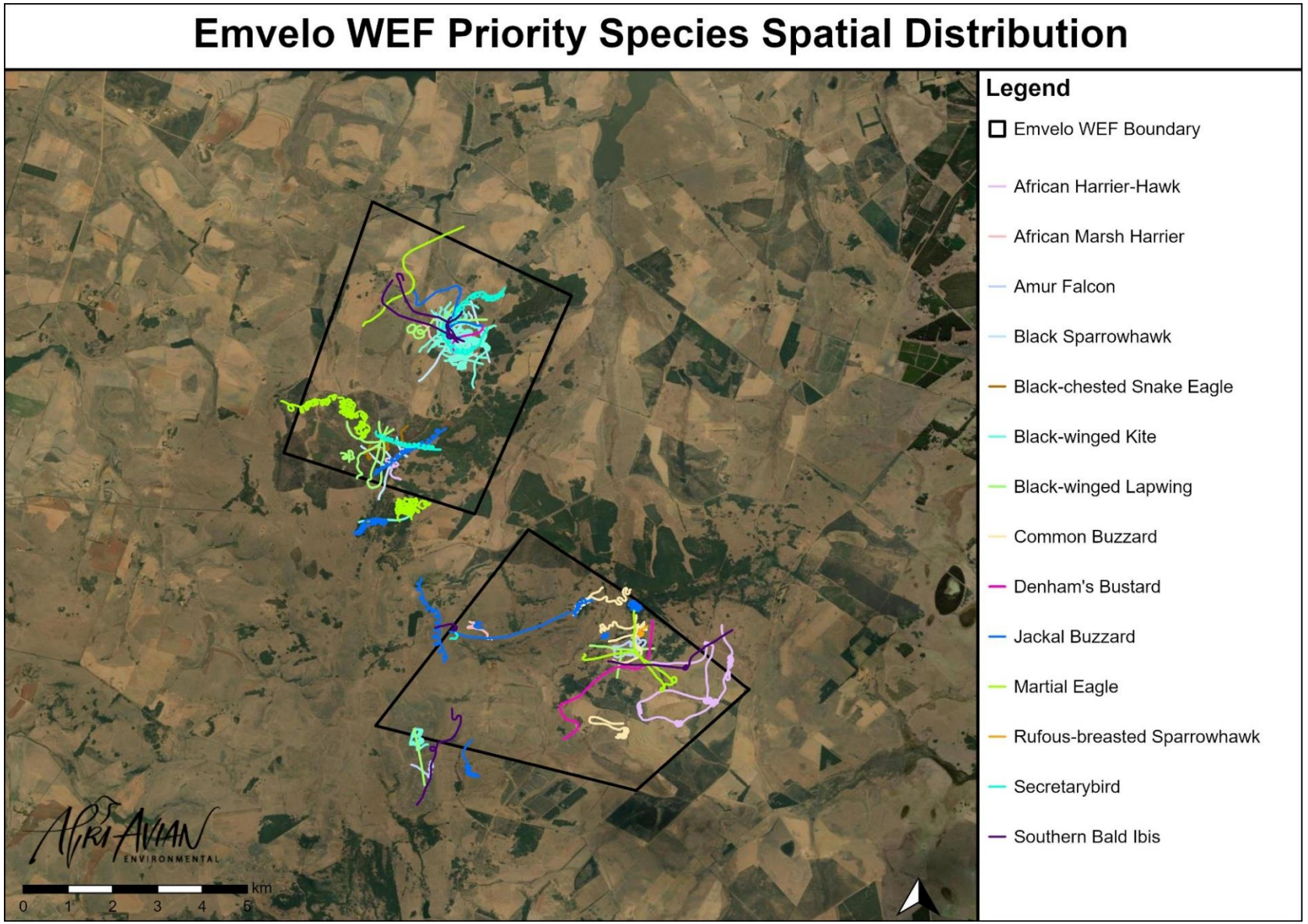


Figure 17: Recorded flight lines of priority species in and near the Emvelo WEF Project Site (based on data recorded from seven surveys).

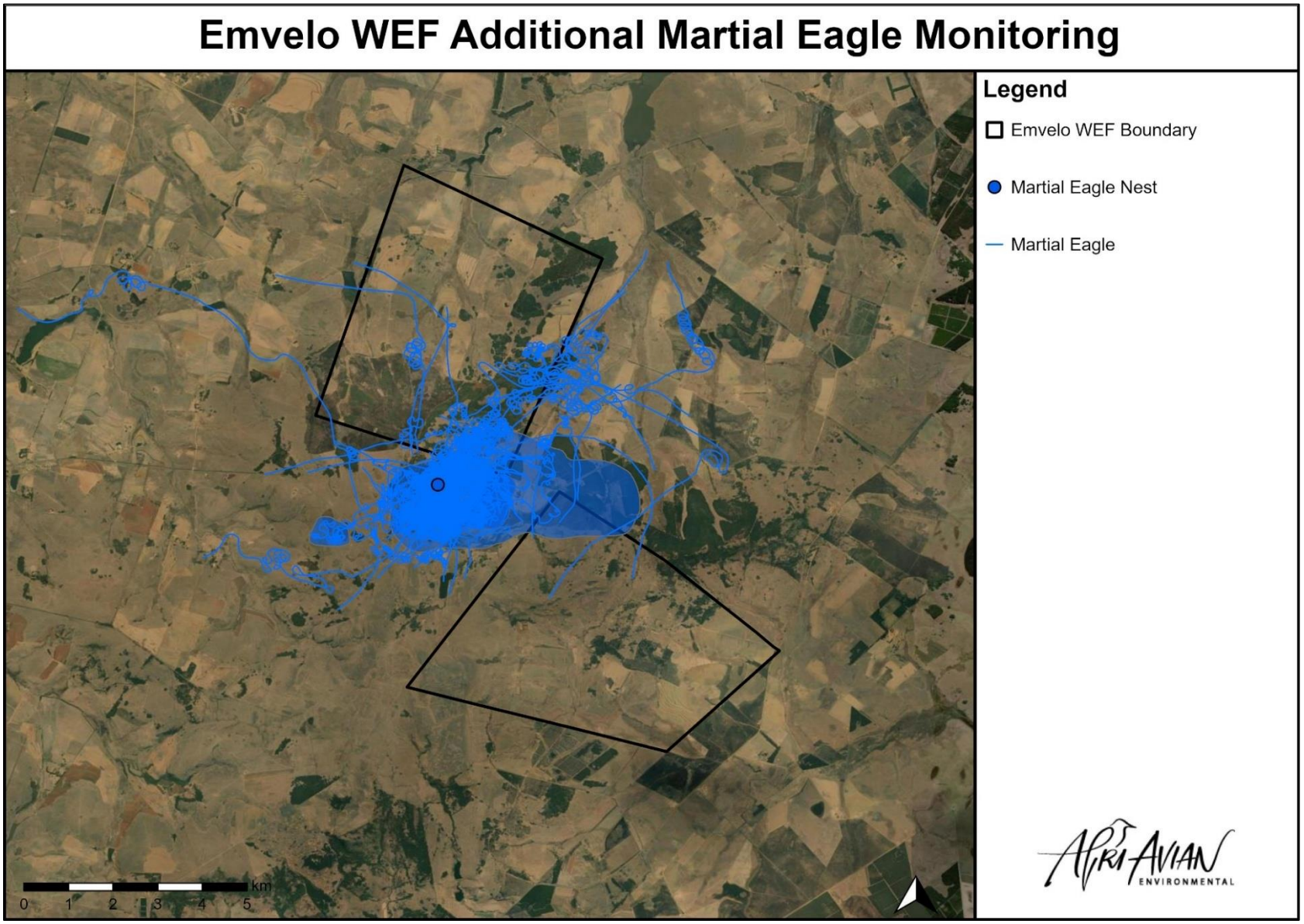


Figure 18: Recorded flight lines for Martial Eagle during the additional five surveys (V1 to V5) in and near the Emvelo WEF Project Site.

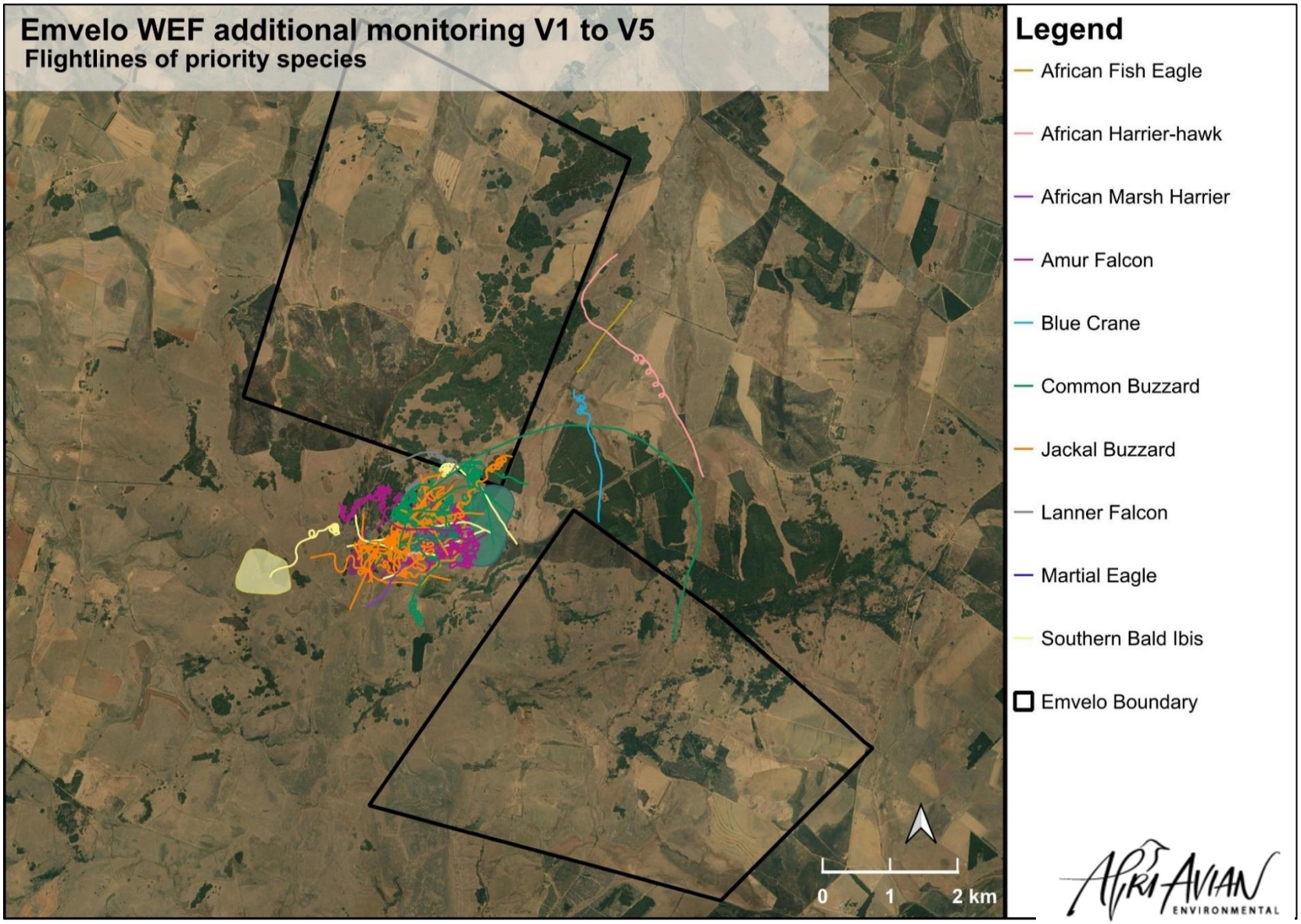


Figure 19: Recorded flight lines of all other priority species (excluding Martial Eagle) during the additional five surveys (V1 to V5) in and near the Emvelo WEF Project Site.

5.8.7 Additional Martial Eagle Monitoring

Additional Vantage Point monitoring was conducted near the identified Martial Eagle nest to gain a better understanding of flight behaviour. Five surveys were conducted, in addition to the seven surveys completed as part of the pre-construction monitoring (see section 5.8 above for survey time envelopes). A total of 60 hours of Vantage Point watches were completed to record flight patterns of Martial Eagles as well as other priority species. Observations were primarily concentrated in the vicinity of the Martial Eagle nest, but where feasible, the eagles were followed to collect as much flight data in the landscape around the nest as possible. During these sampling periods, the duration of priority species flights amounted to 73 hours, 46 minutes, and 18 seconds, with 42 hours, 54 minutes and 19 seconds (almost 60%) of the flights being at medium height (at turbine blade height). See **Figure 20** below for the duration of flights for each priority species.

The flight risk model (FRM) and sensitivity zonation for Martial Eagle were developed using a combination of tracking data, focused field observations, and high-resolution environmental predictor variables. While the model incorporates GPS tracking data from one adult female Martial Eagle (13 months, 6380 transmitted locations) and one juvenile individual (5 months, ~1450 transmitted locations) at the project site, it also includes tracking data (12 months, ~5850 transmitted locations) from a second adult male Martial Eagle monitored at a comparable highland grassland site. This second dataset extended to approximately 12 months and exhibited a remarkably similar spatial use pattern, which is included in the figures reporting on space use. In addition to the GPS tracking data, over 37 hours of direct Martial Eagle flight observations were recorded near the nest site during 60 hours of targeted pre-construction surveys. Together, these datasets provided a robust basis for assessing spatial flight activity in relation to nest proximity and landscape features. This effort produced a substantial dataset of localized flight behaviour, which was used to train a FRM using an artificial neural network (ANN). The ANN was developed using a suite of predictor variables representing topography and focal site characteristics (distance from nest, perch sites, etc.). This enabled a data-driven approach to modelling spatial risk beyond traditional buffer methods (see section 5.8.5).

Importantly, the risk classification framework was not adjusted to reduce turbine constraints, but rather to reflect biologically informed risk thresholds derived from empirical data. The risk model thresholds themselves remained unchanged; what changed was the delineation of more conservative spatial risk zones to better reflect the observed space use and mitigate risk more effectively. While we acknowledge the limitations inherent in working with a small sample size — which is a known challenge for this species — the modelling approach integrates multiple lines of evidence and has prioritized precaution in delineating turbine exclusion zones (i.e., high risk) and mitigation areas (i.e., medium risk). The intent is to implement a risk-responsive mitigation hierarchy that reduces potential collisions.

Regarding the delineation of high and medium sensitivity (risk) zones for Martial Eagle; the original high risk zone (~80 km²) closely mirrors the area of a 5 km circular buffer as recommended by BirdLife South Africa and EWT. However, based on the GPS tracking data and observation records which are showing that approximately 75% of recorded flight activity occurred within 3 km of the nest, a more contracted very high risk zone (about 31 km²) was delineated, within which no wind turbines or other infrastructure will be permitted (i.e., All Infrastructure Exclusion Zone). Also, the additional tracking data indicated the concentrated activity of Martial Eagles (i.e., up to 20% of flight time spent) at a location situated approximately 6 km southeast of the known nest site, which at the time of assessment is confirmed to be a roost based on the amount of time the tracked birds spent at this site, specifically during the summer months (November to March). A site inspection conducted in mid-May 2025 also confirmed the absence of an alternate nest at this location. Subsequently, the tracking data was analysed further and resulted in a slightly expanded high risk zone for Martial Eagle incorporating as a precautionary approach both the nest and the regularly used roost site. Following from this updated sensitivity delineation and based on the revised WEF site layout plan, it appears that wind turbines 12, 13, 14, 19 and 20 are now located in what is delineated as a high risk zone (i.e., Turbine Exclusion Zone). Although these five turbines will also be subject to the stringent mitigation regime that is compulsory for all authorised turbines located in the Medium

Risk zone, including both Automated Shutdown-on-Demand (ASDOD) and dynamic (proactive) diurnal curtailment during periods of expected eagle activity, it is strongly recommended that that these affected turbine positions be reconsidered post-EA (should such EA be granted) during the detailed design phase, prior to construction.

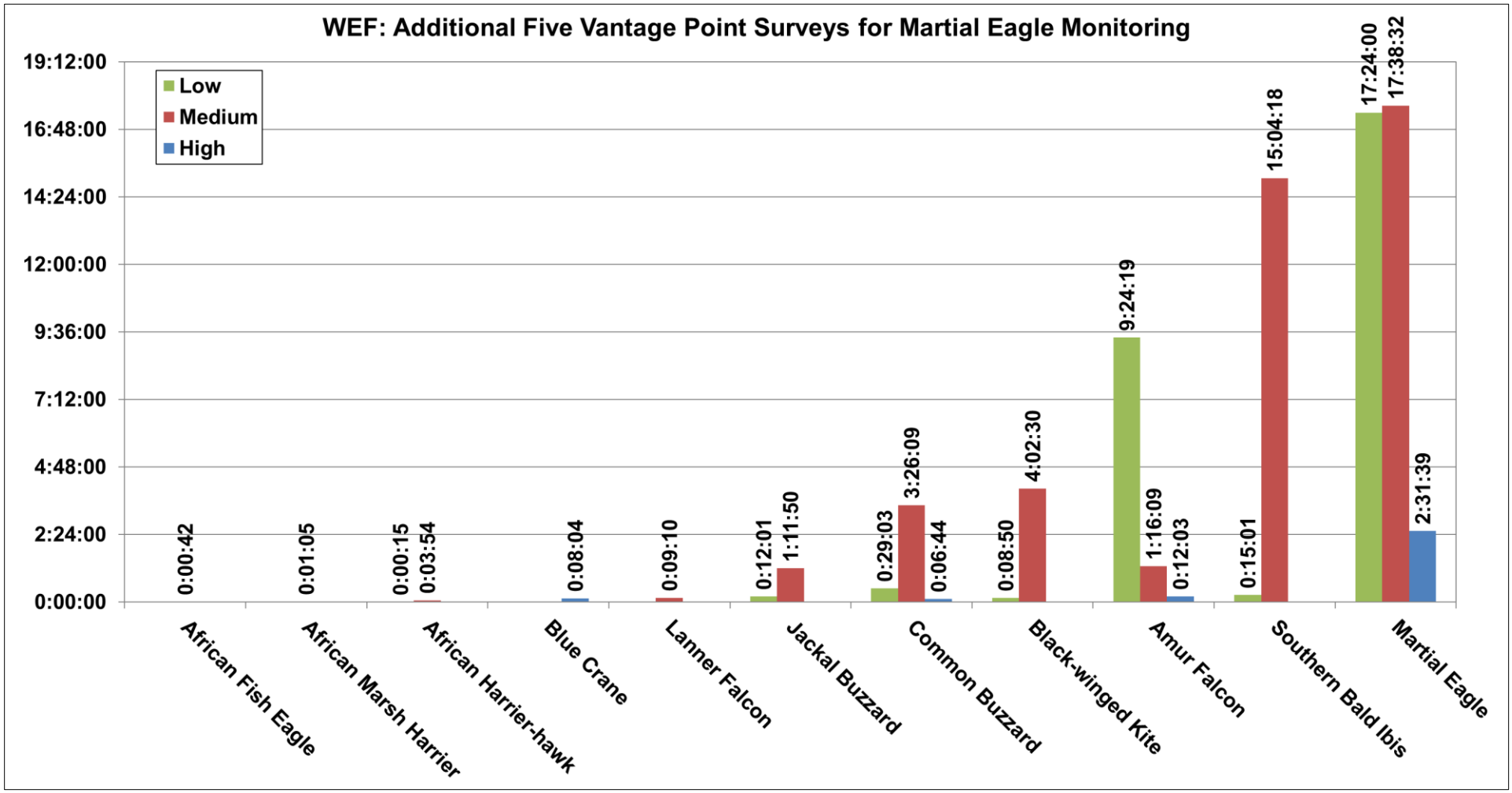


Figure 20: Recorded Flight Times (in Hours: Minutes: Seconds) and Flight Altitudes of Priority Species including Martial Eagle.

5.8.7.1 Assessment of Martial Eagle Tracking data

Martial Eagle tracking data were collected from one adult and one juvenile bird from the nest site located adjacent to the Emvelo WEF Project Site. Eagles were tagged in April/May 2024 by the Endangered Wildlife Trust. Associated data were made available to AfriAvian for analysis to gain insight into the flight activity of the local adult and juvenile as it pertains to flight risk. Refer to Section 5.8.7 above for more information on additional Martial Eagle monitoring and tracking data considered in this assessment.

We pre-processed and analysed all tracking data in R. Data were spatially and temporally cleaned of erroneous and/or poor-quality records using metadata attributes collected by the tracking devices. Given the temporal span of data at the time of analysis (12 months) and data representing a limited number of birds, detailed flight risk modelling was not conducted. However, given the tracking data did incorporate both an adult and juvenile bird over the pre-breeding, breeding and post-breeding periods, the data offered a unique opportunity to gain some understanding of flight risk as it pertains to certain variables. For this analysis, we used two derivatives of the tracking data, namely time spent in an area (hour) and distance travelled (km), as proxies of risk. Variables assessed in relation to these included distance from nest site (km), hour of day, month of year, temperature and wind speed. The two latter weather variables were obtained from local weather masts in the project area and in the direct vicinity of the nest site.

Results from the analysis displayed greater distances travelled over the warmer periods of the day, which peaked between 12:00 and 15:00 (**Figure 21**). The majority (up to 70%) of the adult Martial Eagles' flight time was spent within 3 km of the nest site. While the adult female Martial Eagle also appeared to have spent up to up to 22% of her flight time between 3-7 km of the nest, the adult male Martial Eagle's flight time favoured distances between 7-20 km from the nest with increased flight time spent (up to 20%) around what could likely be a possible roost site located approximately 12 km away from the nest (**Figure 22**). The remaining flight time was spent beyond 20 km. The adult female's time spent between 3-7 km is associated with a confirmed roost site located approximately 6 km away from the nest that was frequented by the adult female pre-breeding (April) and post-breeding (October – November) (**Figure 23**). Greatest distance travelled occurred during moderate temperatures (20-25°C) (**Figure 24**) and moderate to high (4-9 m/s) wind conditions (**Figure 25**).

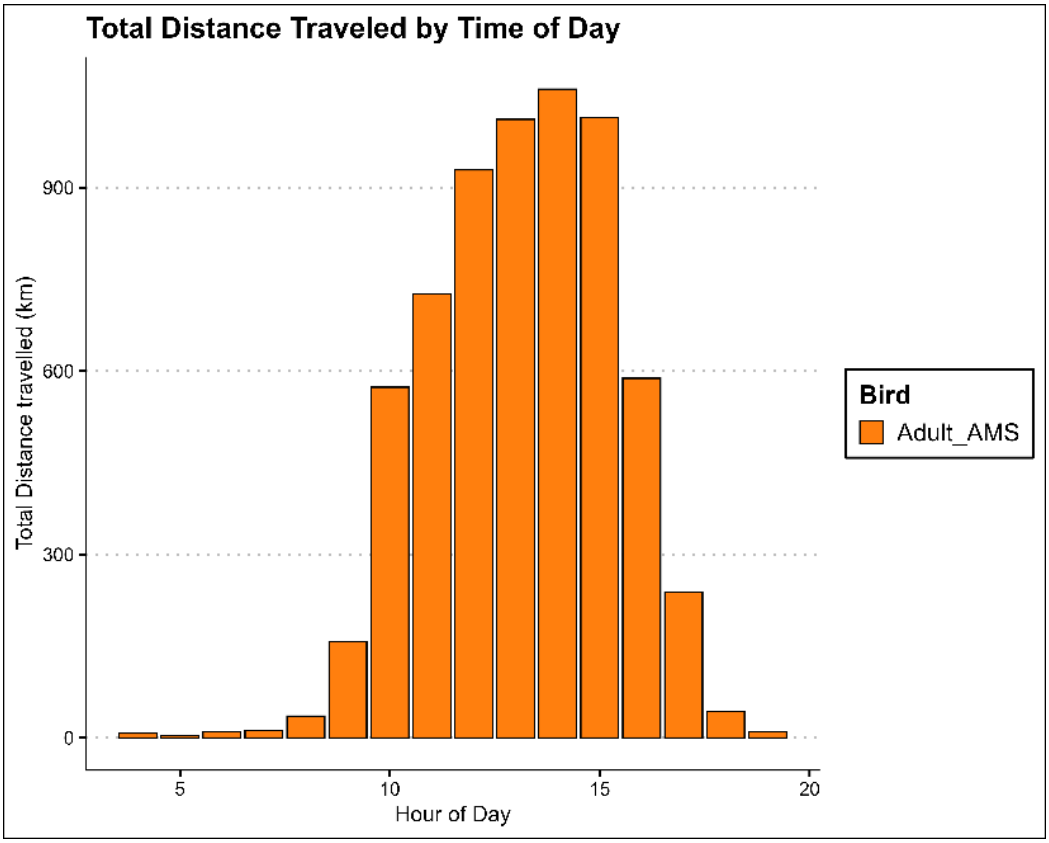


Figure 21: Total distance travelled by the adult female Martial Eagle by hour of day.

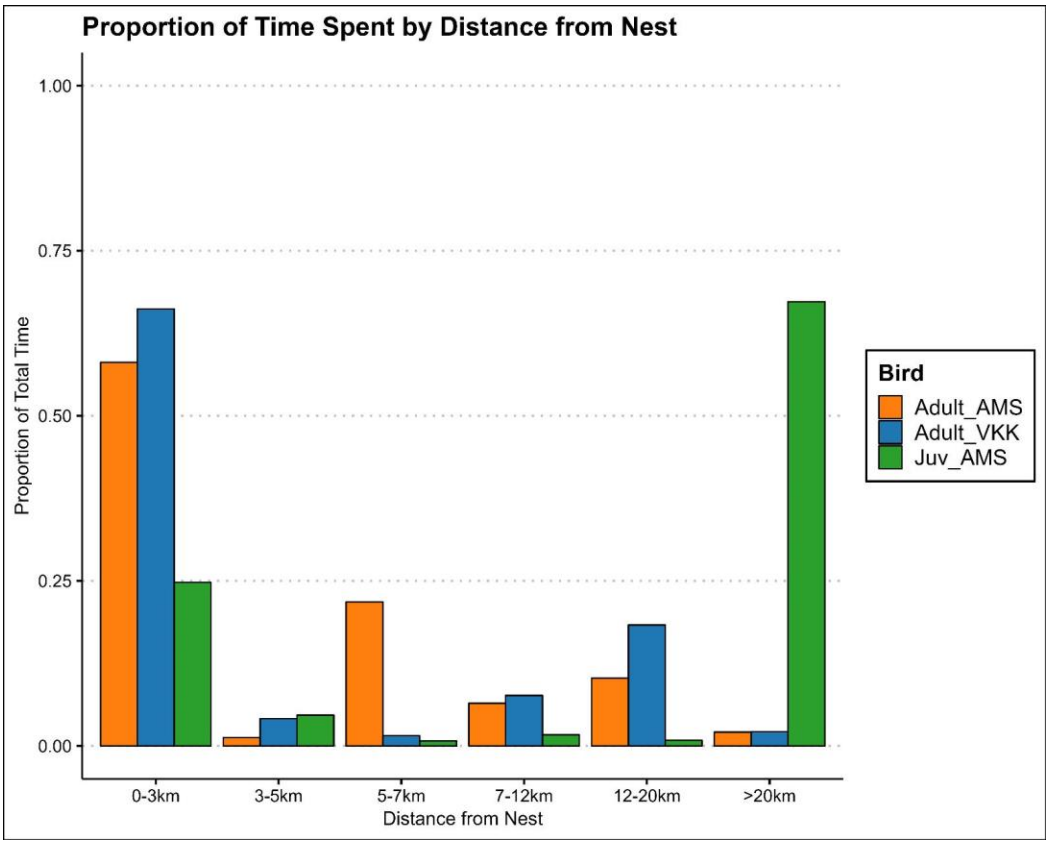


Figure 22: Proportion of time spent by the tracked Martial Eagles (ME) within varied distance bands from the nest site. Orange – Adult female ME (Amsterdam); Blue – Adult male ME (Verkykerskop); Green – Juvenile ME (April 2024 to May 2025).

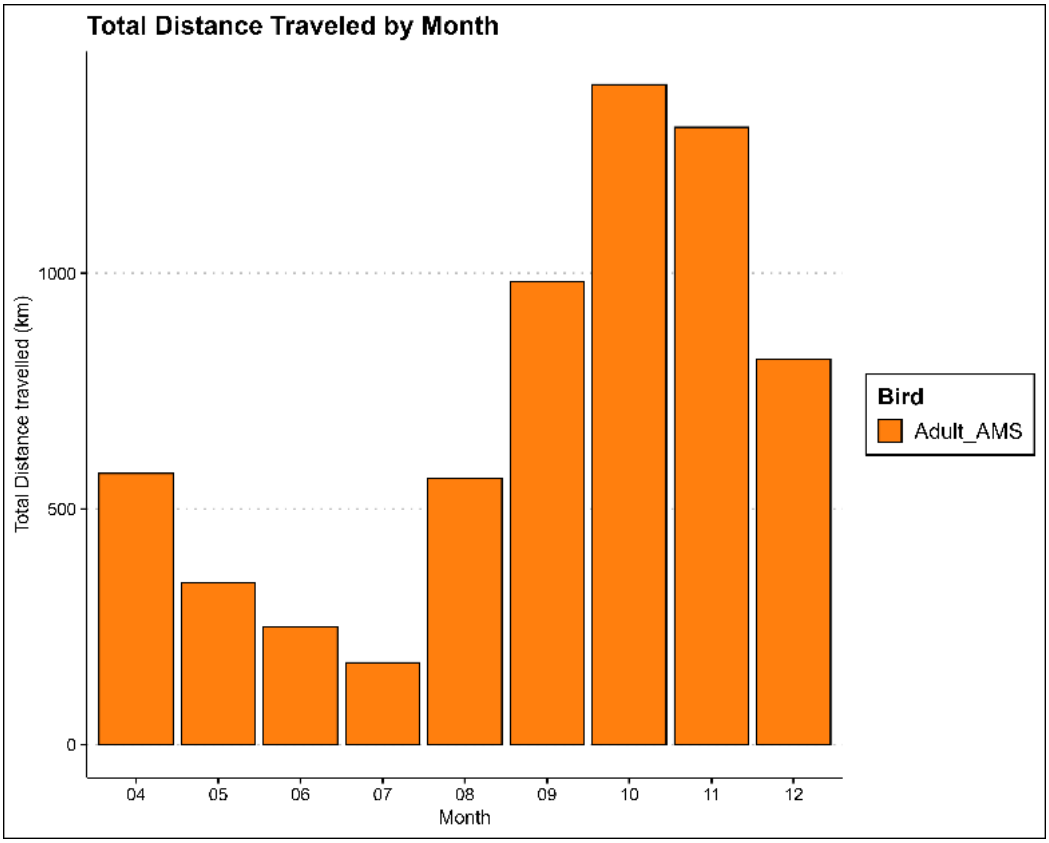


Figure 23: Total distance travelled by the adult female Martial Eagle across months of the year.

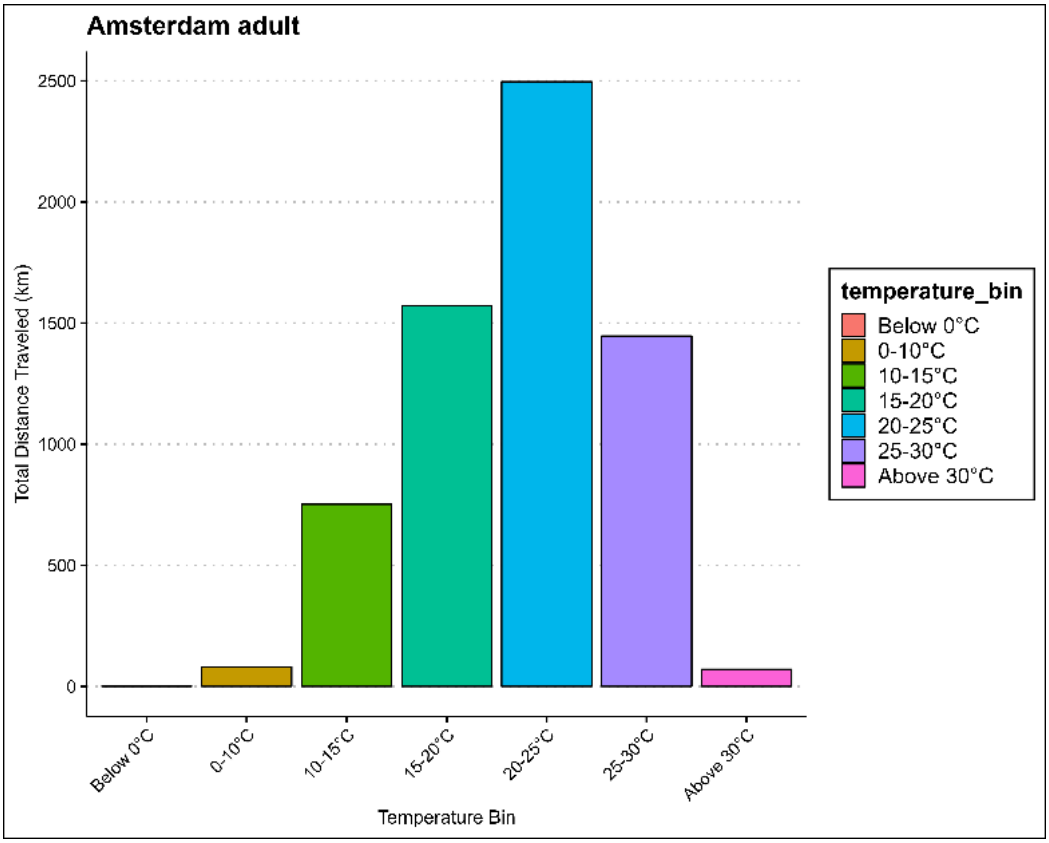


Figure 24: Total distance travelled by the adult female Martial Eagle across varied temperature classes.

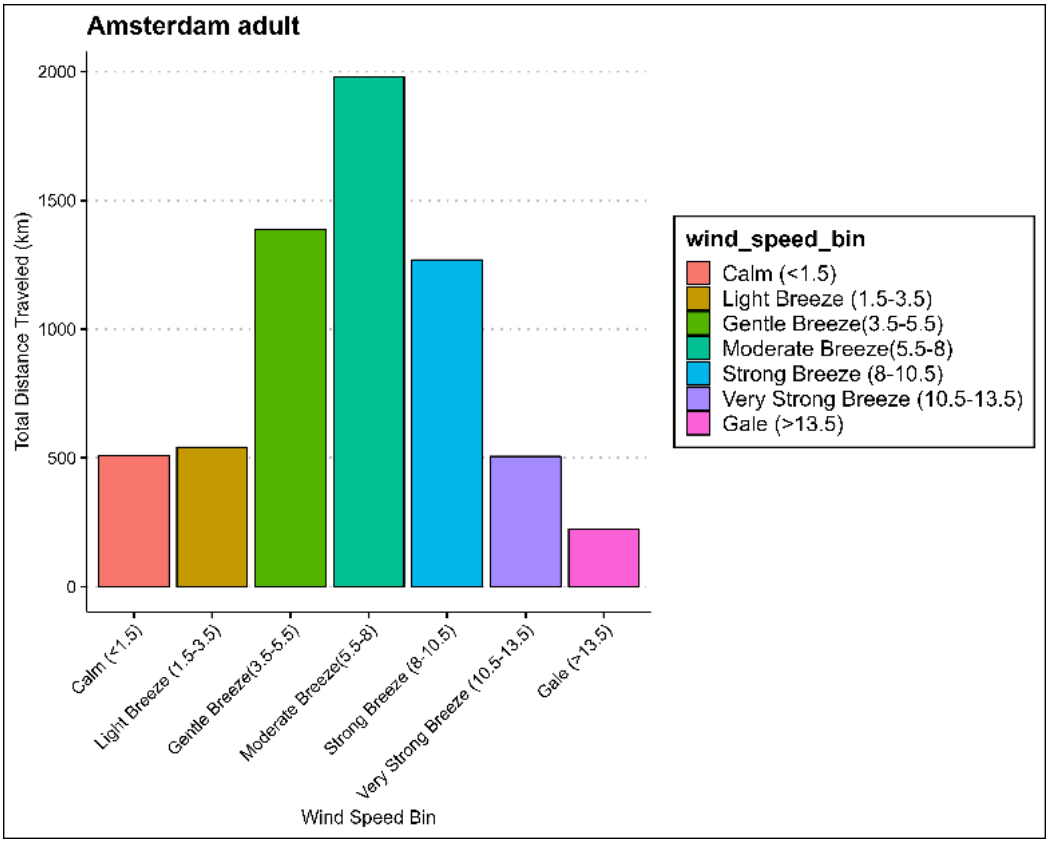


Figure 25: Total distance travelled by the adult female Martial Eagle across varied wind speed classes.

5.8.8 Collision Risk Modelling

Methods

Our Collision Risk Modelling (CRM) approach utilised a Bayesian framework to assessing fatality rates for wind priority species. This framework allows us to use the best available biological data and empirical data, as well as other survey data to inform prior distributions as parameters, whilst posterior distributions reflect the site-specific data collected pre-construction (New et al. 2015). Three crucial components that contribute to the risk of collisions and associated fatalities were incorporated into the analysis, namely bird exposure, collision probability and hazardous area exposure (New et al. 2015). Prior distributions reflecting both exposure and collision probability were generated for a number of species using data from multiple post-construction facilities in South Africa. Defining parameters for exposure and the probability of collision using local data related to the respective species greatly increases the validity of fatality predictions as demonstrated by New et al. (2015) and further confirmed by a local South African case study (Colyn et al. 2024 in prep).

Initially, CRM outputs were generated for five high-priority species: Martial Eagle, Southern Bald Ibis, Cape Vulture, Yellow-breasted Pipit, and Sensitive Species 23. However, we have subsequently expanded the CRM analysis to include all wind priority bird species. Where robust species-specific data were available (e.g., bird exposure rates, collision probabilities), these were used directly to inform the prior distributions of the model.

For species with limited or no local/regional empirical data, ecologically relevant surrogate species were used. Surrogates were selected based on comparable morphology, flight behaviour, habitat use, and foraging strategy, in line with best practice guidelines. This ensures that all priority species are accounted for in the CRM, even in data-poor scenarios, while trying to maintain biological relevance and precaution.

The core principle of our CRM is to assess predicted fatalities based on three key parameters: (1) bird exposure (flight minutes within turbine space), (2) collision probability (chance of being struck while within the rotor-swept

zone), and (3) the hazardous footprint (spatial-temporal turbine risk volume). The Bayesian structure allows for continuous improvement of predictions as additional monitoring data become available, enabling updates to fatality estimates and mitigation strategies within an adaptive management framework.

Subsequently, to predict fatality thresholds for all wind priority species recorded on site, Potential Biological Removal (PBR) estimates were calculated alongside the CRM outputs. This approach enables a scientifically defensible method of establishing species-specific annual fatality thresholds. The PBR framework provides an estimate of the maximum number of individuals that can be removed from a population annually without affecting its viability. By pairing these values with our site-specific CRM fatality predictions—which incorporate the effect of avoidance behaviour and mitigation effectiveness—we can assess whether predicted collision mortality falls within acceptable biological limits.

The ratio of predicted annual fatalities (based on CRM values that take the effectiveness of avoidance and mitigation measures into account) to allowable removals (PBR) is expressed as a percentage annual fatality threshold for each priority species per site, which serves as a practical trigger for additional mitigation. If operational monitoring indicates that annual fatalities are approaching or exceeding PBR-based thresholds, this will trigger an immediate review and escalation of mitigation measures, such as extending curtailment periods, adjusting SDOD protocols, or refining exclusion zones. This framework ensures that mitigation is responsive, data-informed, and conservation-aligned, with threshold exceedance serving as a clear and proactive management trigger.

Appendix 14 includes an index of Potential Biological Removal (PBR) and Collision Risk Model (CRM) results calculated for all priority species recorded on site. **Appendix 15** includes the PBR methodology employed to predict annual fatality thresholds.

Results

Collision risk modelling results for Sensitive Species 23 yielded a mean annual fatality rate of 1.2 birds/year with the original wind turbine layout, which was reduced to 0.62 birds/year with implemented avoidance of core (highly suitable) habitats (**Figure 26**). Mitigation adjacent to transient habitats and other connectivity corridors will be required to mitigate and reduce this rate accordingly. Avoidance of core (highly suitable) Yellow-breasted Pipit habitats reduced annual fatality rates by 63%, yielding a mean fatality rate of 0.31 birds/year (**Figure 26**).

Figure 27 depicts predicted fatality thresholds for two estimation classes for non-threatened priority species recorded at the Emvelo WEF project site:

1. Operation based on the original WEF site layout plan.
    a. One species (Jackal Buzzard) yielded estimates far exceeding a **fatality rate of 1 bird/year**.
2. Operation based on the revised WEF site layout plan with stringent mitigation (i.e., Automated SDoD and proactive curtailment) for all authorised turbines located in high and medium risk zones.
    a. **All species showed a reduced predicted fatality rate per year** compared to the original WEF layout.
    b. One species (Jackal Buzzard) yielded estimates just exceeding a **fatality rate of 1 bird/year**.

Figure 28 shows predicted fatality thresholds for four estimation classes for threatened priority species recorded at the Emvelo WEF project site:

1. Operation based on the original WEF site layout plan
    a. Two species (Martial Eagle and Southern Bald Ibis) yielded estimates reaching or exceeding a **fatality rate of 1 bird/year**.
2. Operation based on the revised WEF site layout plan with avoidance of very high and high-risk zones but no additional mitigation (i.e., compulsory Automated Shutdown on Demand (SDoD)) for all authorised turbines.
    a. **Two species (Martial Eagle and Southern Bald Ibis) showed a reduced (>50%) predicted fatality rate per year** compared to the original WEF layout.

3. Operation based on the revised WEF site layout plan with avoidance of very high and high-risk zones and stringent mitigation i.e., compulsory Automated SDoD and diurnal proactive curtailment.
    a. **Two species (Martial Eagle and Southern Bald Ibis) showed a significantly reduced (>90%) predicted fatality rate per year** compared to both the original WEF layout and the revised WEF layout with only avoidance of very high and high-risk zones.
4. Operation based on the revised WEF site layout plan with stringent mitigation i.e., compulsory Automated SDoD and diurnal proactive curtailment.
    a. **Four species (African March Harrier, Cape Vulture, Denham's Bustard and Secretarybird) showed a reduced (>50%) predicted fatality rate per year** compared to the original WEF layout.

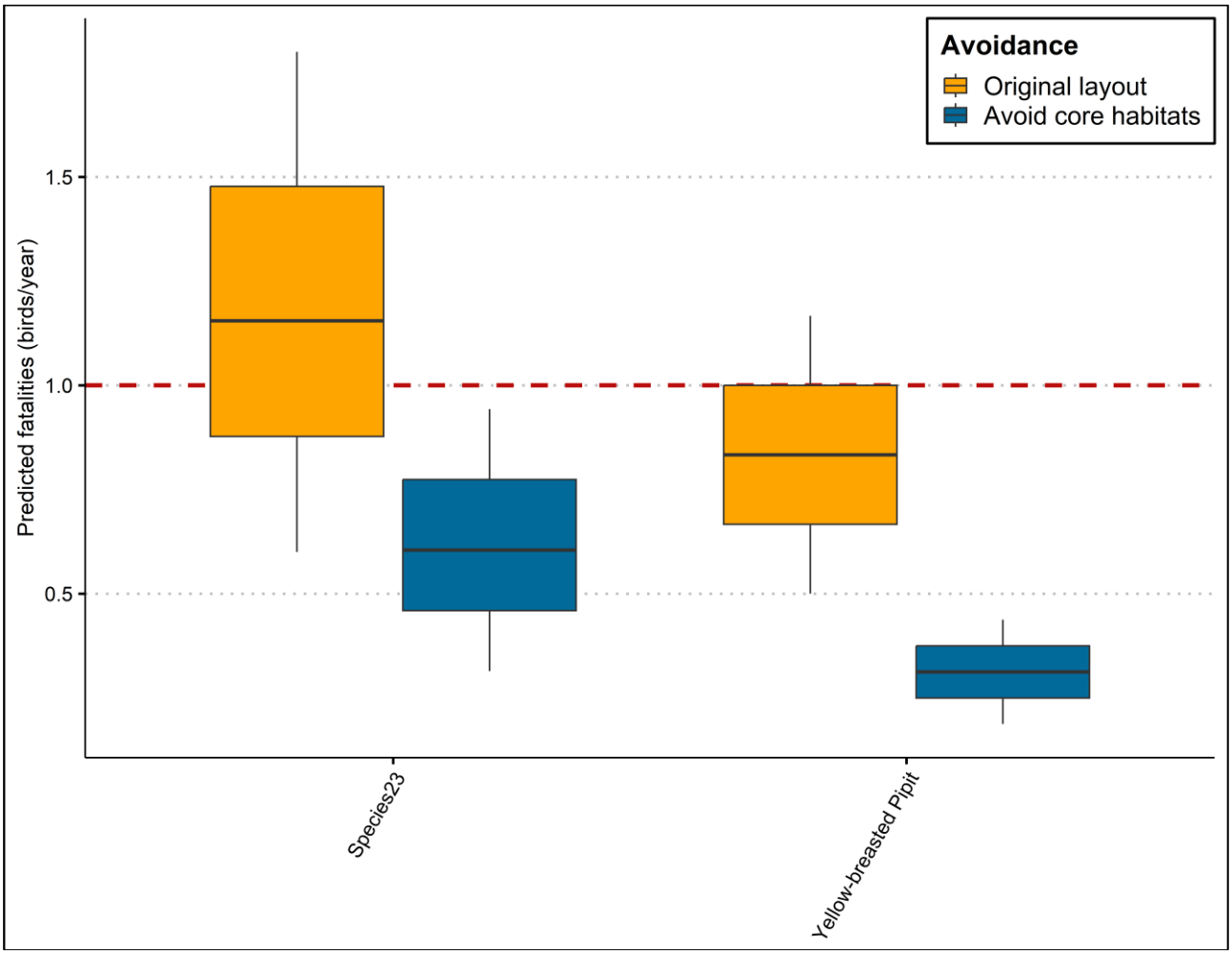


Figure 26: Collision risk modelling predicted fatalities for Sensitive Species 23 and the Yellow-breasted Pipit with two estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with avoidance of core habitats (blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year.

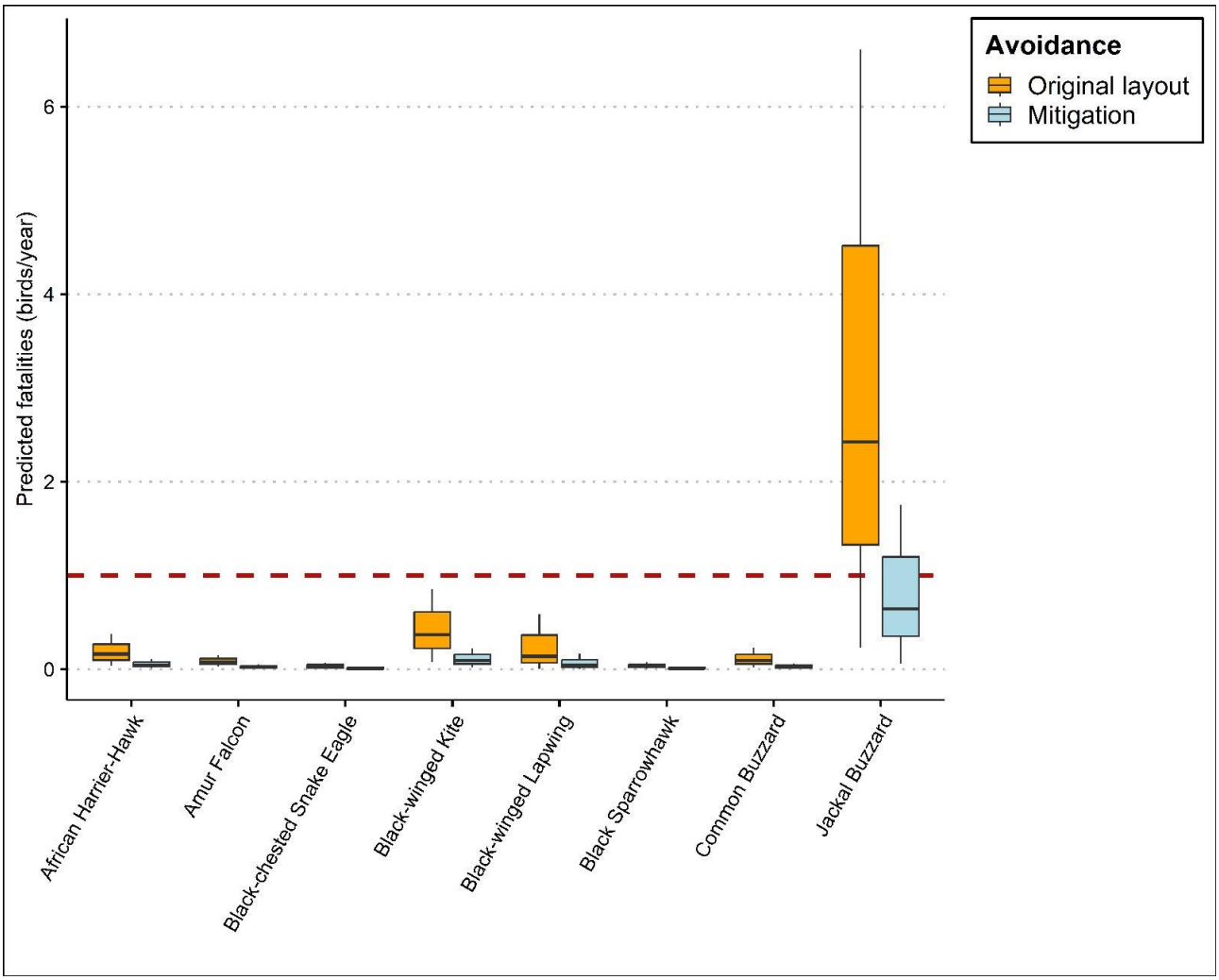


Figure 27: Collision risk modelling predicted fatalities for non-threatened priority species with two estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with stringent mitigation (Automated SDoD and proactive curtailment) for all authorised turbines located in high and medium risk zones (blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year.

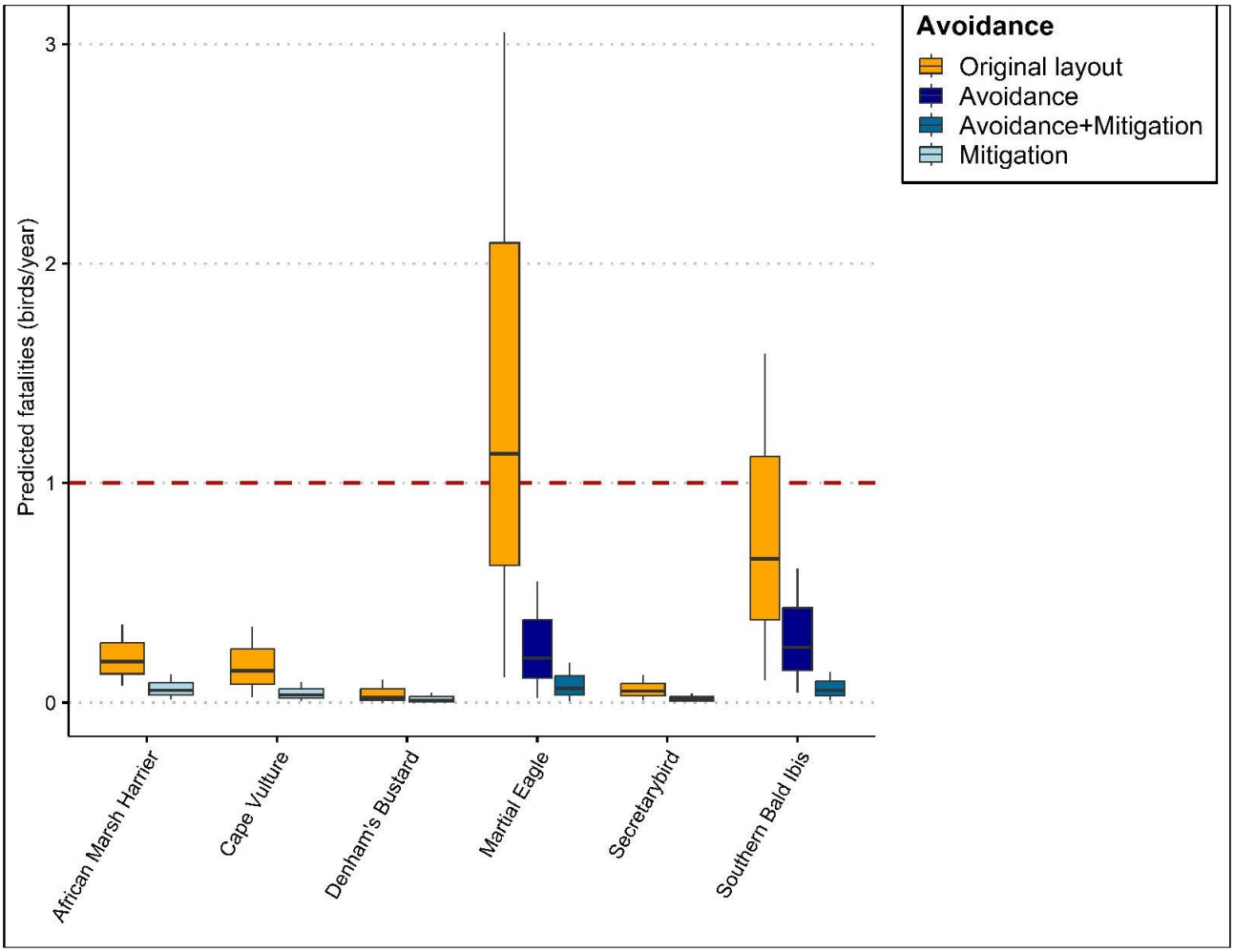


Figure 28: Collision risk modelling predicted fatalities for threatened priority species with four estimation classes; 1) original WEF layout (orange); 2) revised WEF layout with avoidance of very high and high-risk zones but no additional mitigation (dark blue); 3) revised WEF layout with both avoidance of very high and high-risk zones and stringent mitigation for Martial Eagle and Southern Bald Ibis (mitigation = compulsory Automated SDoD and diurnal proactive curtailment) (blue); and 4) revised WEF layout with stringent mitigation (mitigation = compulsory Automated SDoD and diurnal proactive curtailment) (light blue). The red dotted line indicates a fatality threshold of one (1) bird fatality per year.

6. SPECIALIST FINDINGS AND ASSESSMENT OF IMPACTS

6.1 Wind Energy Facility (WEF)

The effects of a wind farm on birds are highly variable and depend on a wide range of factors, including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision):

- Mortality of priority avifauna due to collisions with the wind turbines
- Displacement of priority avifauna due to disturbance during construction and operation of the wind farm
- Displacement of priority avifauna due to habitat change and loss at the wind farm

- Mortality of priority avifauna due to electrocution on the medium voltage overhead lines
- Mortality of priority avifauna due to collisions with the medium voltage overhead lines

It should be noted that the assessment is made on the *status quo* as it is currently on site. The possible change in land use in the broader development site has not been considered because the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is possible that there could be changes in the foreseeable future in the form of mining.

6.1.1 Collision Mortality on Wind Turbines[6]

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 main ecological drawback to wind energy (Drewitt and Langston, 2006).

Collisions with wind turbines appear to kill fewer birds than collisions with other man-made infrastructures, such as power lines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.* 1998).

High bird fatality 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* sp.) and terns (*Sterna* sp.) (Barrios and Rodríguez, 2004; Drewitt and Langston, 2006; Everaert and Stienen, 2008; May *et al.* 2012a; Thelander *et al.* 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for a large number of 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; May *et al.* 2012b). 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.

Species-Specific Factors

- Morphological Features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. Janss (2000) identified weight, wing length, tail length and total

[6] This section is based largely on a (2014) review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira, Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. *Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies*. Biological Conservation 179 (2014) 40– 52.

bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wingspan squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas *et al.* 2008; Herrera-Alsina *et al.* 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture (*Gyps fulvus*), seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards (*Buteo buteo*) and Short-toed Eagles (*Circaetus gallicus*), and this pattern is not related with their local abundance (Barrios and Rodríguez, 2004; De Lucas *et al.* 2008). High wing-loading is associated with low flight manoeuvrability (De Lucas *et al.* 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

Information on the wing loading of the priority species potentially occurring regularly at the proposed WEF was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are bustards and cranes making them less manoeuvrable (Keskin et al. 2019).

- Visual Perception

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt and Langston, 2008; Erickson *et al.* 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Krijgsveld *et al.* 2009). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin, 2011; McIsaac, 2001). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin, 2011). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps sp.) cranes and bustards (Martin and Katzir, 1999; Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Furthermore, for some species, their high-resolution vision areas are often found in the lateral fields of view, rather than frontally (e.g. Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin et.al, 2010; Martin, 2011).

Some of the regularly occurring priority species at the proposed WEF have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the ibises, bustards, and cranes. The exceptions to this are the priority raptors which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better.

- Phenology

Recent studies have shown that, within a wind farm, raptor collision risk and fatalities are higher for resident than for migrating birds of the same species. An explanation for this may be that resident birds generally use the wind farm area several times while a migrant bird crosses it just once (Krijgsveld *et al.* 2009). However, other factors like bird behaviour are certainly relevant. Katzner *et al.* (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes.

South Africa is at the end of the migration path for summer migrants; therefore, the phenomenon of migratory flyways where birds are concentrated in large numbers for a limited period of time, e.g. the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the national landscape. The migratory priority species which could occur at the proposed WEF with some regularity, e.g., White Stork, Amur Falcon, and Common Buzzard will behave much the same as the resident birds once they arrive in the area. The same is valid for

local migrants such as the Denham's Bustard. It is expected that, for the period when they are present, these species will be exposed to the same risks as resident species.

- Bird Behaviour

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight (hanging in the wind with almost motionless wings), which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed Hawks *Buteo jamaicensis* at APWRA (Hoover and Morrison, 2005), and could also be a factor in contributing to the high collision rate for Jackal Buzzards in South Africa (Ralston-Paton & Camagu 2019). The hovering behaviour exhibited by Common Kestrels *Falco tinnunculus* when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios and Rodríguez, 2004). This may also explain the high mortality rate of Rock Kestrels *Falco rupicolus* at wind farms in South Africa (Ralston-Paton & Camagu 2019). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover and Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). In the case of raptors, aggressive interactions may play an important role in turbine fatalities, in that birds involved in these interactions are momentarily distracted, putting them at risk. At least one eye-witness account of a Martial Eagle getting killed by a turbine in South Africa in this fashion is on record (Simmons & Martins 2016).

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña 2012a). Similarly, in South Africa, only two bustard collisions with wind turbines have been reported to date, both Ludwig's Bustards (Ralston-Paton & Camagu 2019). No Denham's Bustards *Neotis denhami* turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

The priority species which could occur with some regularity at the proposed WEF can be classified as either: terrestrial species, soaring species, or occasional long-distance fliers. Terrestrial species spend most of the time foraging on the ground. They do not fly often and when they do, they generally fly for short distances at low to medium altitude. At the project site bustards and korhaans are included in this category. Occasional long-distance fliers generally behave as terrestrial species but can and do undertake long distance flights on occasion. Species in this category are White Stork, Denham's Bustard, Blue Crane, Grey Crowned Crane, Southern Bald Ibis, and Secretarybird. Soaring species spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering, and gliding at medium to high altitudes. At the project site, these include all the raptors.

- Avoidance Behaviours

Two types of avoidance have been described (Furness *et al.*, 2013): 'macro-avoidance' whereby birds alter their flight path to keep clear of the entire wind farm (e.g. Desholm and Kahlert, 2005; Plonczkier and Simms, 2012; Villegas-Patraca *et al.* 2014), and 'micro-avoidance' whereby birds enter the wind farm but take evasive actions to avoid individual wind turbines (Band *et al.* 2007). This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010).

It is anticipated that most birds at the proposed WEF will avoid the wind turbines, as is generally the case at all wind farms (SNH 2010). Exceptions already mentioned are raptors that engage in hunting which might serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and

intraspecific aggressive interaction. Complete macro-avoidance of the wind farm is unlikely for any of the priority species likely to occur at the proposed WEF.

- Bird Abundance

Some authors suggest that fatality rates are related to bird abundance, density or utilization rates (Carrete *et al.* 2012; Kitano and Shiraki, 2013; Smallwood and Karas, 2009), whereas others point out that, as birds use their territories in a non-random way, fatality rates do not depend on bird abundance alone (e.g. Ferrer *et al.* 2012; Hull *et al.* 2013). Instead, fatality rates depend on other factors such as differential use of specific areas within a wind farm (De Lucas *et al.* 2008). For example, at Smøla, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl *et al.* 2013). In the APWRA, Golden Eagles, Red-tailed Hawks and American Kestrels (*Falco spaverius*) have higher collision fatality rates than Turkey Vultures (*Cathartes aura*) and Common Raven (*Corvus corax*), even though the latter are more abundant in the area (Smallwood *et al.* 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas *et al.* 2008).

The abundance of priority species at the proposed WEF will fluctuate depending on the season of the year. Greater numbers are expected during the rainy season, when foraging conditions are better and certain migratory species are present.

Site-Specific Factors

- Landscape Features

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly. Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios and Rodríguez, 2004; Drewitt and Langston, 2008; Katzner *et al.* 2012; Thelander *et al.* 2003). In APWRA, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander *et al.* 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano and Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

The project site does not contain many landscape features as it is situated on a slightly undulating plain. The most significant landscape features from a collision risk perspective are some of the low ridges which may be utilised by some species for lift especially during soaring flight behaviour.

- Flight Paths

For territorial raptors like Golden Eagles (and Verreaux's Eagles – see Ralston-Patton 2017), foraging areas are located closer to the nest. For example, in Scotland Golden Eagles have ranges of about 6 km around the nest, however the core areas where feeding takes place were typically within a 2 - 3 km radius around the nest (McGrady *et al.* 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas close to ridges, can be used to predict the areas used by the species to forage (McLeod *et al.* 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright *et al.* 2006).

The Martial Eagle nest and roost (coordinates provided on request) adjacent to the project site is the hub of the flight activity for the pair of eagles. A No-Go buffer zone informed by extensive flight data on site as well as GPS tracking data from two adult birds and one juvenile individual were used to define high risk turbine

exclusion zones as well as medium risk mitigation zones around the nest and roost to reduce the risk of collisions.

Some of the wetlands and dams act as focal points for flight activity as birds converge on the wetlands and dams, e.g. Grey Crowned Crane in some of the wetlands, and some dams with dead trees used as roosts by Southern Bald Ibis. The same could be said for the roosts and colonies of Southern Bald Ibis on low cliffs (in the broader area) which are focal points for flight activity.

- Food Availability

Factors that increase the use of a certain area or that attract birds, like food availability; also play a role in collision risk. For example, the high density of raptors at the APWRA and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover and Morrison, 2005; Smallwood *et al.* 2001). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). It is speculated that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the availability of food (Smallie 2015).

The agricultural activity is an attractant for Southern Bald Ibis during certain times of the year. Natural grassland is the foraging habitat of choice for a range of priority species, including Secretarybird, Southern Bald Ibis, Yellow-breasted Pipit, Denham's Bustard and White-bellied Bustard.

- Summary

The proposed Emvelo WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Blue Korhaan, Denham's Bustard, Ludwig's Bustard, and Blue Crane[7], although bustards and cranes generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., raptors such as Martial Eagle, Lanner Falcon, Brown Snake Eagle, and Common Buzzard are most at risk of all the priority species likely to occur regularly at the project site.

In summary, the following priority species could be at risk of collisions with the turbines: African Fish Eagle, African Harrier-Hawk, African Marsh Harrier, Amur Falcon, Black Sparrowhawk, Black-bellied Bustard, Black-chested Snake Eagle, Black-winged Kite, Black-winged Lapwing, Blue Crane, Brown Snake Eagle, Cape Vulture, Common Buzzard, Denham's Bustard, Greater Flamingo, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Spotted Eagle-Owl, Cape Eagle-Owl, White Stork, White-bellied Bustard, and Yellow-breasted Pipit. Refer to **Figure 16** above for an indication of the flight times recorded for certain priority species at various altitudes during the monitoring.

6.1.2 Displacement Due to Disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance can in effect amount to habitat loss. Displacement may occur during both the construction and operation phases of wind farms and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

[7] Although the species is unlikely to occur regularly.

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before-and-after and control-impact (BACI) assessments. Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600 m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). The same situation seems to prevail at wind farms in the Eastern Cape where Denham's Bustard is still using wind farm sites as leks.[8] Research on small grassland species in North America indicates that permanent displacement is uncommon and is very species specific (e.g. see Stevens et.al 2013, Hale et.al 2014). There also seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the United Kingdom (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins et. al 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al*. 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long lifespan of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80 m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100 m from a wind turbine ranging from 14 – 93 m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500 m buffer of the turbines by 15– 53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

A measure of displacement will inevitably take place for all priority species as a result of disturbance from construction activities during the construction phase. This will primarily affect ground-nesting species in the remaining high-quality grassland, wetlands, and wetland fringes, although the majority of these habitats are completely avoided by the project footprint. In addition, the Southern Bald Ibises that roost and breed adjacent to the Project Site could face a disruption of their reproductive cycle. Some species could recolonise the area after the completion of construction. However, as a result of habitat fragmentation and operational turbines causing disturbance, other species could only partially return to their previous habitat, possibly resulting in lower densities than before. In summary, the following species could be impacted by disturbance during the

[8] Personal communication by Wessel Rossouw, bird monitor based in Jeffreys Bay, from personal observations in the Kouga municipal area.

construction phase: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Black Sparrowhawk, Black-winged Kite, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Spotted Eagle-Owl, White-bellied Bustard, and Yellow-breasted Pipit.

6.1.3 Displacement due to Habitat Loss

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), though effects 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 changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

However, the results of habitat transformation may be more subtle, whereas the actual footprint of the wind farm may be small in absolute terms; the effects of the habitat fragmentation brought about by the associated infrastructure (e.g. power lines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under power lines, but a study done in Spain (Lane *et al.* 2001 as cited by Raab *et al.* 2009) indicates that the total observation of Great Bustard flocks was significantly higher further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard generally avoids the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes select nesting sites away from roads. This means that power lines and roads also cause loss and fragmentation of the habitat used by the population in addition to the potential direct mortality. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab *et al.* 2010). 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 construction of additional roads is likely to result in habitat fragmentation, although the site already has a large number of access roads, most of which will be upgraded and utilised for the wind farm development. This, together with the disturbance factor of the operating turbines, could have an effect on the density of several species, particularly larger terrestrial species which would utilise the remaining natural grassland, wetlands, and wetland fringes as breeding habitat. It is not expected that any priority species will be permanently displaced from the development site, but densities may be reduced. In summary, the following terrestrial species and raptors are likely to be most affected by habitat transformation: African Grass Owl (recorded during dedicated wetland surveys), Black-winged Lapwing, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Secretarybird, White-bellied Bustard, and Yellow-breasted Pipit.

6.1.4 Electrocution on the 33 kV Medium Voltage Network

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2000). The electrocution risk is largely determined by the design of the electrical hardware.

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the electricity

could potentially pose an electrocution risk to several power line sensitive species that could on occasion perch on these poles.

In summary, the following priority species are expected to be vulnerable to electrocution[9]: African Fish Eagle, African Goshawk, African Harrier-Hawk, African Marsh Harrier, African Sacred Ibis, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Vulture, Common Buzzard, Egyptian Goose, Grey Crowned Crane, Hadada Ibis, Hamerkop, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Cattle Egret, and Yellow-billed Kite.

6.1.5 Collisions with the 33 kV medium voltage network

While the intention is to place the 33 kV 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 species. The topic of collisions is extensively covered under 6.2.2 below and will not be repeated here.

In summary, the following priority species could be vulnerable to collisions with the 33 kV medium voltage lines[10]: African Darter, African Sacred Ibis, African Spoonbill, Black-bellied Bustard, Black-headed Heron, Blue Crane, Cape Shoveler, Cape Vulture, Denham's Bustard, Egyptian Goose, Glossy Ibis, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Little Grebe, Marsh Owl, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Sensitive Species 23, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, and Yellow-billed Duck.

6.2 Grid Connection Components

Negative impacts on avifauna by electricity infrastructure generally take two main forms namely electrocution and collisions (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Van Rooyen 2004; Jenkins *et al*. 2010). Displacement due to habitat transformation and disturbance associated with the construction of the electricity infrastructure is another impact that could potentially impact on avifauna.

6.2.1 Electrocutions

Electrocution refers to the scenario where a bird is perched, or attempts to perch, on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132 kV tower specification, the electrocution impact for the majority of priority species will be negligible. The Cape Vulture is the only priority species, due to their size and gregarious nature, capable of bridging the clearance distances of an OHL constructed using this specification.

Ordinarily, the construction of a single circuit powerline using the approved bird-friendly pylon/tower design D-DT-7649 in accordance with the Distribution Technical Bulletin titled *Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467* will eliminate the electrocution risk. The configuration of the insulators and the clearance distances between the live and earthed

[9] These include both wind and powerline priority species

[10] These include both wind and powerline priority species.

components on this structure can comfortably accommodate a perching vulture. However, if the OHL will be built on lattice structures, it is imperative that there is a minimum clearance of 1.8 m between the jumper cables and/or insulators and the horizontal earthed component on the lattice structure (pers. comm. Lourens Leeuwner - Eskom-EWT Strategic Partnership Manager). Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles must be implemented (if suitable insulation material is readily available); alternatively, all jumper cables must be suspended below the crossarms.

Electrocutions within the proposed on-site substation are possible, however, the likelihood of this impact on the more sensitive SCC is remote, as these species are unlikely to regularly utilise the infrastructure within the on-site substation station for perching or roosting. Species that are more vulnerable to this impact are medium-sized raptors, corvids, owls, and certain species of waterbirds.

It is assumed that the OHL will be built with 132 kV pylon/tower designs therefore the powerline-sensitive species potentially vulnerable to electrocution on the actual towers/pylons is Cape Vulture. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, and Yellow-billed Kite.

6.2.2 Collisions

Collisions are the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes, and various species of waterbirds, and to a lesser extent, vultures. 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, Anderson 2001). In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological, and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes, and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds have not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight

altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994)."

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 (**Figure 29**).

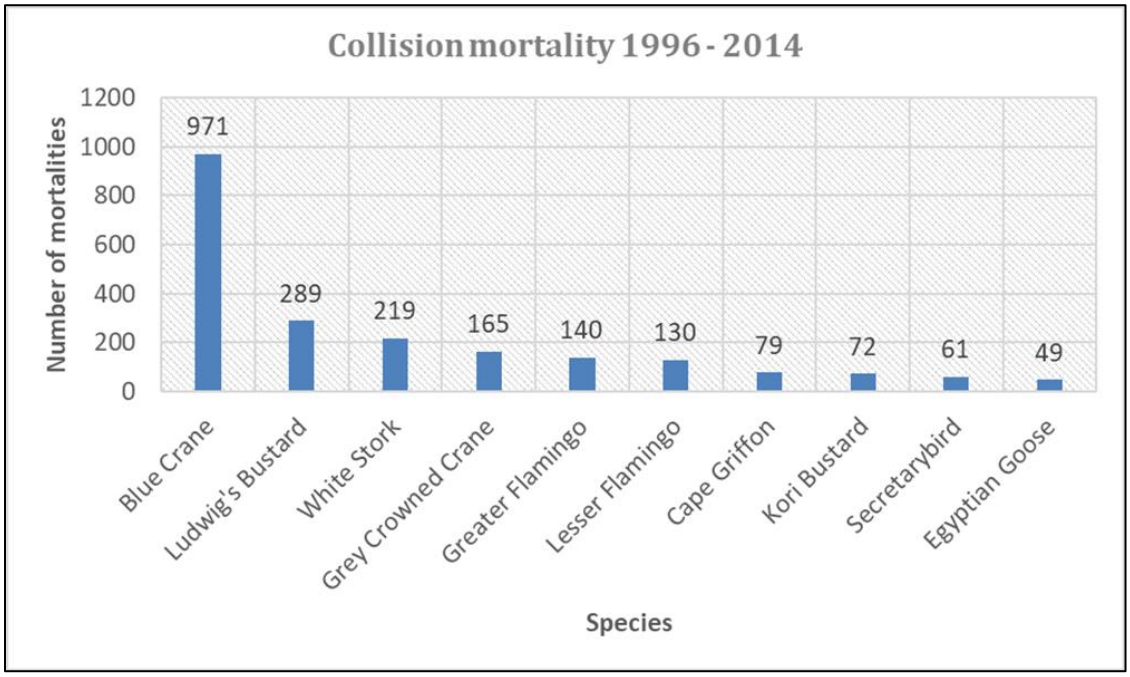


Figure 29: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

Powerline collisions are generally accepted as a key threat to bustards (Raab *et al*. 2009; Raab *et al*. 2010; Jenkins & Smallie 2009; Barrientos *et al*. 2012, Shaw 2013). In a recent 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. 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).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures.

Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards *Ardeotis kori*, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (A*ccipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes and are also known to be vulnerable to power line collisions.

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al*. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Bernardino *et al.* 2018; Sporer *et al.* 2013, Barrientos *et al*. 2011; Jenkins *et al*. 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al*. 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10 m intervals only reduces the mortality by 57%. Barrientos *et al*. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al*. 2010).

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 400 kV transmission lines near Hydra substation in the Karoo. 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*. 2017).

The up to 132 kV OHL could pose a collision risk to virtually all powerline sensitive avifauna potentially present in the area, depending on where those spans are located. Species potentially at risk are African Darter, African Grass Owl (recorded during dedicated wetland surveys), African Sacred Ibis, African Spoonbill, Black-bellied Bustard, Black-headed Heron, Blue Crane, Cape Shoveler, Cape Vulture, Denham's Bustard, Egyptian Goose, Glossy Ibis, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Little Grebe, Marsh Owl, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, and Yellow-billed Duck.

6.2.3 Displacement due to Habitat Transformation

During the construction of power lines, service roads (jeep tracks) and substations, habitat destruction/transformation inevitably takes place. The construction activities will constitute the following:

- Site clearance and preparation;
- Construction of the infrastructure (i.e. the on-site substation, OHL, and service road);
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site;
- Removal of vegetation for the proposed substation and stockpiling of topsoil and cleared vegetation;
- Excavations for infrastructure;

These activities could impact on birds breeding, foraging, and roosting in or in close proximity of the proposed onsite substations through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the substation yard is unavoidable. Fortunately, due to the nature of the vegetation, and judged by the existing power lines, very little if any vegetation clearing will be required in the power line servitudes. The habitat in the study area is extensive, very uniform, and largely untransformed from a bird impact perspective; therefore, the loss of a few hectares of habitat for priority species due to direct habitat transformation associated with the construction of the proposed substation is likely to have a low impact on them. The species most likely to be more heavily impacted would be small, common, non-Red Data species which happen to be resident in those few hectares of Karoo habitat.

Powerline sensitive species which are potentially vulnerable to displacement due to habitat transformation are mostly ground nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl, and White-bellied Bustard.

6.2.4 Displacement due to Disturbance

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. Large terrestrial species are most likely to be affected by displacement due to disturbance.

There is a Martial Eagle nest located approximately 1.8 km north-east of the proposed 132 kV OHL and its associated assessment corridor. Should the 132 kV OHL be utilised, the chances of the birds being temporary displaced due to disturbance by the construction activities are very high. Powerline sensitive species which are potentially vulnerable to displacement due to disturbance are mostly ground nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl, and White-bellied Bustard.

6.3 The Identification and Assessment of Potential Impacts: Wind Energy Facility

The potential impacts on avifauna identified in the course of the study are listed and assessed in the tables below. The impact criteria are explained in Appendix 6.

6.3.1 Construction Phase

- Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.
- Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.

Table 10: Rating of impacts: Construction Phase

Impact Phase: Construction							
Potential impact description: Habitat Transformation							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	M	H	Negative	M	M	H
With Mitigation	L	M	H	Negative	M	M	H
Can the impact be reversed?			Partially, with rehabilitation				
Will impact cause irreplaceable loss of resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report. • No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles. • Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. • Construction of new roads should only be considered if existing roads cannot be upgraded. • The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. • No construction should take place in all infrastructure exclusion zones as indicated in Section 6.5 of this report. • Eradication and effective control of alien invasive species must be undertaken according to the approved Alien Invasive Plant Species Management Plan during all phases of the proposed development. • Should agricultural activities continue during WEF operations, proper grazing management systems should be implemented to prevent overgrazing, limit trampling and improve soil condition of grassland and wetland habitats across the project site. Controlled burns or prescribed fires are essential in managing grassland and wetland biodiversity and ecosystem health and should be implemented during WEF operations according to an approved Fire Management Plan. • Following construction, rehabilitation of all disturbed areas (e.g., temporary access tracks and laydown areas) must be undertaken. A habitat restoration plan is to be developed by a specialist and included within the EMPr.							
Residual impact	Medium to low post-mitigation on condition that all relevant required mitigation measures are implemented, given the overall sensitivity of the avifaunal habitats in the area.						

Impact Phase: Construction							
Potential impact description: Displacement due to Disturbance							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	M	H	Negative	M	H	H
With Mitigation	L	M	H	Negative	M	M	H
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report. • No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles. • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area 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. • No construction should take place in all infrastructure exclusion zones as indicated in Section 6.5 of this report unless existing roads are to be upgraded.							
Residual impact	Medium post-mitigation on condition that all relevant required mitigation measures are implemented, given the overall sensitivity of the avifaunal habitats in the area.						

6.3.2 Operational Phase

- Mortality due to collisions with the wind turbines.
- Mortality due to electrocutions on the overhead sections of the internal 33 kV cables (if any).
- Mortality due to collisions with the overhead sections of the internal 33 kV cables (if any).

Table 11: Rating of impacts: Operational Phase

IMPACT PHASE: OPERATIONAL							
Potential impact description: Mortality due to Collisions with Wind Turbines							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	H	H	Negative	H	H	M
With Mitigation	M	M	H	Negative	M	M	M
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			Potentially yes (breeding SCC)				
Can impact be avoided, managed, or mitigated?			Yes				

Mitigation measures to reduce residual risk or enhance opportunities:

- No turbines (including the rotor swept area) should be located in Turbine Exclusion Zones as indicated in Section 6.5 and Figure 35 of this report.
- Diurnal and nocturnal Automated Shut Down on Demand (SDoD) (camera and radar) to accommodate low light conditions and night flying species, with Observer-led SDoD as additional mitigation, as well as diurnal proactive curtailment based on environmental and weather conditions conducive to bird flight activity must be fully implemented on all authorised wind turbines located in both ‘high risk zones’ and 'medium risk zones' throughout the lifespan of the proposed WEF. Analysis of Martial Eagle tracking data has revealed strong correlations between flight activity and variables such as time of day, wind speed, and temperature. These correlations will be further refined prior to the WEF becoming operational – also see Section 5.8.7.1 for more information.
    - SDoD and radar technology must be in operation at the onset of commercial operation date (COD).
    - SDoD success must be monitored throughout the lifetime of the WEF, where monitoring data during operation will continuously inform the SDoD needs for each turbine.
    - The SDoD programme must be developed and included in the approved EMPr, post-EA (should such EA be granted) during the detailed design phase prior to construction. Specific details of the SDoD programme will be included in a comprehensive Biodiversity Management Plan (BMP) which will be developed and implemented prior to the commercial operational date of the WEF.
- **Sensitive Species 23:** All wind turbines located within the modelled medium risk zone traversing Species 23 habitat connectivity corridors (see Section 6.5 and Figure 32) must implement dynamic, real-time nocturnal curtailment i.e., from dawn to dusk for the duration of the summer season. The following turbines at each facility are affected: WTGs 5, 13, 15, 19, 20, 23 and 25.
    - Dynamic real-time habitat mapping and assessment for the species will need to be conducted every 7-14 days (semi-monthly) from October onward, using the latest satellite imagery, supplemented with on-site weather station rainfall and soil moisture data. This near real-time, dynamic modelling will generate a **habitat suitability index** by integrating rainfall (water levels), wetland saturation, and vegetation state. Vegetation state will consider both structural components influenced by grazing and burning, as well as seasonal productivity measured through remotely sensed habitat suitability time-series analysis. Note that the satellite imagery is updated weekly, therefore the frequency of checking these datasets cannot be increased; however, the proposed mitigation strategy prescribes the onsite implementing of hydrometric equipment that would measure the ambient conditions (such as soil moisture, temperature, etc.) on an hourly basis. Therefore, changes in the local weather parameters will be detected much more frequently than at a 7-14 day interval. Also, wetland monitoring at the onset of spring / summer will be conducted more frequently, and regional rainfall patterns will also be monitored in order to determine when conditions become or are likely to become suitable for the species. Structural assessments will be conducted using drone-derived Digital Terrain Model (DTMs), while productivity trends will be monitored across the growing season to capture phenological and productivity changes. When the dynamic habitat suitability index indicates

favourable habitat conditions following the onset of late spring-early summer (October) rainfall, wind turbines located in the medium risk mitigation zone must be curtailed at night (from dusk until dawn) for the duration of the summer season. Habitat condition thresholds (favourable/unfavourable) derived from the dynamic habitat suitability index has been calibrated using observed species presence-absence datasets. This habitat condition tracking tool can be deployed in near real time and will issue notifications to the designated avifaunal specialist if favourable conditions are triggered via an online webapp.

- **Live-bird monitoring and carcass searches** should be implemented in the operational phase to assess collision rates, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al. 2015). Given the sensitivity of the site, live-bird monitoring should be conducted for at least the first 5 years of operation and be reassessed thereafter to determine the continued frequency of such monitoring as informed by a site-specific Biodiversity Management Plan. Carcass searches must be conducted annually for the lifespan of the facility to assess collision rates.
- **All authorised wind turbines** must have at least **one blade painted according to a CAA approved pattern** to reduce the risk of raptor collisions (Blade Patterning Guidelines 2024). See **Appendix 12**.
- Fatality thresholds must be monitored on an annual basis for the lifespan of the WEF. The ratio of predicted annual fatalities (based on Collision Risk Modelling (CRM) values that take the effectiveness of avoidance and mitigation measures into account) to allowable Potential Biological Removals (PBR) is expressed as a **percentage annual fatality threshold for each priority species per site**, which serves as a practical trigger for additional mitigation. If operational monitoring indicates that annual fatalities are approaching or exceeding PBR-based thresholds, this will trigger an immediate review and escalation of mitigation measures, such as extending curtailment periods, adjusting SDOD protocols, or refining exclusion zones. This framework ensures that mitigation is responsive, data-informed, and conservation-aligned, with threshold exceedance serving as a clear and proactive management trigger.
- Additional mitigation measures, when required during operations, must be implemented timeously in accordance with the practicality and associated ease of implementation. **All revised mitigation measures should be implemented within a time period of maximum six (6) months.**

Residual risk	A residual risk of mortality through collisions remains, however with appropriate mitigations measures detailed above the significance of this risk is expected to be **medium**.

IMPACT PHASE: OPERATIONAL							
Potential impact description: Mortality due to Collisions with Overhead Power Lines (internal 33 kV cables) (if any)							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	L	H	H	Negative	H	H	H
With Mitigation	L	H	H	Negative	M	L	M
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • Bird flight diverters should be installed on all the overhead line sections for the full span directly associated with the proposed WEF according to the applicable Eskom standard at the time. • Design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings.							

Residual impact	There will be a residual impact which is potentially of medium negative significance with the implementation of mitigation measures

IMPACT PHASE: OPERATIONAL							
Potential impact description: Mortality due to Electrocution (internal 33 kV cables) (if any)							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	L	H	M	Negative	M	M	H
With Mitigation	L	H	M	Negative	L	L	H
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • Underground cabling should be used as much as is practically and ecologically possible. • If the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted timeously to ensure that a bird-friendly pylon design is used, and that appropriate mitigation is implemented pro-actively for complicated pylon structures e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformers. • Regular inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to look for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).							
Residual impact	There is a potential residual impact of low significance with mitigation.						

6.3.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning (dismantling) of the wind turbines and associated infrastructure.

Table 12: Rating of impacts: Decommissioning Phase

IMPACT PHASE: DECOMMISSIONING							
Potential impact description: Displacement due to Disturbance							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	M	H	Negative	M	M	H
With Mitigation	L	M	H	Negative	M	M	H
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss of resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • A site specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction;							

• Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area 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.	
Residual impact	Yes, but acceptable (low significance) with mitigation

6.4 The Identification and Assessment of Potential Impacts: Grid Components

The potential impacts on avifauna identified during the study are listed and assessed in the tables below. The impact criteria are explained in **Appendix 6**.

6.4.1 Construction Phase

- Displacement of powerline sensitive species due to disturbance
- Displacement of powerline sensitive species due to habitat transformation.

Table 13: Rating of impacts: Construction Phase

Impact Phase: Construction							
Potential impact description: Displacement due to Disturbance							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	L	M	Negative	M	L	M
With Mitigation	L	L	L	Negative	L	L	M
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • Martial Eagle nest – A 2.5 km no disturbance buffer zone must be implemented around the nest. No construction activity should take place in this zone from March to December, which is the breeding season for these eagles. • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area 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. • No construction should take place in all infrastructure exclusion zones as indicated in Section 6.5 of this report unless existing roads are to be upgraded.							
Residual impact	Yes, but acceptable (low significance) with mitigation						
Impact Phase: Construction							
Potential impact description: Habitat Transformation							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	H	L	Negative	M	L	H
With Mitigation	L	M	L	Negative	L	L	H
Can the impact be reversed?			Partially, with rehabilitation				

Will impact cause irreplaceable loss of resources?	No
Can impact be avoided, managed, or mitigated?	Yes
Mitigation measures to reduce residual risk or enhance opportunities: • Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. • Construction of new roads should only be considered if existing roads cannot be upgraded. • The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. • No construction should take place in all infrastructure exclusion zones as indicated in Section 6.5 of this report. • Eradication and effective control of alien invasive species must be undertaken according to the approved Alien Invasive Plant Species Management Plan during all phases of the proposed development. • Should agricultural activities continue during operations, proper grazing management systems should be implemented to prevent overgrazing, limit trampling and improve soil condition of grassland and wetland habitats across the project site. Controlled burns or prescribed fires are essential in managing grassland and wetland biodiversity and ecosystem health and should be implemented during WEF operations according to an approved Fire Management Plan. • Following construction, rehabilitation of all disturbed areas (e.g., temporary access tracks and laydown areas) must be undertaken. A habitat restoration plan is to be developed by a specialist and included within the EMPr.	
Residual impact	Yes, but acceptable (low significance) with mitigation

6.4.2 Operational Phase

- Mortality of priority species due to collisions with the 132 kV OHL
- Electrocutions on the 132 kV OHL and/or in the Substation Yard

Table 14: Rating of impacts: Operational Phase

IMPACT PHASE: OPERATIONAL							
Potential impact description: Mortality due to Collisions with Power Lines (132 kV)							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	L	H	H	Negative	H	H	H
With Mitigation	L	H	H	Negative	M	M	M
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • Mitigation in the form of Bird Flight Diverters on the OHL is required. The entire length of the OHL should be fitted with Eskom approved Bird Flight Diverters. Design specification should conform to types of							

devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings. • The operational monitoring programme must include regular monitoring (i.e. quarterly) of the power lines for collision mortalities.							
Residual impact	There will be a residual impact which is potentially of medium negative significance with the implementation of mitigation measures.						
IMPACT PHASE: OPERATIONAL							
Potential impact description: Mortality due to Electrocutions (132kV OHL and/or Substation Yard)							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	L	H	M	Negative	M	M	H
With Mitigation	L	H	M	Negative	L	L	H
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • A bird-friendly pylon design should be used. • Additional mitigation in the form of insulating sleeves on jumper cables present on strain pylons and terminal pylons must be implemented. • Monitor the electrocution mortality in the substation complex. Apply additional mitigation if any SCC are electrocuted.							
Residual impact	There is a potential residual impact of low significance with mitigation.						

6.4.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning (dismantling) of the grid connection.

Table 15: Rating of impacts: Decommissioning Phase

IMPACT PHASE: DECOMMISSIONING							
Potential impact description: Displacement due to Disturbance							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	M	L	M	Negative	M	L	M
With Mitigation	L	L	L	Negative	L	L	M
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss of resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities:							

• A site specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction. • Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. • Martial Eagle nest – A 2.5 km no disturbance buffer zone must be implemented around the nest. No dismantling activity should take place in this zone from March to December, which is the breeding season for these eagles. • Measures to control noise and dust should be applied according to current best practice in the industry. • No off-road driving should be allowed.	
Residual impact	Yes, but acceptable (low significance) with mitigation

6.5 The Identification of Environmental Sensitivities: Wind Energy Facility

The following environmental sensitivities were identified from an avifaunal perspective for the proposed wind energy facility (See **Figures 30–35** for maps of the Very High Sensitivity All Infrastructure Exclusion (No-Go) Zones, the High Sensitivity Turbine Exclusion Zones, and the Medium Sensitivity Mitigation Zones):

6.5.1 Very High Sensitivity – All Infrastructure Exclusion Zones.

- A **2.5 km No-Go zone** around the identified **Martial Eagle nest** should be implemented and maintained to reduce the risk of collision mortality and displacement due to disturbance (**Figure 30**).
- All **wetland No-Go areas** as identified by the Aquatic Specialist should be buffered by an additional 110 m on either side to reduce the risk of turbine collisions and to prevent the disturbance of priority species breeding and roosting in these areas. Priority species in this category include African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Marsh Harrier, Black-winged Pratincole, Blue Crane, Grey Crowned Crane, Long-crested Eagle, Marsh Owl, and Sensitive Species 23 (**Figure 31**).
- **Sensitive Species 23 habitat** – Fine scale habitat modelling and identification of wetland corridors for cryptic / low detection probability wetland species was conducted. High suitability wetland areas were identified by the habitat suitability model and further refined based on habitat surveys conducted during December 2024 to February 2025 (**Figure 32**).
- Modelled **Yellow-breasted Pipit habitat areas** are considered **No-Go zones**. These high-quality grassland areas were identified to prevent displacement of birds due to disturbance and habitat destruction. The Yellow-breasted Pipit model output represents the habitat patches most suitable for the species' using a multi-year assessment of imagery indices etc. spanning 2019–2023. This is to account for variability related to drivers of habitat suitability for grassland habitat specialist species such as these endemic pipits. Primary drivers of variability include seasonal rainfall across years, burning/fire, and grazing intensity. The model boundaries will extend beyond suitable habitat into other habitats (forest edge, roads, etc.) in some areas as we have accounted for typical blade swept area (BSA) by buffering the habitat output. This output should be considered high sensitivity and avoided (no-go) given habitat loss/degradation is the primary issue. **Currently, based on the revised WEF site layout plan, Wind Turbine Generator (WTG) 23 is located on the edge of the All Infrastructure Exclusion (i.e., No-Go) Zone (Figure 33). This WTG must be micro-sited to be located outside of the All Infrastructure Exclusion Zone post-EA (should such EA be granted) during the detailed design phase prior to construction.**

6.5.2 High Sensitivity – Turbine Exclusion Zones.

- A **Martial Eagle nest** is located in a stand of alien trees north-west of the Project Site. A **Martial Eagle roost** was also confirmed on site and is situated approximately 6 km away southeast of the nest. The modelled Turbine Exclusion Zone (No-Go buffer) as depicted in **Figure 30** must be implemented around

the nest and roost to reduce the risk of turbine collisions. **Currently, based on the revised WEF site layout plan, WTGs 12, 13, 14, 19 and 20 are located within the Turbine Exclusion Zone. Even though these five WTGs will be subjected to stringent Automated SDoD as well as diurnal proactive curtailment as additional compulsory mitigation, it is strongly recommended that these affected turbine positions be reconsidered post-EA (should such EA be granted) during the detailed design phase, prior to construction.**

- There are two **Southern Bald Ibis colonies** located south of the WEF Project Site as depicted in **Figure 34**. A shaped turbine exclusion zone has been delineated based on extensive and detailed modelled flight activity. The modelling workflow incorporated all the flight data collected within the area during the pre-construction monitoring. The model identifies high risk flight areas by considering associations between the underlying habitat and topography in relation to the recorded Southern Bald Ibis flight data and proximity to roosts. **Currently WTG 25 is located near the edge with the blade swept area penetrating the Turbine Exclusion Zone**. **This WTG including its blade swept area must be micro-sited out of this zone completely.**
- **High Sensitivity grassland habitat** for Yellow-breasted Pipit. **Currently, based on the revised WEF site layout plan, WTG 23 is located inside the Turbine Exclusion Zone (Figure 33). This WTG must be micro-sited to be located outside of the Turbine Exclusion Zone post-EA (should such EA be granted) during the detailed design phase prior to construction.**
- **Sensitive Species 23 habitat** defined through detailed habitat modelling as depicted in **Figure 32** and then appropriately buffered by 350 m, movement corridors were determined and buffered to accommodate for nocturnal movement and migration for Sensitive Species 23. These habitats are wetlands and/or rank grasslands, and as such would also be important for other threatened wetland species (Striped Flufftail, African Grass Owl, etc.). **Currently, based on the revised WEF site layout plan, WTGs 5, 13 and 15 are located near the edge of the Turbine Exclusion Zone. It is recommended that these WTGs be micro-sited to ensure that the blade swept area do not penetrate the Turbine Exclusion Zone.**

6.5.3 Medium Sensitivity – Mitigation Zones.

- A **Martial Eagle nest** is located in a stand of alien trees west of the Project Site. A **Martial Eagle roost** was also confirmed on site and is situated approximately 6 km away southeast of the nest. Compulsory Automated Shutdown on Demand (SDoD) must be implemented on all authorised turbines located in the medium risk zones. **Currently, based on the revised WEF site layout plan, there are 16 turbines located within this zone (Figure 30).**
- There are two **Southern Bald Ibis colonies** located south of the Project Site. Stringent mitigation in the form of Automated SDoD and diurnal proactive curtailment must be implemented on all authorised turbines located in the medium risk zones. **Currently, based on the revised WEF site layout plan, there are two (2) turbines located within this zone (Figure 34).**
- **Sensitive Species 23 habitat** – a connectivity analysis using least-cost pathway workflows has delineated areas of low to high resistance, identifying connectivity within the local area between core and transient wetland habitats (of particular importance to Sensitive Species 23). **All wind turbines located within this zone must implement dynamic, real-time nocturnal curtailment for the entire duration of the summer season as detailed in Table 11 (Figure 32)**.

See **Figures 30–34** for maps of the All Infrastructure Exclusion (No-Go) Zones, Turbine Exclusion Zones, and Medium Sensitivity Mitigation Zones. The combined avifaunal sensitivity map for the proposed Emvelo WEF is included as **Figure 35**.

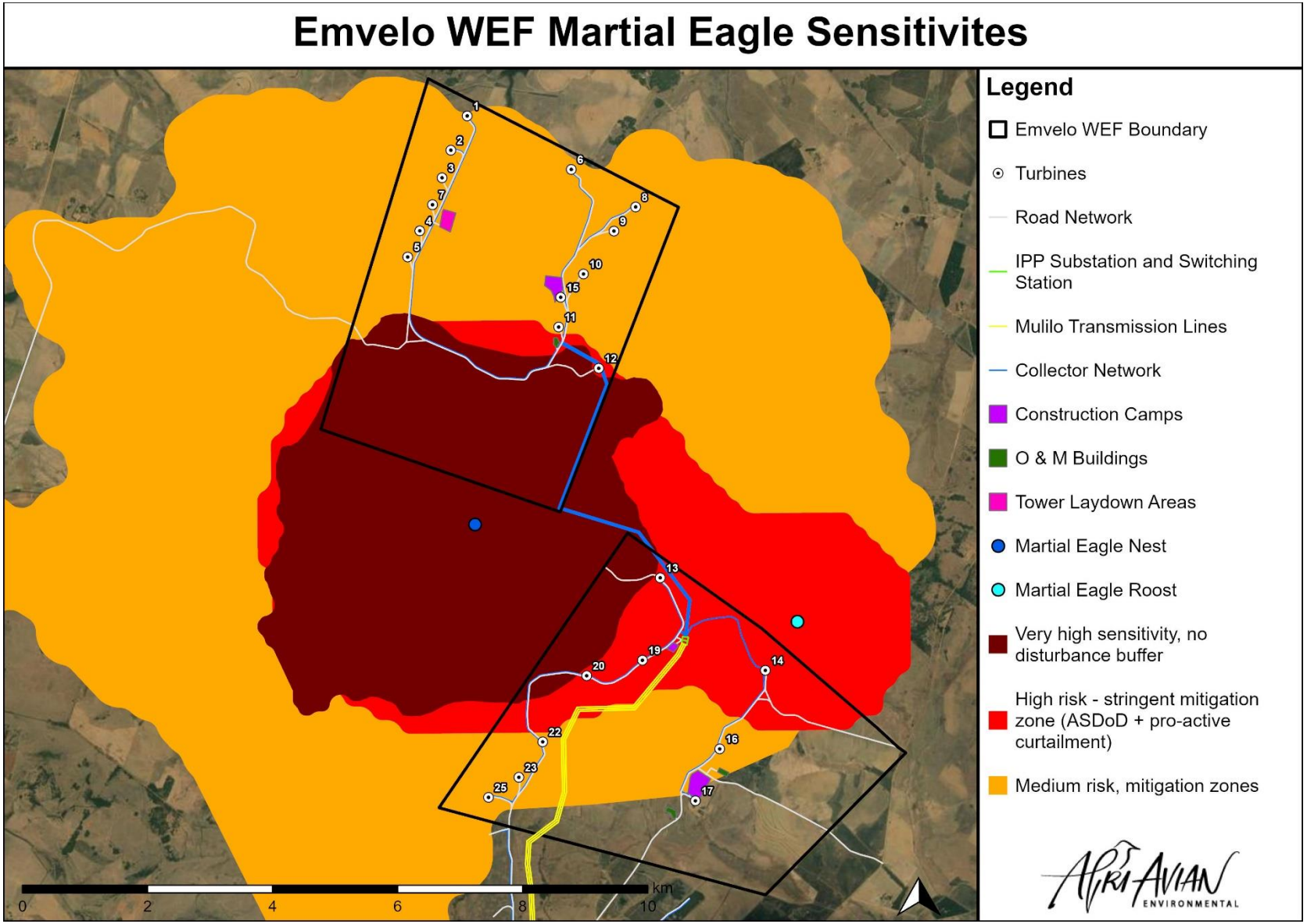


Figure 30: Buffer zones around the Martial Eagle nest and roost.

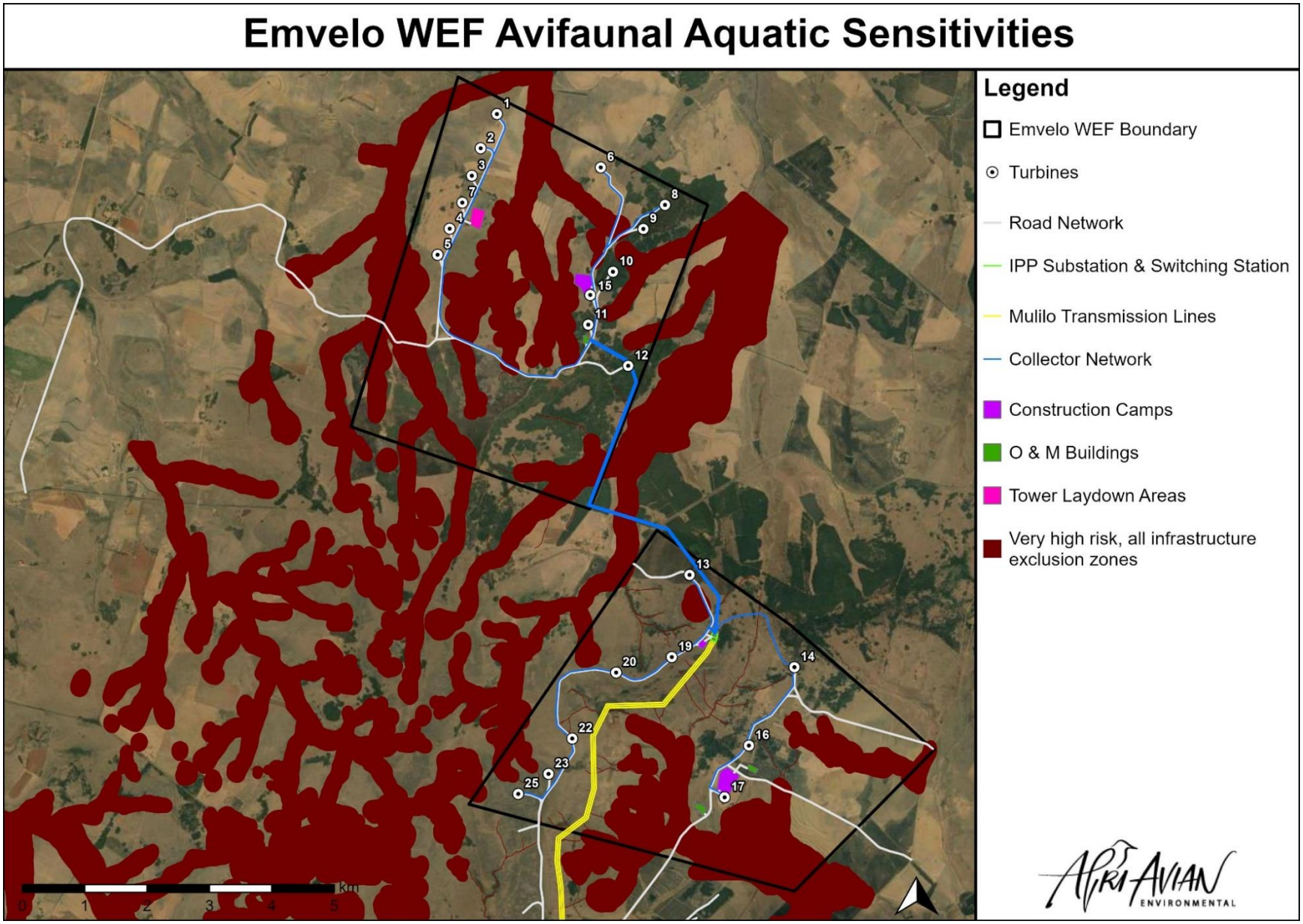


Figure 31: Aquatic buffer zones from an avifaunal perspective.

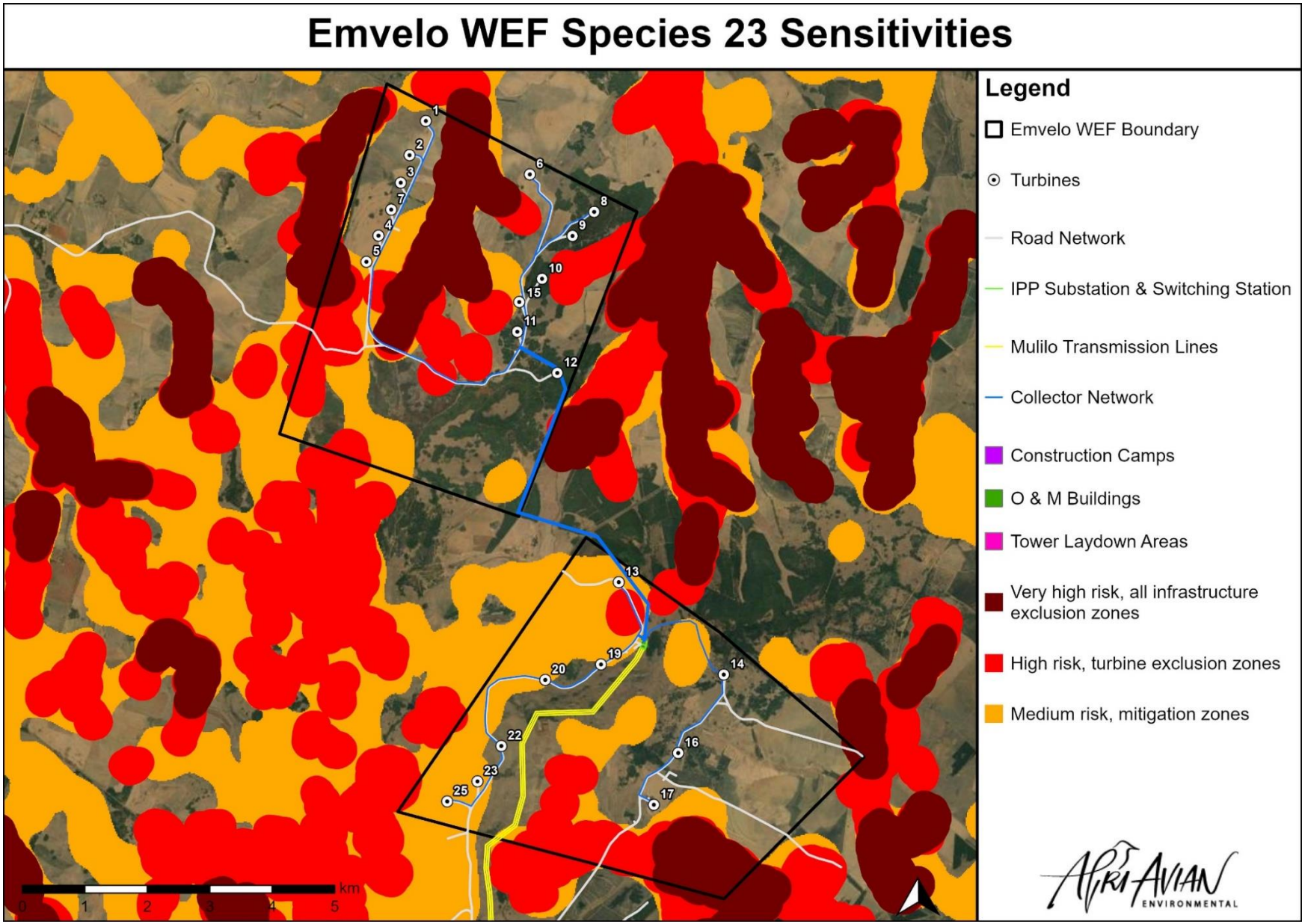


Figure 32: Recommended buffer zones around suitable Sensitive Species 23 habitat.

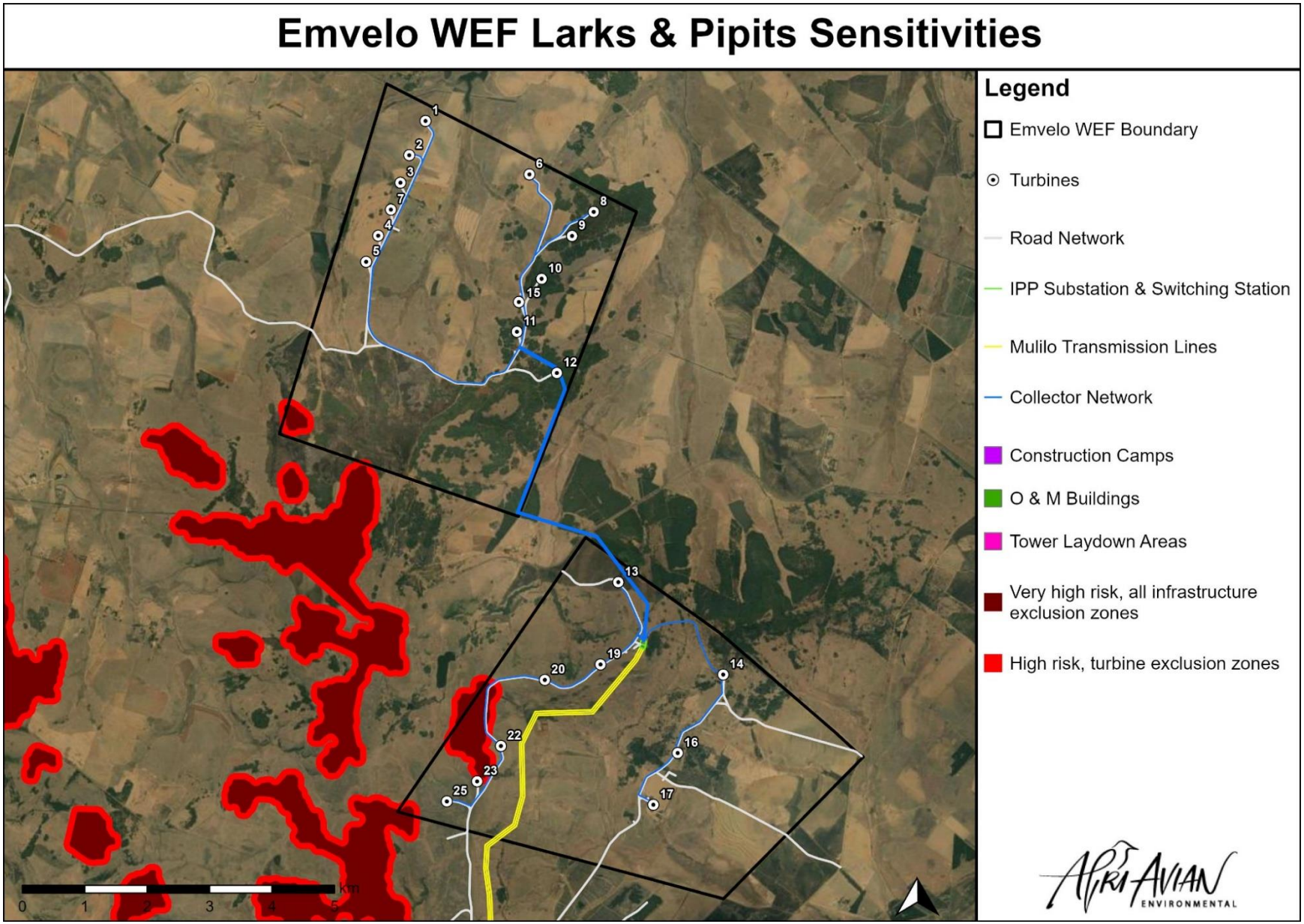


Figure 33: No-Go Zones around Yellow-breasted Pipit Habitat.

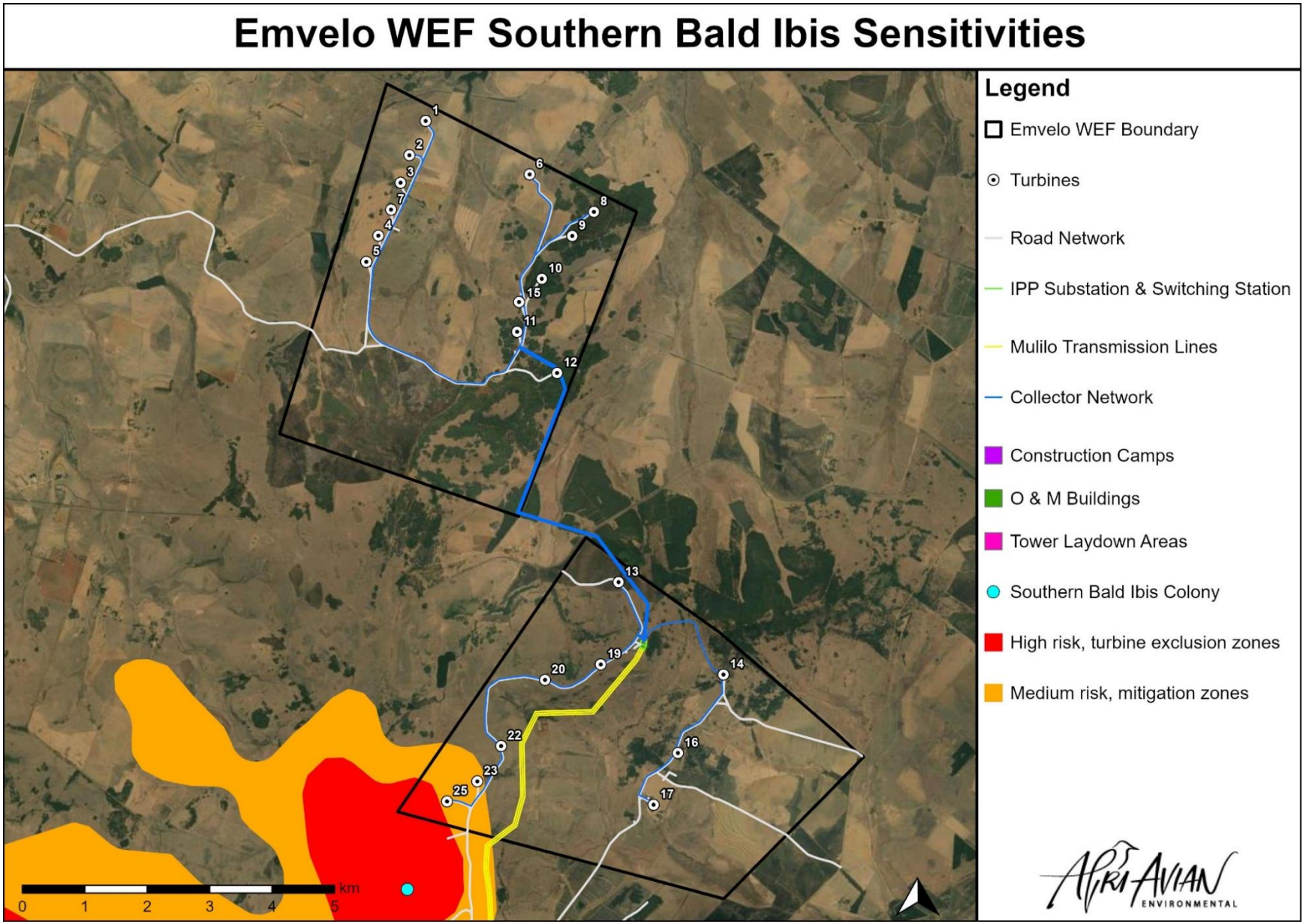


Figure 34: Proposed shaped turbine exclusion zones and medium sensitivity zones around Southern Bald Ibis colonies/habitat.

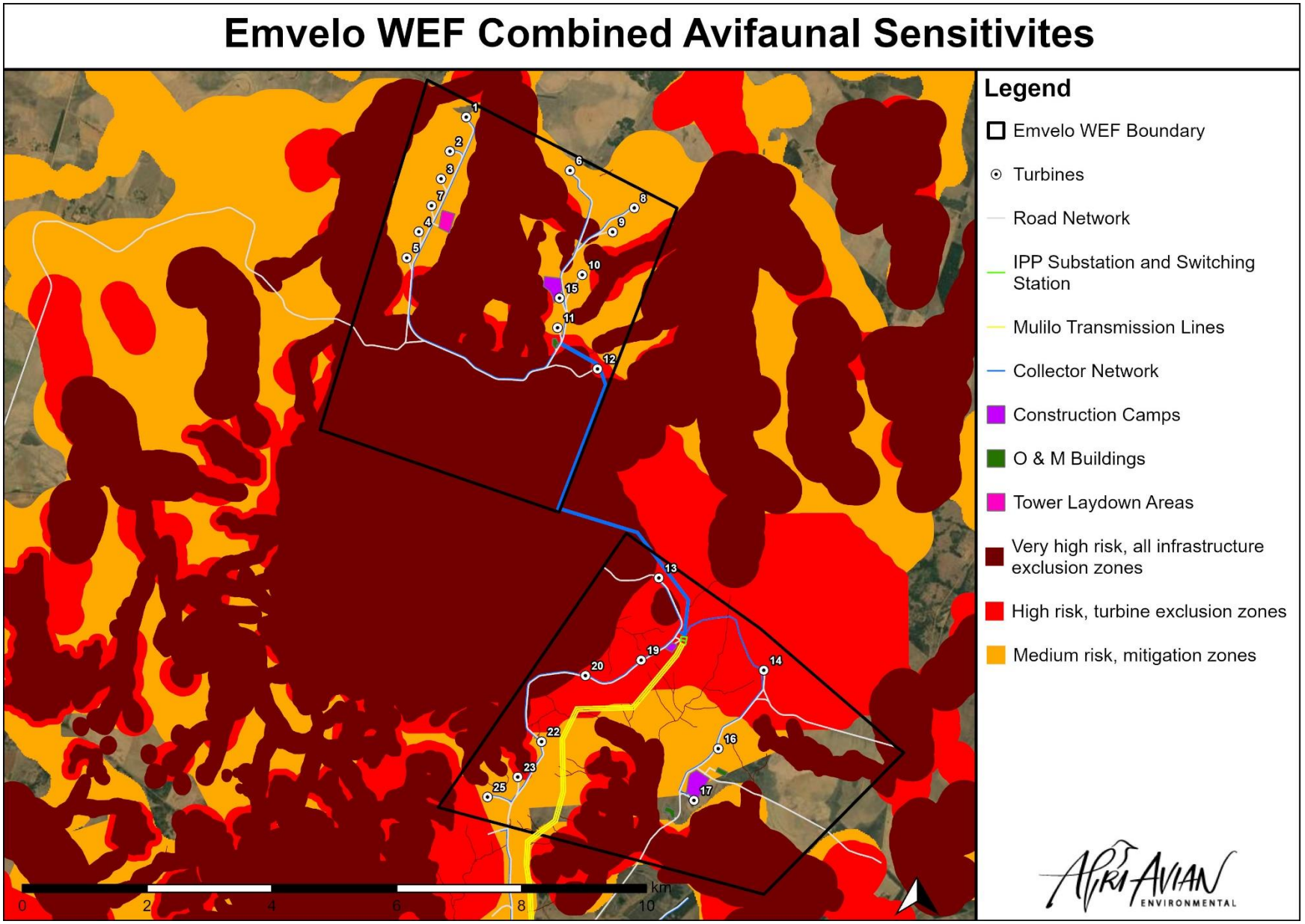


Figure 35: Combined avifaunal sensitivity map for the proposed Emvelo WEF.

6.6 The Identification of Environmental Sensitivities: Grid Components

The following environmental sensitivities were identified from an avifaunal perspective for the proposed grid connection **(the identified avifaunal environmental sensitivities are applicable to ALL Grid Connection Alternatives)**:

Due to the potential presence of several power line sensitive species, including SCC, which could utilise the whole PAOI and Broader Area, including the Grid Connection Development Area, for foraging, roosting, and nesting, the entire PAOI has been assessed to be a high sensitivity zone (**Figure 36**) from a collision impact perspective and an electrocution risk perspective. Therefore, **Bird Flight Diverters to be applied to the entire length of the OHLs and a bird-friendly pylon design must be used**.

6.6.1 High Sensitivity: Surface Water & Grasslands – Line Marking Required.

Surface water is crucially important for priority avifauna, including several SCC such as Martial Eagle, Lanner Falcon and Secretarybird, and many non-priority species, including several waterbirds. **Drainage lines, dams, and wetlands** attract waterbirds and several other bird species. Powerlines that are placed near these sources of surface water pose a collision risk to birds using the water for drinking and bathing. Drainage lines are also natural flight paths for birds. The **grassland habitat** in the area is crucially important to SCC such as Denham's Bustard, Secretarybird and Southern Bald Ibis, for foraging and roosting, all three SCC have been recorded in the PAOI.

Mitigation in the form of Bird Flight Diverters on the OHL is required. The entire length of the medium and high voltage OHLs should be fitted with Eskom approved Bird Flight Diverters (**Figure 36**). For the 132 kV OHL in high-risk areas such as wetlands, watercourses and drainage line crossings the BFD design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters.

6.6.2 High Sensitivity Seasonal No Disturbance Buffer – Breeding Red Data Species Nests.

Martial Eagle nest – A 2.5 km no disturbance buffer zone (**Figure 36**) must be implemented around the nest. No construction activity should take place in this zone from March to December, which is the breeding season for these eagles.

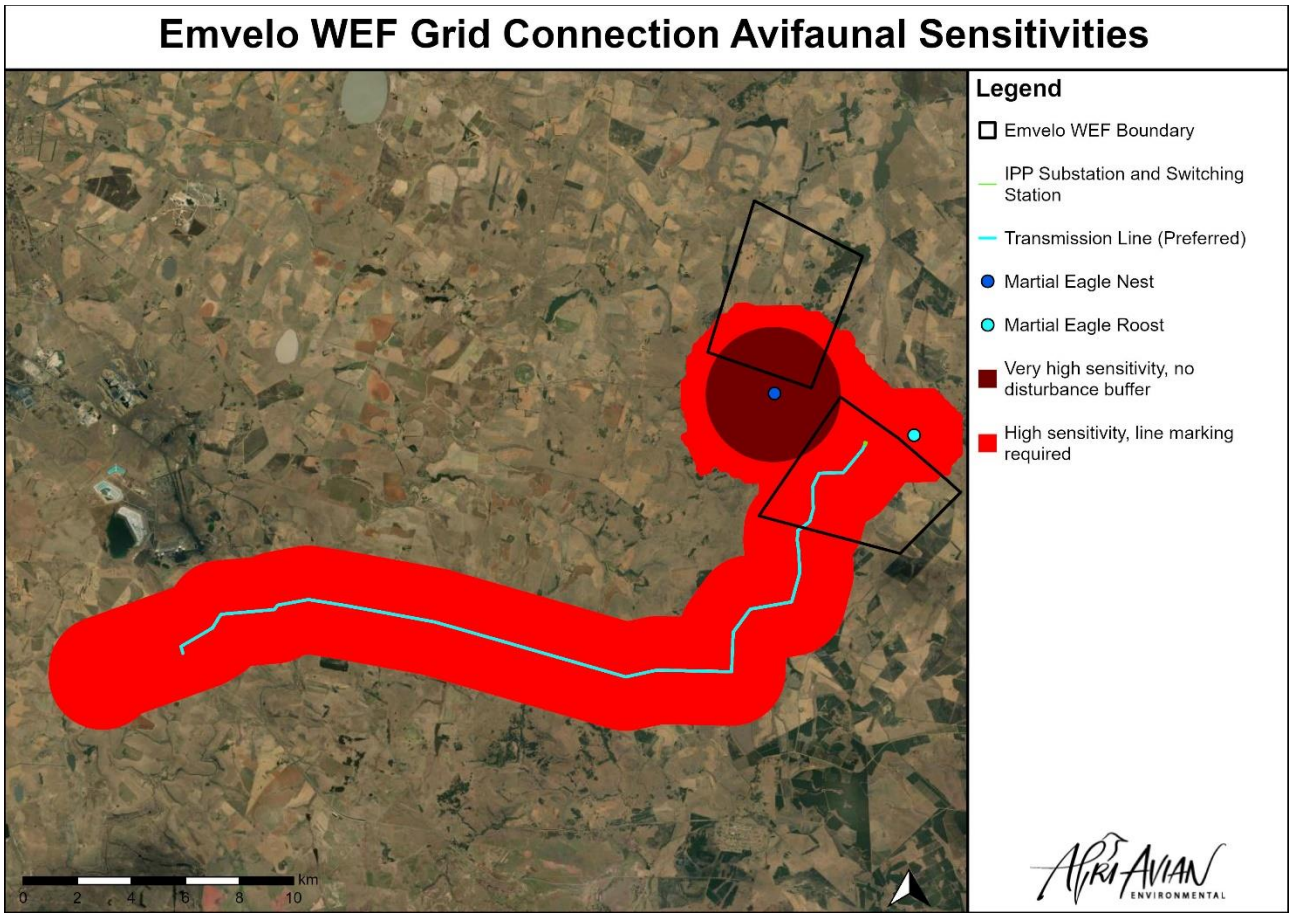


Figure 36: Avifaunal Sensitivities identified for the Emvelo Grid Connection. NOTE: Due to the large amount of wetlands/drainage lines and natural grasslands in the area it is recommended that the entire OHL be fitted with Bird Flight Diverters. And a bird-friendly pylon design must be used for the OHL to minimize the electrocution risk.

6.7 Cumulative Impacts

In relation to an activity, cumulative impact means "*the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities*" (NEMA EIA Reg GN R982 of 2014).

Specialists are required to assess cumulative impacts associated with similar developments within a 35 km radius of the proposed developments. The purpose of the cumulative assessment is to test if such impacts are relevant to the proposed developments in the proposed locations (i.e., whether the addition of the proposed project in the area will increase the impact). In this regard, specialist studies considered whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment or sense of place
- Unacceptable increase in impact

There are currently two approved Renewable Energy Facilities within 35 km of the Mulilo WEF Cluster based on the data using the REEA_OR_2024_Q3 (**Figure 37**).

6.7.1 Wind Energy Facility

The maximum number of wind turbines which are currently proposed for the other wind farms which are located within a 35 km radius (i.e., Sheepmoor WEF, Camden I WEF and Camden II WEF) in similar habitat around the proposed Emvelo WEF is 109. None of these have been constructed to date, and each of the planned projects will still be subject to a bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. The Emvelo WEF will consist of up to 22 turbines, which brings the total number of potential turbines within the 35 km radius to 133. The 22 turbines of Emvelo WEF constitute about 18% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is considered **moderate to high**.

The total land parcel area where renewable energy developments are planned, including the Emvelo WEF, amounts to approximately 268.3 km² (26,830 ha), which constitutes about 7% of the total area of similar habitat available to birds in the 35 km radius around the project. The cumulative impact of the planned wind energy projects at the time of writing is considered **moderate** as far as the creation of high-risk zones are concerned within the area contained in the 35 km radius.

The land parcel area of the proposed Emvelo WEF (46.5 km^2) amounts to about 19% of the total amount of land parcel area designated for renewable energy developments, but less than 2% of the total area available (3848 km^2) in the 35 km radius. The contribution of the Emvelo WEF to the cumulative impact of all the renewable energy facilities is therefore **moderate to low** as far as potential displacement of priority species due to habitat transformation is concerned.

Figure 37 shows the location of all planned renewable energy projects located within a 50 km radius around the proposed Emvelo WEF. Refer to **Table 16** for the cumulative impacts rating.

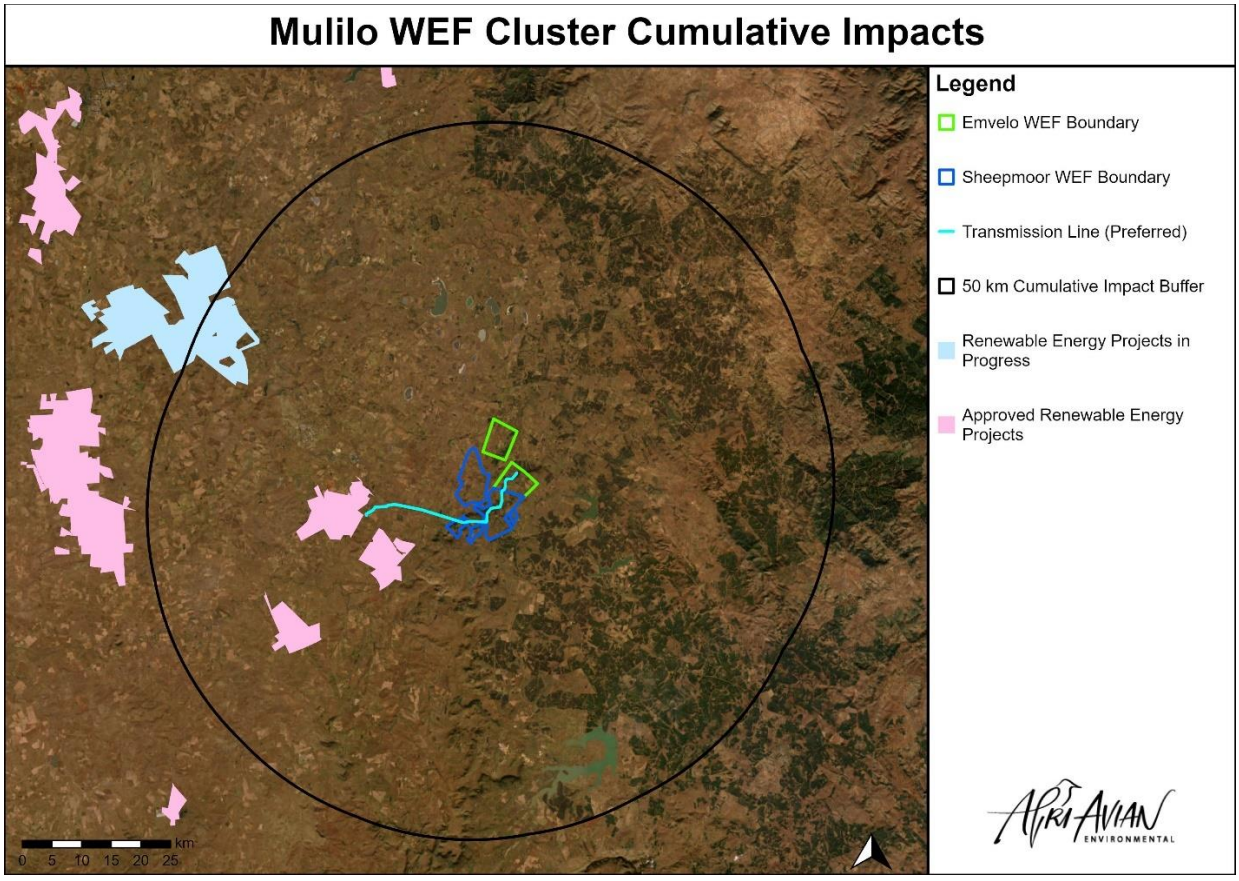


Figure 37: Renewable energy projects within a 50 km radius of the proposed Emvelo WEF.

Table 16: Rating of Cumulative Impacts: WEF

Impact Phase: Cumulative							
Potential impact description: Cumulative Impacts on Birds							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	H	M	H	Negative	H	M	M
With Mitigation	H	M	H	Negative	M	M	M
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss of resources?			No				
Can impact be avoided, managed, or mitigated?			Yes				
Mitigation measures to reduce residual risk or enhance opportunities: • All mitigation measures listed in this report and recommended for other projects must be adhered to. • The applicant and/or operational project company should proactively collaborate with other renewable energy operators in the area. Operational monitoring data must be shared with Birdlife SA.							
Residual impact	A residual impact of medium negative significance is likely, as the cumulative impact is difficult to mitigate.						

6.7.2 Grid Connection Infrastructure

The are several existing HV lines in the 35 km radius around the proposed Grid Connection Project, of which about 300 km worth of OHL is contained in the 35 km radius (**Figure 38**). The sum of all the existing and planned HV lines in the 35 km radius amounts to an estimated 383 km, of which the proposed Emvelo WEF Grid Connection will constitute approximately 30 km, or about 8%. The contribution of the Emvelo WEF Grid Connection to the cumulative impact of all the grid connections and existing HV lines is **medium**. However, the combined contribution of all the grid connections to the cumulative impact of the HV lines in the 35 km radius, which is mainly collision mortality of priority species, is **high**. The cumulative collision impact of all the grid connections and existing HV lines in the 35 km radius is assessed to be **high** pre-mitigation and **medium** post-mitigation (**Table 17**).

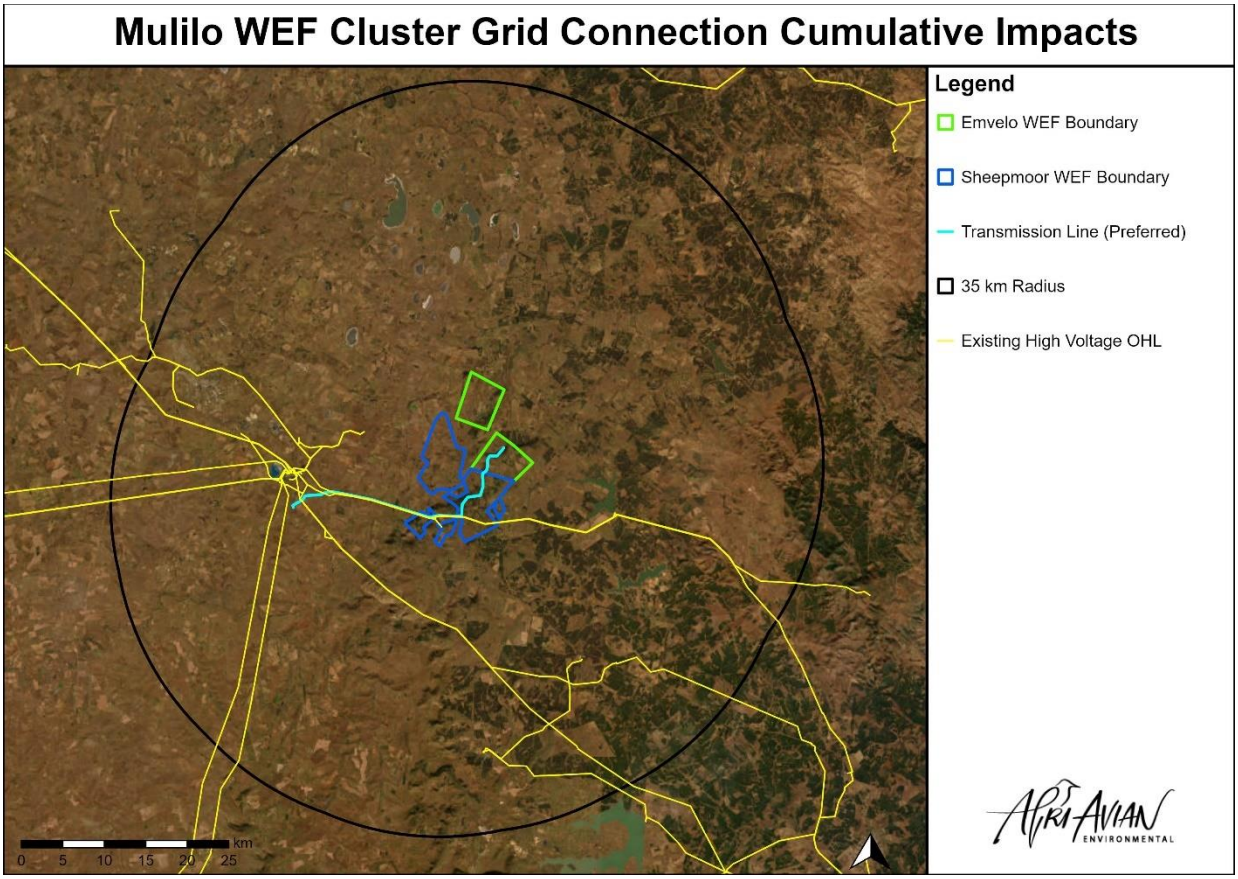


Figure 38: Proposed renewable energy projects within a 35 km radius around the proposed Emvelo WEF.

Table 17: Rating of Cumulative Impacts: Grid Connection Components

Impact Phase: Cumulative							
Potential impact description: Cumulative Impacts on Birds							
	Extent	**Duration**	**Intensity**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	H	M	H	Negative	H	M	M
With Mitigation	H	M	H	Negative	M	M	M
Can the impact be reversed?	Yes						
Will impact cause irreplaceable loss of resources?	No						
Can impact be avoided, managed, or mitigated?	Yes						
Mitigation measures to reduce residual risk or enhance opportunities: • All mitigation measures listed in this report and recommended for other projects must be adhered to. • The applicant and/or operational project company should proactively collaborate with other renewable energy operators in the area. Operational monitoring data must be shared with Birdlife SA.							
Residual impact	A residual impact of medium negative significance is likely, as the cumulative impact is difficult to mitigate.						

6.7.3 Cumulative Impact of the WEF combined with its Grid Connection

The contribution of the Emvelo WEF and its associated electrical grid infrastructure (i.e., 132 kV OHL connection to the proposed Camden Substation) to the cumulative impact of all the renewable energy facilities and their associated electrical grid infrastructure collectively is therefore considered moderate as far as potential displacement of priority species due to habitat transformation as well as potential risk of collision and electrocution is concerned.

6.8 Conditions for inclusion in the EMPr: WEF

Please refer to **Appendix 7** for the monitoring requirements to be included in the EMPr for the WEF.

6.9 Conditions for inclusion in the EMPr: Grid Connection Components

Please refer to **Appendix 8** for the monitoring requirements to be included in the EMPr for the Grid Connection Components.

7. COMPARATIVE ASSESSMENT OF ALTERNATIVES

7.1 Wind Energy Facility

The final layout was assessed in this report as part of the EIA Phase.

7.2 Grid Components

The grid connection infrastructure proposal includes four (4) transmission line route alignment alternatives, each within a 300 m wide assessment corridor (150 m on either side of power line). These alternatives have been considered and assessed as part of the EIA process and will be amended or refined to avoid identified environmental sensitivities. The four alternatives are:

- 132kV OHL Preferred – 32.9 km
- 132kV OHL Alternative 1 – 33.5 km
- 132kV OHL Alternative 2 – 35.2 km
- 132kV OHL Alternative 3 – 35.9 km

From an avifaunal perspective, OHL Alternatives 2 and 3 are least preferred as they have the longest span and therefore pose a higher collision risk to birds. The Preferred OHL Alternative is favoured from an avifaunal perspective as it has the shortest span (thereby slightly reducing the collision risk compared to the other alternatives).

7.3 No-Go Alternative

7.3.1 Wind Energy Facility

The no-go alternative will result in the current *status quo* being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to sensitive avifauna, especially Red Data species. The no-go option would eliminate any additional impact on the ecological integrity of the proposed development site as far as avifauna is concerned.

7.3.2 Grid Connection Components

The no-go alternative will result in the current *status quo* being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to sensitive avifauna, especially Red Data species. The no-go option would eliminate any additional impact on the ecological integrity of the proposed development site as far as avifauna is concerned.

8. CONCLUSION AND SUMMARY

8.1 Summary of Findings

8.1.1 Wind Energy Facility

The proposed Emvelo WEF will 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 33 kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33 kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

8.1.1.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

A measure of displacement will inevitably take place for all priority species as a result of disturbance from construction activities during the construction phase. This will primarily affect ground-nesting species in the remaining high-quality grassland, wetlands, and wetland fringes. However, this impact could be extended to tree and cliff nesting species breeding in or directly adjacent to the project boundary. The project boundary is in close proximity to a Martial Eagle (Endangered) nest- and roost sites. In addition, the Southern Bald Ibises (Vulnerable) that roost and breed adjacent to the Emvelo WEF project site could face a disruption of their reproductive cycle. Some species could recolonise the area after the completion of construction. However, as a result of habitat fragmentation and operational turbines causing disturbance, other species could only partially return to their previous habitat, resulting in lower densities than before. In summary, the following species could be impacted by disturbance during the construction phase: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Black Sparrowhawk, Black-winged Kite, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Sensitive Species 23, Spotted Eagle-Owl, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **Medium** pre- and post-mitigation.

8.1.1.2 Displacement due to habitat transformation in the construction phase.

The construction of additional roads is likely to result in further habitat fragmentation, although the site already has many existing access roads, most of which will be upgraded and utilised for the wind farm development. It is noted that some of the roads to be upgraded will infringe on the habitat classified as very high sensitivity through habitat suitability modelling, these infringements will however mostly be along the edges of these grassland areas. This, together with the disturbance of the operating turbines, could influence the density of several species. This is the case for larger terrestrial species that utilise the remaining natural grassland, wetlands, and wetland fringes as breeding habitat, and also for smaller, range-restricted species for which the area is considered to provide suitable habitat. It is not expected that priority species will be permanently

displaced from the development site, but densities may be reduced. In summary, the following terrestrial species and raptors are likely to be most affected by habitat transformation: African Grass Owl (recorded during dedicated wetland surveys), Black-winged Lapwing, Blue Crane, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Secretarybird, Sensitive Species 23, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **Medium** pre- and post-mitigation.

8.1.1.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed WEF will pose a collision risk to several priority species which could regularly occur at the site. Species exposed to this risk are large terrestrial species, and occasional long-distance fliers i.e., bustards, cranes, storks, Southern Bald Ibis and Secretarybird, although bustards and cranes generally seem to be less vulnerable to turbine collisions than originally anticipated (Ralston-Paton & Camagu 2019). Small passerines may also be vulnerable during display flight activities. Soaring priority species such as Cape Vulture and a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collisions. The regularly occurring priority species that could be at risk of collisions with the turbines are the following: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Amur Falcon, Black Sparrowhawk, Black-winged Kite, Black-winged Lapwing, Black-winged Pratincole, Blue Crane, Common Buzzard, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Secretarybird, Southern Bald Ibis, Sensitive Species 23, Spotted Eagle-Owl, White Stork, White-bellied Bustard, and Yellow-breasted Pipit. The overall impact significance is rated as **High** pre-mitigation and **Medium** post-mitigation.

8.1.1.4 Electrocution on the 33 kV MV overhead lines (if any) in the operational phase.

The following priority species are potentially vulnerable to electrocution on the 33 kV overhead lines: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Harrier-Hawk, African Marsh Harrier, Amur Falcon, Black Sparrowhawk, Black-winged Kite, Common Buzzard, Grey Crowned Crane, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Rufous-breasted Sparrowhawk, Southern Bald Ibis and Spotted Eagle-Owl. The overall impact significance is rated as **Medium** pre-mitigation and **Low** post-mitigation.

8.1.1.5 Collisions with the 33 kV MV overhead lines (if any) in the operational phase.

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines may have to run above ground for technical reasons. These spans could pose a collision risk to priority avifauna, depending on where those spans are located. Priority species potentially at risk are African Grass Owl (recorded during dedicated wetland surveys), Blue Crane, Denham's Bustard, Grey Crowned Crane, Marsh Owl, Secretarybird, Southern Bald Ibis, Spotted Eagle-Owl, White Stork, and White-bellied Bustard. The overall impact significance is rated as **Medium** pre-mitigation and **Low** post-mitigation.

8.1.1.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact significance is likely to be similar in nature to the construction phase.

8.1.1.7 Cumulative Impacts.

Considering the other three renewable energy (RE) (specifically wind) projects currently proposed within the 35 km radius, the maximum number of turbines including those proposed for the proposed Emvelo WEF, totals 135 in similar habitat around the proposed project. The Emvelo WEF's turbines constitute about 18% of the total number of planned turbines in the area and as such poses a **moderate to high** cumulative impact. Furthermore, these planned WEFs including the Emvelo WEF constitutes about 7% of the total area of similar habitat available

to birds in the 35 km radius around the project. As such, the cumulative impact of these planned WEF projects at the time of writing is considered **moderate** as far as the creation of high-risk zones are concerned within the area contained in the 35 km radius. Finally, the contribution of the Emvelo WEF, which footprint comprises about 19% of the total land parcel area designated for RE developments in the 35 km radius, to the cumulative impact of all the RE facilities collectively is therefore **moderate to low** as far as potential displacement of priority species due to habitat transformation is concerned.

Table 18 summarises the expected impacts of the proposed Emvelo WEF and proposed mitigation measures per impact.

Table 18: Overall Impact Significance for the proposed Emvelo WEF (Pre- and Post-Mitigation)

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No construction should take place in the All-Infrastructure Exclusion Zones as indicated in Section 6.5 of this report unless existing roads are to be upgraded. (4) No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Medium
Construction: Displacement due to habitat transformation	Medium	(1) Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. (4) No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report of this report.	Medium
Operational: Collisions with the turbines	High	(1) No turbines (including the rotor swept area) should be located in Turbine Exclusion Zones as indicated in Section 6.5 and Figure 35 of this report. (2) Diurnal and nocturnal Automated Shut Down on Demand (SDoD) (camera and radar) to accommodate low light conditions and night flying species, with Observer-led SDoD as additional mitigation, as well as diurnal proactive curtailment based on environmental and weather conditions conducive to bird flight activity must be fully implemented on	Medium

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		all authorised wind turbines located in both ‘high risk zones’ and 'medium risk zones' throughout the lifespan of the proposed WEF. Analysis of Martial Eagle tracking data has revealed strong correlations between flight activity and variables such as time of day, wind speed, and temperature. These correlations will be further refined prior to the WEF becoming operational – also see Section 5.8.7.1 for more information. • SDoD and radar technology must be in operation at the onset of commercial operation date (COD). • SDoD success must be monitored throughout the lifetime of the WEF, where monitoring data during operation will continuously inform the SDoD needs for each turbine. • The SDoD programme must be developed and included in the approved EMPr, post-EA (should such EA be granted) during the detailed design phase prior to construction. Specific details of the SDoD programme will be included in a comprehensive Biodiversity Management Plan (BMP) which will be developed and implemented prior to the commercial operational date of the WEF. (3) **Sensitive Species 23:** All wind turbines located within the modelled medium risk zone traversing Species 23 habitat connectivity corridors (see Section 6.5 and Figure 32) must implement dynamic, real-time nocturnal curtailment i.e., from dawn to dusk for the duration of the summer season. The following turbines at each facility are affected: WTGs 5, 13, 15, 19, 20, 23 and 25. • Dynamic real-time habitat mapping and assessment for the species will need to be conducted every 7-14 days (semi-monthly) from October onward, using the latest satellite imagery, supplemented with on-site weather station rainfall and soil moisture data. This near real-time, dynamic modelling will generate a **habitat suitability index** by integrating rainfall (water	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		levels), wetland saturation, and vegetation state. Vegetation state will consider both structural components influenced by grazing and burning, as well as seasonal productivity measured through remotely sensed habitat suitability time-series analysis. Note that the satellite imagery is updated weekly, therefore the frequency of checking these datasets cannot be increased; however, the proposed mitigation strategy prescribes the onsite implementing of hydrometric equipment that would measure the ambient conditions (such as soil moisture, temperature, etc.) on an hourly basis. Therefore, changes in the local weather parameters will be detected much more frequently than at a 7-14 day interval. Also, wetland monitoring at the onset of spring / summer will be conducted more frequently, and regional rainfall patterns will also be monitored in order to determine when conditions become or are likely to become suitable for the species. Structural assessments will be conducted using drone-derived Digital Terrain Model (DTMs), while productivity trends will be monitored across the growing season to capture phenological and productivity changes. When the dynamic habitat suitability index indicates favourable habitat conditions following the onset of late spring-early summer (October) rainfall, wind turbines located in the medium risk mitigation zone must be curtailed at night (from dusk until dawn) for the duration of the summer season. Habitat condition thresholds (favourable/unfavourable) derived from the dynamic habitat suitability index has been calibrated using observed species presence-absence datasets. This habitat condition tracking tool can be deployed in near real time and will issue notifications to the designated avifaunal specialist if favourable conditions are triggered via an online webapp.	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
		(4) **Live-bird monitoring and carcass searches** should be implemented in the operational phase to assess collision rates, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al. 2015). Given the sensitivity of the site, live-bird monitoring should be conducted for at least the first 5 years of operation and be reassessed thereafter to determine the continued frequency of such monitoring as informed by a site-specific Biodiversity Management Plan. Carcass searches must be conducted annually for the lifespan of the facility to assess collision rates. (5) **All authorised wind turbines** must have at least **one blade painted according to a CAA approved pattern** to reduce the risk of raptor collisions (Blade Patterning Guidelines 2024). See **Appendix 12**. (6) Fatality thresholds must be monitored on an annual basis for the lifespan of the WEF. The ratio of predicted annual fatalities (based on Collision Risk Modelling (CRM) values that take the effectiveness of avoidance and mitigation measures into account) to allowable Potential Biological Removals (PBR) is expressed as a **percentage annual fatality threshold for each priority species per site**, which serves as a practical trigger for additional mitigation. If operational monitoring indicates that annual fatalities are approaching or exceeding PBR-based thresholds, this will trigger an immediate review and escalation of mitigation measures, such as extending curtailment periods or adjusting SDOD protocols. This framework ensures that mitigation is responsive, data-informed, and conservation-aligned, with threshold exceedance serving as a clear and proactive management trigger. (7) Additional mitigation measures, when required during operations, must be implemented timeously in accordance with the practicality and associated ease of implementation. **All revised mitigation measures should be implemented within a time period of maximum six (6) months.**	

Nature of Impact and Phase	Overall Impact Significance (Pre-Mitigation)	Proposed Mitigation	Overall Impact Significance (Post-Mitigation)
Operational: Electrocutions on the 33 kV MV network	Medium	(1) Underground cabling must be used as much as is practically possible. (2) If the use of overhead lines is unavoidable due to technical reasons (or other environmental constraints e.g. water courses), the Avifaunal Specialist must be consulted timeously to ensure that a bird-friendly pylon design is used, and that appropriate mitigation is implemented pro-actively for complicated pylon structures e.g., insulation of live components to prevent electrocutions on terminal structures and pylon transformers. (3) Monthly inspections of the overhead sections of the internal reticulation network must be conducted during the operational phase to search for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).	Low
Operational: Collisions with the 33 kV MV network	Medium	Bird flight diverters (design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings) should be installed on all the overhead line sections for the full length directly associated with the proposed WEF according to the applicable Eskom standard at the time.	Low
Decommissioning: Displacement due to disturbance	Medium	(1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No off-road driving should be allowed. (4) No dismantling activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Medium
Cumulative Impacts	High	As above	Medium

8.1.2 Grid Connection Components

The proposed Emvelo WEF grid connection will 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.
- Collisions with the overhead line in the operational phase.
- Mortality due to electrocution on the proposed overhead line in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

8.1.2.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

Construction activities could impact birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although this is often impractical to implement due to tight construction schedules. Powerline-sensitive species which are potentially most vulnerable to displacement due to disturbance are mostly ground-nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl, and White-bellied Bustard. The overall impact significance is rated as **medium** pre-mitigation and **low** post-mitigation.

8.1.2.2 Displacement due to habitat transformation in the construction phase.

During the construction of powerlines, service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. These activities could impact birds breeding, foraging, and roosting in, or in close proximity to the proposed OHL grid connection, through the transformation of habitat. Relevant to this development, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the on-site substation is unavoidable. In the case of the OHL, the direct habitat transformation is limited to the on-site substation and pole/tower footprints and the narrow access road/track under the proposed OHL. The loss of habitat in the substation footprint (1,5 ha will be a relatively insignificant percentage of the habitat that regularly supports powerline sensitive species, and the resultant impact is likely to be fairly minimal. Powerline sensitive species which are potentially most vulnerable to displacement due to habitat transformation are mostly ground-nesting species: African Grass Owl (recorded during dedicated wetland surveys), Black-bellied Bustard, Blue Crane, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Secretarybird, Spotted Eagle-Owl, and White-bellied Bustard. The overall impact significance is rated as **medium** pre-mitigation, and it will decrease to **low** post-mitigation.

8.1.2.3 Collisions with the overhead line in the operational phase.

The up to 132 kV OHL could pose a collision risk to virtually all power line sensitive avifauna, depending on where the spans are located. Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions, power line configuration, and visual capacity. Species potentially at risk are African Darter, African Grass Owl (recorded during dedicated wetland surveys), African Sacred Ibis, African Spoonbill, Black-bellied Bustard, Black-headed Heron, Blue Crane, Cape Shoveler, Cape Vulture, Denham's Bustard, Egyptian Goose, Glossy Ibis, Great Egret, Greater Flamingo, Grey Crowned

Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Little Grebe, Marsh Owl, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, and Yellow-billed Duck and other sensitive wetland species. The overall impact significance is rated as **high** pre-mitigation, and it will decrease to **medium** post-mitigation.

8.1.2.4 Mortality due to electrocutions on the proposed grid connection infrastructure in the operational phase.

Electrocution refers to the scenario where a bird is perched, or attempts to perch, on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132 kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification due to their size and gregarious nature is the Cape Vulture. The overall impact significance is rated as **medium** pre-mitigation, and it will decrease to **low** post-mitigation.

Electrocutions within the proposed on-site substation are possible, however, the likelihood of this impact on the more sensitive Species of Conservation Concern (SCC) is remote, as these species are unlikely to regularly utilise the infrastructure within the on-site substation station for perching or roosting. Powerline sensitive species that are more vulnerable to electrocutions are medium-sized raptors, corvids, owls, and certain species of waterbirds. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, and Yellow-billed Kite. The overall impact significance is rated as **low** pre- and post-mitigation**.**

8.1.2.5 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact significance is likely to be similar in nature to that of the construction phase.

8.1.2.6 Cumulative Impacts.

There are several existing high voltage (HV) powerlines in the 35 km radius around the proposed Grid Connection Project, of which about 300 km worth of OHL is contained in the 35 km radius. The sum total of all the existing and planned HV lines in the 35 km radius amounts to an estimated 383 km, of which the proposed Emvelo WEF Grid Connection will constitute 30 km, or about 8%. The contribution of the Emvelo WEF Grid Connection to the cumulative impact of all the grid connections and existing HV lines is thus low. However, the combined contribution of all the grid connections to the cumulative impact of the HV lines in the 35 km radius, which is mainly collision mortality of priority species with the powerlines is high. The cumulative collision impact of all the grid connections and existing HV lines in the 35 km radius is assessed to be **high** pre-mitigation and **medium** post-mitigation.

Table 19 summarises the expected impacts of the proposed grid connection and proposed mitigation measures per impact.

Table 19: Overall Impact Significance for the Grid Connection (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	(1) Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No construction should take place in the All-Infrastructure Exclusion Zones as indicated in Section 6.5 of this report unless existing roads are to be upgraded. (4) No construction activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Low
Construction: Displacement due to habitat transformation	Medium	(1) Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. (2) Construction of new roads should only be considered if existing roads cannot be upgraded. (3) The recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned to limit the impact of habitat transformation on priority species. (4) No construction should take place in All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report.	Low

Operational: Collisions with the overhead 132 kV grid connection	High	(1) Mitigation in the form of Bird Flight Diverters on the OHL is required. The entire length of the OHL should be fitted with Eskom approved Bird Flight Diverters. Design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings. (2) The operational monitoring programme must include regular monitoring (i.e. quarterly) of the power lines for collision mortalities.	Medium
Operational: Electrocutions on the grid connection infrastructure	Medium	(1) A bird-friendly pylon design should be used. (2) Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles must be implemented. (3) Monitor the electrocution mortality in the substation complex. Apply mitigation if electrocution happens regularly.	Low
Decommissioning: Displacement due to disturbance	Medium	(1) Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. (2) Measures to control noise and dust should be applied according to current best practice in the industry. (3) No off-road driving should be allowed. (4) No dismantling activities within 2.5 km (No-Go buffer) of the Martial Eagle nest (coordinates on request) should take place in the period March to December, which is the breeding season for these eagles.	Low
Cumulative Impacts	High	As above	Medium

8.2 Conclusions

8.2.1 Wind Energy Facility

The proposed Emvelo WEF is expected to have high and medium impacts on avifauna pre-mitigation, but through the implementation of appropriate mitigation measures the impact significance could be reduced to an **overall medium and low risk**. Based on the proposed revised 22-turbine site layout plan, it is strongly recommended that the affected turbines – as indicated in Section 6.5 above - be micro-sited or removed to avoid the recommended avifaunal no-go areas and turbine exclusion zones, including the rotor-swept areas. For detailed information on the delineation of the respective exclusion zones, please refer to Section 6.5 above.

8.2.2 Grid Connection Components

The proposed Emvelo WEF Grid Connection will have a moderate impact significance on avifauna pre-mitigation which, in most instances, could be reduced to an overall low impact significance through the implementation of appropriate mitigation. From an avifaunal perspective, OHL Alternatives 1 and 2 are least preferred as they have the longest span and therefore pose a higher collision risk to birds. The Preferred OHL Alternative is preferred over OHL Alternative 3 as it avoids the 2.5 km No Disturbance Buffer around the Martial Eagle nest (coordinates provided on request).

In conclusion, the proposed WEF development and its associated electrical grid infrastructure is supported by this Specialist, on the condition that the implementation of compulsory mitigation measures as recommended in this report are strictly adhered to.

8.3 Conditions for inclusion in the Environmental Authorisation

Please refer to **Section 6.5** of this report for recommendations relating to the WEF that should be included as minimum conditions in the Environmental Authorisation (EA).

Please refer to **Section 6.6** of this report for recommendations relating to the Grid Connection Components that should be included as minimum conditions in the EA.

9. ENVIRONMENTAL SENSITIVITIES

According to the Animal Species Theme on the DFFE Screening Tool Animal Species Theme, the proposed WEF Project Site and the associated Grid Connection Project Area of Influence (PAOI) are classified as having a Medium to High sensitivity. The Medium and High sensitivity rating for avifauna is due to the possible occurrence of several Species of Conservation Concern (SCC) namely: Grey Crowned Crane (Globally and Regionally Endangered), Martial Eagle (Globally and Regionally Endangered), Southern Bald Ibis (Globally and Regionally Vulnerable), White-bellied Bustard (Regionally Vulnerable), Secretarybird (Globally Endangered and Regionally Vulnerable) and African Grass Owl (Regionally Vulnerable).

A **High** sensitivity classification for the WEF Project Site and the Grid Connection PAOI was confirmed during the on-site surveys. The following SCC have been recorded on site:

- African Grass Owl (Regionally Vulnerable)
- African Marsh Harrier (Regionally Endangered)
- Denham's Bustard (Globally Near Threatened, Regionally Vulnerable)
- Secretarybird (Globally Endangered, Regionally Vulnerable)
- White-bellied Bustard (Regionally Vulnerable),
- Blue Crane (Globally Vulnerable, Regionally Near Threatened)

- Grey Crowned Crane (Globally and Regionally Endangered)
- Martial Eagle (Globally and Regionally Endangered)
- Lanner Falcon (Regionally Vulnerable),
- Greater Flamingo (Regionally Near Threatened)
- Sensitive Species 23 (Regionally and Globally Critically Endangered)
- Southern Bald Ibis (Regionally and Globally Vulnerable)
- Cape Vulture (Globally Vulnerable and Regionally Endangered)
- Yellow-breasted Pipit (Regionally and Globally Vulnerable)

Specialist Sensitivity Analysis and Verification

The following avifaunal sensitivities were identified in and near the WEF Project Site and the Grid Connection PAOI (Refer to Section 6.5 and 6.6 for more details):

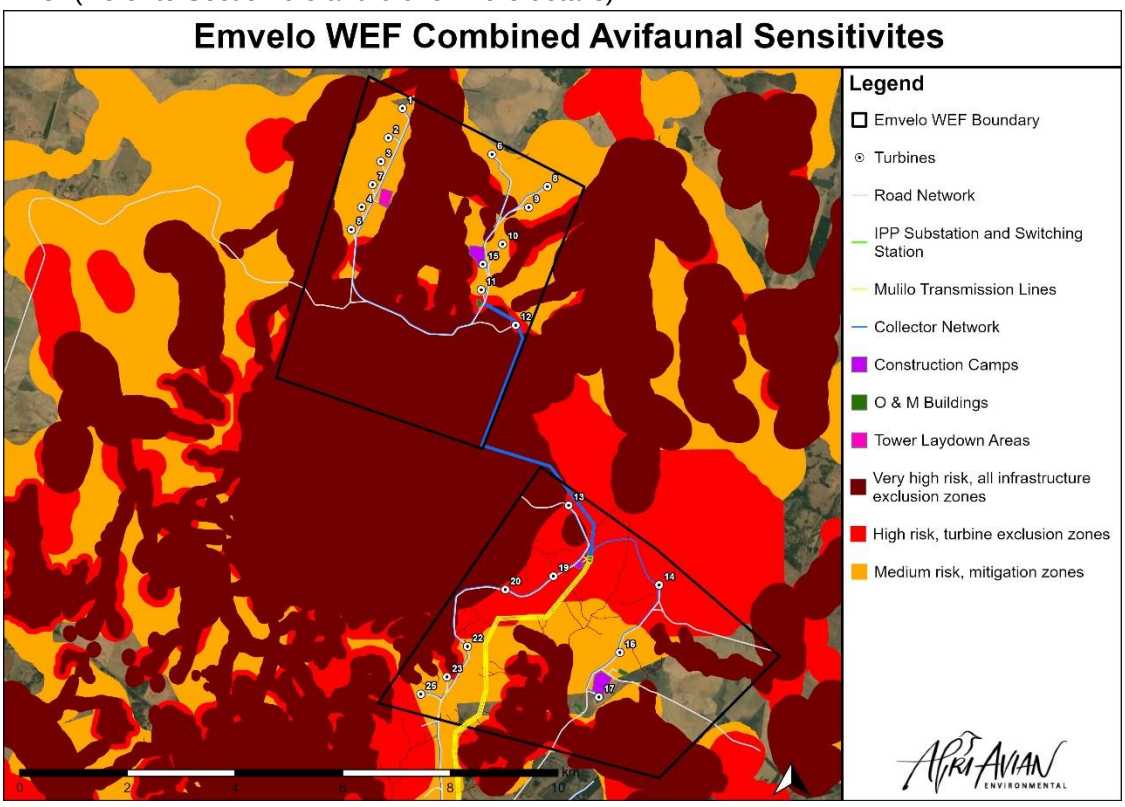


Figure 39: Avifaunal Sensitivities identified for the Emvelo WEF Project.

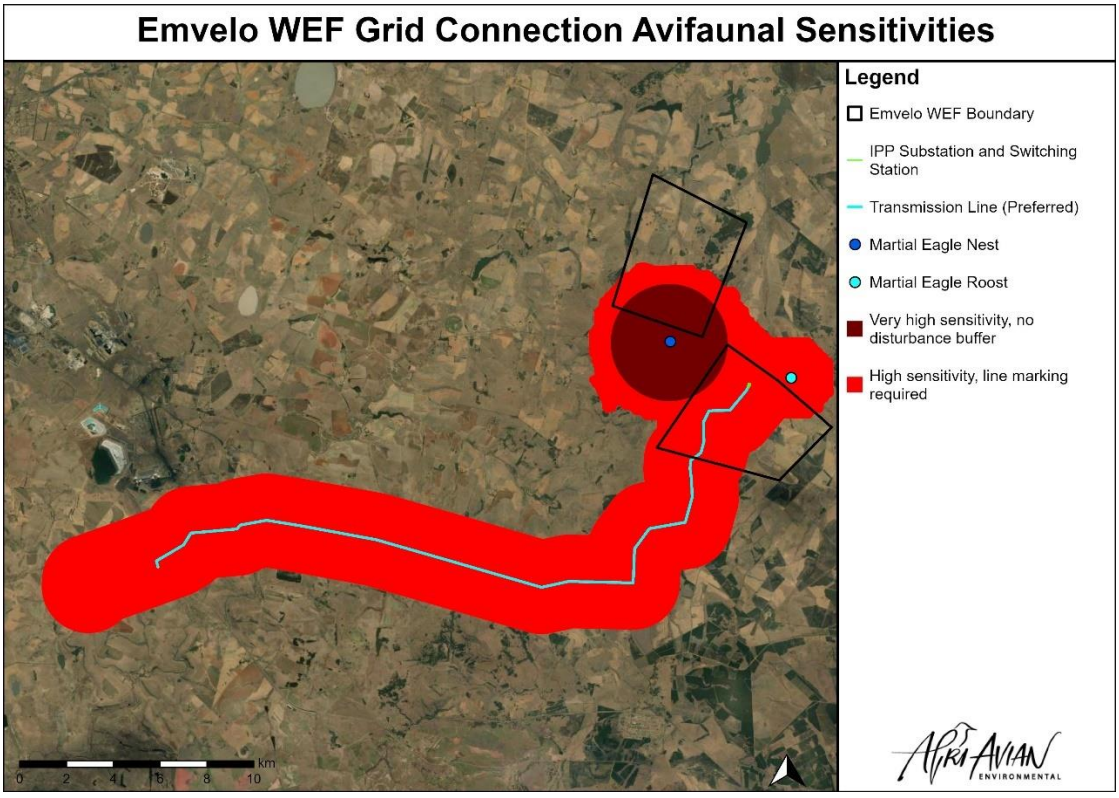


Figure 40: Avifaunal Sensitivities identified for the Emvelo Grid Connection.

10. POST CONSTRUCTION MONITORING PROGRAMME

The new procedures and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA came into force in March 2020. According to these regulations, a detailed post-construction monitoring programme must be included as part of the bird specialist study. See Appendix 9 for a proposed programme.

11. REFERENCES

- ALONSO, J. A. AND ALONSO, J. C. 1999. Collision of birds with overhead transmission lines in Spain. Pp. 57–82 in Ferrer, M. and Janss, G. F. E., eds. Birds and power lines: Collision, electrocution, and breeding. Madrid, Spain: Quercus.
- Altamont Pass Avian Monitoring Team. 2008. Bird Fatality Study at Altamont Pass Wind Resource Area October 2005 – September 2007. Draft Report prepared for the Almeda County Scientific Review Committee.
- ANIMAL DEMOGRAPHY UNIT. 2020. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za.
- AVIAN POWER LINE INTERACTION COMMITTEE (APLIC). 2012. Mitigating Bird Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute. Washington D.C.
- BARRIENTOS R, PONCE C, PALACIN C, MARTÍN CA, MARTÍN B, ET AL. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. PLoS ONE 7(3): e32569. doi: 10.1371/journal.pone.0032569.
- BARRIENTOS, R., ALONSO, J.C., PONCE, C., PALACÍN, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.
- Barrios, L. & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.
- BEAULAURIER, D.L. 1981. Mitigation of bird collisions with transmission lines. Bonneville Power Administration. U.S. Dept. of Energy.
- BERNARDINO, J., BEVANGER, K., BARRIENTOS, R., DWYER, J.F. MARQUES, A.T., MARTINS, R.C., SHAW, J.M., SILVA, J.P., MOREIRA, F. 2018. Bird collisions with power lines: State of the art and priority areas for research. https://doi.org/10.1016/j.biocon.2018.02.029. Biological Conservation 222 :1 – 13.
- Carette, M., Zapata-Sanchez, J.A., Benitez, R.J., Lobon, M. & Donazar, J.A. (2009) Large scale risk-assessment of wind farms on population viability of a globally endangered long-lived raptor. Biological Conservation 142: 2954-2961.
- CERVANTES F, MURGATROYD M, ALLAN DG, FARWIG N, KEMP R, KRÜGER S, MAUDE G, MENDELSOHN J, RÖSNER S, SCHABO DG, TATE G, WOLTER K, AMAR A. 2023. A utilization distribution for the global population of Cape Vultures *Gyps coprotheres* to guide wind energy development. Ecological Applications (33) https://doi.org/10.1002/eap.2809.
- Civil Aviation Regulations. 1997. Part 139.01.33 of the civil aviation regulations, 1997, to the Aviation Act, 1962 (Act 74 of 1962).
- Colyn R.B., Henderson, CL., Altwegg, R., Smit-Robinson, HA. 2020. Habitat transformation and climate change: Implications for the distribution, population status and colony extinction of Southern Bald Ibis (Geronticus calvus) in southern Africa. Condor: Ornithological Applications 122: 1-17.
- De Lucas, M., Janss, G.F.E., Whitfield, D.P. & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45: 1695 – 1703.
- Drewitt, A.L. & Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. Ibis 148, 29-42.
- ENDANGERED WILDLIFE TRUST. 2014. Central incident register for powerline incidents. Unpublished data.

- Erickson, W. P., G. D. Johnson, and D. P. Young, Jr. 2005. A summary and comparison of bird mortality form anthropogenic causes with an emphasis on collisions. U.S. Department of Agriculture Forest Service General Technical Report PSW-GTR-191, Albany, California, USA.
- Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, c/o RESOLVE, Washington, D.C., USA.
- Everaert, J., Devos, K. & Kuijken, E. 2001. Windturbines en vogels in Vlaanderen: Voorlopige Onderzoeksresultaten En Buitenlandse Bevindingen [Wind Turbines and Birds in Flanders (Belgium): Preliminary Study Results in a European Context]. Instituut Voor Natuurbehoud. Report R.2002.03. Brussels B.76pp. Brussels, Belgium: Institut voor Natuurbehoud.
- EWEA 2003. Wind Energy – The Facts. Volume 4: Environment. The European Wind Energy Association (EWEA), and the European Commission's Directorate General for Transport and Energy (DG TREN). pp182-184. (www.ewea.org/documents/)
- Farfán M.A., Vargas J.M., Duarte J. and Real R. (2009). What is the impact of wind farms on birds? A case study in southern Spain. Biodiversity Conservation. 18: 3743-3758.
- Ferrer, M., De Lucas, M., Janss, G.F.E., Casado, E., Munoz, A.R., Bechard, M.J., Calabuig, C.P. 2012. Weak relationship between risk assessment studies and recorded mortality on wind farms. Journal of Applied Ecology. 49. p38-46.
- Fox, A.D., Desholm, M., Kahlert, J., Christensen, T.K. & Krag Petersen, I.B. 2006. Information needs to support environmental impact assessments of the effects of European marine offshore wind farms on birds. In Wind, Fire and Water: Renewable Energy and Birds. Ibis 148 (Suppl. 1): 129–144.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- HOBBS, J.C.A. & LEDGER J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. Proceedings of the Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986.
- HOBBS, J.C.A. & LEDGER J.A. 1986b. Power lines, Birdlife and the Golden Mean. Fauna and Flora, 44:23-27.
- Hockey, P.A.R., Dean, W.R.J, and Ryan, P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- Hötker, H., Thomsen, K.-M. & H. Jeromin. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.
- Howell, J.A. & DiDonato, J.E. 1991. Assessment of avian use and mortality related to wind turbine operations: Altamont Pass, Alameda and Contra Costa Counties, California, September 1988 Through August 1989. Final report prepared for Kenentech Windpower.
- Hunt, W.G. 2001. Continuing studies of golden eagles at Altamont Pass. Proceedings of the National Avian-Wind Power Planning Meeting IV.
- Hunt, W.G., Jackman, R.E., Hunt, T.L., Driscoll, D.E. & Culp, L. 1999. A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Population Trend Analysis 1994–97. Report to National Renewable Energy Laboratory, Subcontract XAT-6-16459–01. Santa Cruz: University of California.
- Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.
- Jenkins, A. & Smallie, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? Africa Birds and Birding. Vol 14, No 2.
- Jenkins, A., De Goede, J.H. & Van Rooyen, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildlife Trust.

- Jenkins, A.R., De Goede, J.H., Sebele, L. & Diamond, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International 23: 232-246.
- Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.
- Johnson, G.D., Strickland, M.D., Erickson, W.P. & Young, D.P. 2007. Use of data to develop mitigation measures for wind power impact on birds. In: De Lucas, M., Janss, G.F.E., & Ferrer, M eds: Birds and Wind Farms Risk Assessment and Mitigation. Quercus, Madrid.
- Johnson, G.D., Strickland, M.D., Erickson, W.P., Sheperd, M.F. & Sheperd D. A. 2000. Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a four-year study. Technical Report prepared for Northern States Power Company, Minneapolis, MN 262pp.
- Keskin, G., Durmus, S., Őzelmas, Ű and Karakaya, M. 2019. Effects of wing loading on take-off and turning performance which is a decisive factor in the selection of resting location of the Great Bustard (*Otis tarda*). Biological Diversity and Conservation 12:28-32.
- Kemp, A. C., G. M. Kirwan, D. A. Christie, J. S. Marks, and P. F. D. Boesman (2020). Secretarybird (*Sagittarius serpentarius*), version 1.1. In Birds of the World (S. M. Billerman and B. K. Keeney, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.secret2.01.1
- Key Biodiversity Areas Partnership (2025) *Key Biodiversity Areas factsheet: Chrissie Pans*. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, American Bird Conservancy, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Re:wild, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from https://keybiodiversityareas.org/ on Feb 4, 2025.
- Koops, F.B.J. & De Jong, J. 1982. Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. Electrotechniek 60: 641 – 646.
- Kruckenberg, H. & Jaene, J. 1999. Zum Einfluss eines Windparks auf die Verteilung weidender Bläßgänse im Rheiderland (Landkreis Leer, Niedersachsen). Natur Landsch. 74: 420–427.
- Kruger, R. & Van Rooyen, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: The Molopo Case Study. Proceedings of the 5th World Conference on Birds of Prey and Owls. August 4-8,1998. Midrand, South Africa.
- KRUGER, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. Bloemfontein (South Africa): University of the Orange Free State. (M. Phil. Mini thesis)
- Langgemach, T. 2008. Memorandum of Understanding for the Middle-European population of the Great Bustard, German National Report 2008. Landesumweltamt Brandenburg (Brandenburg State Office for Environment).
- Langston, R.H.W. & Pullan, J.D. 2003. Wind farms and birds: an analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues. Report written by Birdlife International on behalf of the Bern Convention. Council Europe Report T-PVS/Inf
- Larsen, J.K. & Madsen, J. 2000. Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): A landscape perspective. Landscape Ecol. 15: 755–764.
- Leddy, K.L., Higgins, K.F., Naugle, D.E., 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 11, 100–104.
- LEDGER, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Eskom Test and Research Division. (Technical Note TRR/N83/005).
- LEDGER, J.A. & ANNEGARN H.J. 1981. Electrocution Hazards to the Cape Vulture (*Gyps coprotheres*) in South Africa. Biological Conservation 20:15-24.
- LEDGER, J.A. 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. The Certificated Engineer, 57:92-95.
- LEDGER, J.A., J.C.A. HOBBS & SMITH T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. Proceedings of the International Workshop on Avian Interactions with Utility Structures. Miami (Florida), Sept. 13-15, 1992. Electric Power Research Institute.

- Madders, M & Whitfield, D.P. Upland raptors and the assessment of wind farm impacts. 2006. Ibis. Volume 148, Issue Supplement s1. pp 43-56.
- Marnewick M.S., Retief, E.F., Theron, N.T., Wright, D.R., & Anderson, T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
- MARTIN, G., SHAW, J., SMALLIE J. & DIAMOND, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- Mucina. L. & Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho, and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- Orloff, S. & Flannery, A. 1992. Wind turbine effects on avian activity, habitat use and mortality in Altamont Pass and Solano County Wind Resource Areas, 1989–91. California. Energy Commission.
- Pearce-Higgins J.W, Stephen L, Langston R.H.W, Bainbridge, I.P.& R Bullman. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 2009, 46, 1323–1331
- Pearce-Higgins, J.W., Stephen, L., Douse, A., & Langston, R.H.W. Greater impacts on bird populations during construction than subsequent operation: result of multi-site and multi-species analysis. Journal of Applied Ecology 2012, 49, 396-394.
- Pedersen, M.B. & Poulsen, E. 1991. Impact of a 90 m/2MW wind turbine on birds. Avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Danske Vildtunderogelser Haefte 47. Rønde, Denmark: Danmarks Miljøundersøgelser.
- Perold V, Ralston-Paton S & Ryan P (2020): On a collision course? The large diversity of birds killed by wind turbines in South Africa, Ostrich, DOI: 10.2989/00306525.2020.1770889
- Raab, R., Julius, E., Spakovszky, P. & Nagy, S. 2009. Guidelines for best practice on mitigating impacts of infrastructure development and afforestation on the Great Bustard. Prepared for the Memorandum of Understanding on the conservation and management of the Middle-European population of the Great Bustard under the Convention on Migratory species (CMS). Birdlife International. European Division.
- Raab, R., Spakovszky, P., Julius, E., Schütz, C. & Schulze, C. 2010. Effects of powerlines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International. Birdlife International.
- Ralston-Patton S. 2017. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa, March 2017
- Ralston-Patton, M & Camagu, N. 2019. Birds & Renewable Energy Update for 2019. Birds and Renewable Energy Forum, 10 October 2019. BirdLife South Africa.
- Retief E.F., Diamond M, Anderson M.D., Smit, H.A., Jenkins, A & M. Brooks. 2012. Avian Wind Farm Sensitivity Map. Birdlife South Africa http://www.birdlife.org.za/conservation/birds-and-wind-energy/windmap.
- Scottish Natural Heritage (2005, revised 2010) Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance. SNH, Battleby.
- Scottish Natural Heritage. 2010. Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. SNH Avoidance Rate Information & Guidance Note.
- SHAW, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.
- SHAW, J.M., PRETORIUS, M.D., GIBBONS, B., MOHALE, O., VISAGIE, R., LEEUWNER, J.L.& RYAN, P.G. 2017. The effectiveness of line markers in reducing power line collisions of large terrestrial birds at De Aar, Northern Cape. Eskom Research, Testing and Development. Research Report. RES/RR/17/1939422.
- Smallwood, K. S. (2013), Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin, 37: 19–33
- South African Bird Atlas Project 2. Accessed on 30 June 2021. http://sabap2.adu.org.za.
- SPORER, M.K., DWYER, J.F., GERBER, B.D, HARNESS, R.E, PANDEY, A.K. 2013. Marking Power Lines to Reduce Avian Collisions Near the Audubon National Wildlife Refuge, North Dakota. Wildlife Society Bulletin 37(4):796–804; 2013; DOI: 10.1002/wsb.329

- Stewart, G.B., Coles, C.F. & Pullin, A.S. 2004. Effects of Wind Turbines on Bird Abundance. Systematic Review no. 4. Birmingham, UK: Centre for Evidence-based Conservation.
- Stewart, G.B., Pullin, A.S. & Coles, C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation. 34, 1-11.
- Taylor, M.R., Peacock F, & Wanless R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- TAYLOR, M.R., PEACOCK F, & WANLESS R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- Thelander, C.G., Smallwood, K.S. & Rugge, L. 2003. Bird Risk Behaviours and Fatalities at the Altamont Pass Wind Resource Area. Report to the National Renewable Energy Laboratory, Colorado.
- Ugoretz, S. 2001. Avian mortalities at tall structures. In: Proceedings of the National Avian Wind Power Planning Meeting IV pp. 165-166. National Wind Coordinating Committee. Washington DC.
- VAN ROOYEN, C.S. & LEDGER, J.A. 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230, in Ferrer, M. & G.F.M. Janns. (eds.). Birds and Power lines. Quercus, Madrid (Spain). Pp 238.
- VAN ROOYEN, C.S. & TAYLOR, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina.
- VAN ROOYEN, C.S. 1998. Raptor mortality on power lines in South Africa. Proceedings of the 5th World Conference on Birds of Prey and Owls. Midrand (South Africa), Aug.4 – 8, 1998.
- VAN ROOYEN, C.S. 1999. An overview of the Eskom-EWT Strategic Partnership in South Africa. EPRI Workshop on Avian Interactions with Utility Structures Charleston (South Carolina), Dec. 2-3, 1999.
- Van Rooyen, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In: The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.
- VAN ROOYEN, C.S. 2007. Eskom-EWT Strategic Partnership: Progress Report April-September 2007. Endangered Wildlife Trust, Johannesburg.
- VAN ROOYEN, C.S. VOSLOO, H.F. & R.E. HARNESS. 2002. Eliminating bird streamers as a cause of faulting on transmission lines in South Africa. Proceedings of the IEEE 46th Rural Electric Power Conference. Colorado Springs (Colorado), May. 2002.
- VERDOORN, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV power lines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. Proceedings of the 2nd International Conference on Raptors: Urbino (Italy), Oct. 2-5, 1996.

APPENDIX 1: TERMS OF REFERENCE

Scoping and EIA processes will be undertaken for the **proposed WEFs**, in terms of Government Notice (GN) No. R. 983 of 4 December 2014 (as amended to GNR 327), promulgated under the National Environmental Management act, 1998 (Act No. 107 of 1998) (NEMA) EIA Regulations, 2014 (as amended).

You will be required to submit **one S&EIA report per WEF** with impact assessment tables and site verification report as per the dates provided in Section 2 of this document.

- Include the assessment of the grid connection with each respective S&EIA report for the proposed WEFs for submission to the National Department of Forestry, Fisheries and the Environment (DFFE).

The specialist report will include the specialist impact assessment of the proposed development(s). You will be required to submit **one S&EIA report per WEF**. The terms of reference for specialist studies includes (but is not limited to):

- Project Description
- Site Sensitivity Verification Report (SSVR)
- Methodology
- Assumptions and Limitations
- Desktop Screening
- Mapping
- Sensitivity Analysis and/or modelling, including sensitivity and no-go features overlain on the development site
- Defining the legal, planning and policy context
- Description of the Baseline Environment
- Determination of potential impacts (direct, indirect, cumulative)
- Determination of residual risks
- Reporting
- Recommendation and input into project design
- Management Plan and/or Monitoring Programme
- Sensitivity Verification Reporting in terms of GN 320 of 20 March 2020 and/or a Compliance Statement in terms of GN 320 / GN 1150 of 30 October 2020
- Incorporate and address Public Comment following PPP
- Submission of Shapefiles

The **Specialist S&EIA Report(s)** must comply with the requirement of GN 43110 of NEMA: Environmental Themes Reporting Criteria and the Relevant Protocols Gazetted, unless no protocol is prescribed, then the Appendix 6 of the EIA Regulations 2014, as amended, must be followed.

APPENDIX 2: SPECIALIST CV

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	22 years

Key Qualifications

Albert Froneman (*Pr. Sci.Nat*) has more than 22 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Key Project Experience

Renewable Energy Facilities – avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oyster Bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskopvlakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal

monitoring project

15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Facility (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Aletta Wind Energy Facility 12-month bird monitoring (Biotherm)
28. Maralla Wind Energy Facility 12-month bird monitoring (Biotherm)
29. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
30. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
31. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
32. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
33. KurumanWind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
34. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
35. Klipheuwel-Dassiefontein Wind Energy Facility, Caledon, Western Cape – Operational phase bird monitoring – Year 5 (Klipheuwel-Dassiefontein Wind Energy Facility)
36. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
37. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). Emvelo and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
38. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
39. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
40. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
41. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
42. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
43. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
44. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
45. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
46. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
47. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
48. Kappa Solar PV facility, Touwsrivier, Western Cape, pre-construction monitoring (Veroniva)
49. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
50. Pofadder Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)

51. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
52. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
53. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).
54. Iphiko Wind Energy facilities, Laingsburg, Western Cape, screening and pre-construction monitoring (G7 Energies)
55. Kangnas Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
56. Perdekraal East Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
57. Aberdeen 1, 2 & Aberdeen Kudu (3&4) Wind Energy Facilities, Eastern Cape, 12- month pre-construction monitoring (Atlantic Renewable Energy Partners)
58. Loxton / Beaufort West Wind Energy Facilities, Northern Cape, 12-month pre-construction monitoring (Genesis Eco-Energy Developments)
59. Ermelo & Volksrust Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
60. Aardvark Solar PV facility, Copperton, Northern Cape, 12-month pre-construction monitoring (ABO)
61. Bestwood Solar PV facility, Kathu, Northern Cape, pre-construction monitoring (AMDA)
62. Boundary Solar PV facility, Kimberley, Northern Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
63. Excelsior Wind Energy Facility, Swellendam, Western Cape, Operational Phase 2 years avifaunal monitoring & implementation of Shut Down on Demand (SDOD) pro-active mitigation strategy (Biotherm)
64. De Aar cluster Solar PV facilities, De Aar, Western Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
65. Rinkhals Solar PV facilities, Kimberley, Northern Cape, Pre-construction monitoring (ABO)
66. Kolkies Sadawa Solar PV facilities, Touwsrivier, Western Cape, pre-construction monitoring (Mainstream)
67. Leeudoringstad Solar PV facilities, Leeudoringstad, Northwest, Pre-construction monitoring (Upgrade Energy)
68. Noupoort Umsobomvu Solar PV facilities, Noupoort, Northern Cape, Pre-construction monitoring (EDF Renewables)
69. Oya Solar PV facilities, Matjiesfontein, Western Cape, pre-construction monitoring (G7 Energies)
70. Scafell Solar PV facilities, Sasolburg, Free state, pre-construction monitoring (Mainstream)
71. Vrede & Rondawel Solar PV facilities, Kroonstad, Free state, pre-construction monitoring (Mainstream)
72. Gunstfontein Wind Energy Facilities, Sutherland, Northern Cape, additional pre-construction monitoring (ACED)
73. Ezelsjacht Wind Energy Facility, De Doorns, Western Cape, pre-construction monitoring (Mainstream)
74. Klipkraal Wind Energy Facility, Fraserburg, Northern Cape, avifaunal screening (Klipkraal WEF)
75. Pofadder Wind Energy Facility, Pofadder, Northern Cape, pre-construction monitoring (Atlantic Renewable Energy Partners)

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.

2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assessment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality
12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports. Bird Impact Assessment Study - Proposed 60-year Ash Disposal Facility near to the Kusile Power Station
19. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
20. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
21. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
22. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
23. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
24. Avifaunal Specialist Study – Meerkat Hydro Electric Dam – Hope Town, Northern Cape
25. The Stewards Pan Reclamation Project – Bird Impact Assessment study
26. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation
27. Strategic Environmental Assessment for Gas Pipeline Development, CSIR
28. Avifaunal Specialist Assessment - Proposed monopole telecommunications mast – Roodekrans, Roodepoort, Gauteng (Enviroworks)
29. Gromis-Nama-Aggeneis 400kv IPP Integration: Environmental Screening - Avifaunal Specialist Desktop Study
30. Melkspruit - Rouxville 132kV Distribution Line - Avifaunal Amendment and Walk-through Report
31. Gamma - Kappa 2nd 765kV transmission line – Avifaunal impact assessment GIS analysis

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Ohrigstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA –GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map production City of Tshwane – New bulk feeder pipeline projects x3Map production
37. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
38. ESKOM Geluk Rural Powerline GIS & Mapping
39. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
40. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
41. ESKOM Lephalale CNC – GIS Specialist & Mapping
42. ESKOM Marken CNC – GIS Specialist & Mapping
43. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
44. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping

45. Vlakfontein Filling Station – GIS Specialist & Mapping - EIA
46. Prieska – Hoekplaas Solar PV & BESS - GIS Specialist & Mapping – EIA
47. Mulilo Total Hydra Storage (MTHS) De Aar - GIS Specialist & Mapping – EIA
48. Merensky Uchoba Powerline, Steelpoort - GIS Specialist & Mapping – EIA
49. Douglas Solar Part 2 Amendment – grid connection - GIS Specialist & Mapping – EIA

Professional Affiliations

- South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.
- Southern African Wildlife Management Association - Member
- Zoological Society of South Africa - Member

Curriculum Vitae: **Megan Loftie-Eaton**

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	PhD Biological Sciences
Nationality	:	South African
Years of Experience	:	10 years

Key Qualifications

Megan Loftie-Eaton **(**Pr. Sci.Nat) holds a PhD in Biological sciences from the Avian Demography Unit, University of Cape Town, and has more than 10 years' experience conducting bird research, atlasing, mapping and environmental assessment consulting. Megan was an assistant researcher on the African Penguin EarthWatch Research Team, conducting population surveys on penguins and other seabirds, sustainable agriculture research, biodiversity surveys and ecological monitoring. She has acted as coordinator, Social media manager and communications officer for various programmes including The Biodiversity and Development Institute (OdonataMAP, Citizen Science Projects), LepiMAP, BirdMAP, ADU and Hoedspruit Hub. She is on the Expert Panel for a virtual museum covering several vertebrate taxa.ma Megan is also very active with the bird atlasing project, she presented and assessed several atlasing workshops in Africa and Europe. She facilitated an assessed Ecology courses and provided training materials for it. She has been involved in Environmental and specifically Avian assessments since 2020 by conducting fieldwork, completing assessments, and acting as an environmental assessment practitioner. She has several additional qualifications, including a FGASA Level 1 Nature guide qualification, a First aid level one qualification, snake and scorpion training courses and a course in humane trapping methods. She completed online global environmental management course, and a NQF level 5 outcomes-based assessment course. Megan is an author or co-author on several scientific papers and currently she operates as an Avifaunal specialist working with Chris van Rooyen Consulting.

Key Project Experience

Renewable Energy Facilities – avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Philipstown Kudu Solar Energy Facilities and associated infrastructure
2. Umsobomvu Solar Energy Facilities and associated infrastructure
3. Ezelsjacht Wind Energy Facility and associated infrastructure
4. Heuweltjies en Kraaltjies Wind Energy Facilities and associated infrastructure
5. Mercury Solar Energy Facilities and associated infrastructure
6. Perdekraal East Wind Energy Facility and associated infrastructure
7. Skilpad Solar Energy Facility and associated infrastructure

Other Avifaunal Projects

1. Blue Stone Quarry Wall Restoration, Robben Island, Western Cape, South Africa – Avifaunal Impact Assessment

Professional registrations and industrial affiliations

- **Professional Natural Scientist in Ecology (Member #135161)** registered with the South African Council for Natural Scientific Professions (SACNASP)
- **Environmental Assessment Practitioner (Number 2021/3690)** registered with the Environmental Assessment Practitioners Association of South Africa (EAPASA)
- **Member** of the Zoological Society of Southern Africa (ZSSA)

Curriculum Vitae: Robin Colyn

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc Biological Sciences
Nationality	:	South African
Years of Experience	:	13 years

ENVIRONMENTAL SCIENTIST | LANDSCAPE ECOLOGIST | MACHINE LEARNING AND DATA ANALYST

A passionate environmental scientist with over 10 years of experience in monitoring, managing, and modeling threatened species and habitats, impact monitoring and mitigation, as well as assessing conservation protected area networks. Core proficiencies include processing, analyzing, and modeling GIS and remote sensing data, automating analytics with scripted workflows, and utilizing both traditional and deep machine learning techniques. He specializes in applying geospatial, ecological, and climate modeling techniques, including semantic and instance segmentation, population viability analysis, habitat change detection/monitoring, and climate change modeling. His expertise also extends to advanced remote sensing analysis, applied data science and ecological statistics using R and Python. Additionally, he has thorough experience with conservation spatial planning tools such as Marxan, PANDA, and PrioritizeR. He is a member of the IUCN Species Survival Commission (SSC) Red List Authority.

Scientific peer-reviewed publications:

Colyn. R.B., Anderson, T.A., Anderson, M.D., Retief, E., van der Westhuizen-Coetzer, E., Smit-Robinson, H.A. 2024. The use of image classification to estimate flamingo abundance from aerial, drone and satellite imagery. *Journal of African Ornithology*: https://doi.org/10.2989/00306525.2024.2325674.

Lee, A.K., Pienaar, C., Colyn, R.B. 2024. Reassessing the Population and Distribution of the Southern Bald Ibis: Insights from Diverse Citizen Science Data Sources. *Waterbirds* 46(2-4), 229-242.

Lee, A., Whitecross, M., Smit-Robinson, H., Allan, D.G., van den Heever, L., Jenkins, A., Retief, R., Colyn, R., Tarboton, W., Chetty, K., Brink, C.W. 2023. A review of the conservation status of Black Stork Ciconia nigra in South Africa, Lesotho, and Eswatini. *Bird Conservation International 33: DOI: https://doi.org/10.1017/S0959270923000059 .*

Jenkins, A.R., van Zyl, A.J., Colyn, R.B., Brink, C.W., Smit-Robinson, H.A., Whitecross, A. 2023. Drivers of the scarcity in the globally threatened Taita Flacon *Falco fasciinucha*: competition and habitat quality in the eastern escarpment region of South Africa. *Bird Conservation International* 33: DOI: https://doi.org/10.1017/S0959270923000205 .

Colyn, RB., Whitecross, MA., Howes, CA., Smit-Robinson, HA. 2020. Restricted breeding habitat of the Critically Endangered White winged Flufftail in Ethiopia and its conservation implications. *Ostrich*: https://doi.org/10.2989/00306525.2020.1737259

Colyn, RB., Ehlers Smith, DA., Ehlers Smith YC., Smit-Robinson, HA., Downs, CT. 2020. Predicted distributions of avian specialists: A framework for conservation of endangered forests under future climates. *Diversity and Distributions*, 1: 1-16.

Colyn, R.B., Campbell A. and Smit-Robinson H. 2020. The use of a camera trap and acoustic survey design to ascertain the vocalisation and breeding status of the highly elusive White-winged Flufftail *Sarothrura ayresi*. *Avian Conservation and Ecology* 15: 12-25. http://www.ace-eco.org/vol15/iss2/art12/

Colyn R.B., Henderson, CL., Altwegg, R., Smit-Robinson, HA. 2020. Habitat transformation and climate change: Implications for the distribution, population status and colony extinction of Southern Bald Ibis (Geronticus calvus) in southern Africa. *Condor: Ornithological Applications* 122: 1-17.

Colyn, R.B., Coetzer, C., Smit-Robinson, H., Chetty, K., Lee, and Ryan, P.G. 2020. The impact of climate, grazing and fire on the breeding activity and density of threatened birds in a highland grassland ecosystem in South Africa. *Bird Conservation International*, [*In review*]

Colyn R.B., Campbell A. and Smit-Robinson H. 2019. Camera-trapping successfully and non-invasively reveals the presence, activity and habitat choice of the Critically Endangered White-winged Flufftail Sarothrura ayresi in a South African high-altitude wetland. *Bird Conservation International*, doi:10.1017/S0959270918000400.

Jenkins A.R., Ried T., du Plesis J., Colyn R.B., Ben G. and Millikin R. 2018. Combining radar and direct observation to estimate pelican collision risk at a proposed wind farm on the Cape west coast, South Africa. *Plos ONE* 13(2): 1 -19.

Colyn R.B., Radloff F. and O'Riain J. 2018. Camera trapping mammals in the scrubland's of the Cape Floristic Kingdom – the importance of effort, spacing and trap placement. *Biodiversity Conservation*, 27: 503-520.

Colyn R.B., Campbell A. and Smit-Robinson H. 2017. The application of camera trapping to assess Rallidae species richness within palustrine wetland habitat in South Africa. *Ostrich*: http://dx.doi.org/10.2989/00306525.2017.1292562.

Campbell A. and Colyn R.B. 2017. Insight into the opportunistic feeding habits of Chorister Robin-chat Cossypha dichroa. *Biodiversity Observations* 8(32): 1-4.

Colyn R.B. and Smit-Robinson H. 2016. Fennoscandian-ringed Western Osprey (Pandion haliaetus) recovery, Ingula, KwaZulu-Natal, South Africa. *Biodiversity Observations* 7(73): 1-5.

Colyn R.B., du Plesis J. and Jenkins, A. 2014. First recorded raptor mortality at a South African wind farm. *Gabar* 24:2.

Colyn, R.B., Garcia-Heras, M.S., Simmons, R.E., Arroyo, B., Mougeot, F., Brink, C.W., Whitecross M.A., Smit-Robinson, H.A. 2023. The conservation implications of historic habitat loss and future climate change on the distribution of Black Harrier (Circus maurus) across southern Africa. *Conservation Biology, [In review]*

Colyn, R.B., Theron, N., Rossouw, W., Smit-Robinson, H., Lee, A., Ryan, P.G. 2023. The distribution, population status and trend of endemic mesic highland grassland bird species in South Africa. *Bird Conservation International*, *[In review]*

APPENDIX 3: PRE-CONSTRUCTION MONITORING PROTOCOL

The objective of the pre-construction monitoring conducted at the proposed Mulilo Wind Energy Facilities (WEFs) Cluster (Emvelo WEF and Sheepmoor WEF) is to gather baseline data over a period of four seasons on the following aspects pertaining to avifauna:

- The abundance and diversity of birds on the proposed WEF site and on a suitable control site, to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species to assess the potential collision risk with the turbines and associated power line infrastructure.

Currently, as it is not expected that species specific guidelines (i.e. those for Cape Vulture, Verreaux's Eagle, or Black Harrier) will be relevant, one set of guidelines are applicable to these wind facilities:

- Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.* Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa. Hereafter referred to as the wind guidelines.

The wind guidelines are applicable to all wind energy facilities which require environmental authorisation, and monitoring at the Amsterdam WEF Cluster site is being conducted in line with these guidelines. The wind guidelines require a minimum of four site visits a year. Wind priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms.

Pre-construction monitoring conducted by a team of onsite monitors resulted in data collection at the Emvelo WEF site as well as a Control Site and includes a dataset covering a period of approximately 18 months during the following time envelopes:

- 21 February–03 March 2022
- 21–27 April 2022
- 01–16 June 2022
- 06–21 October 2022
- 14–17 January 2023 (Transect counts only)
- 05–09 May 2023
- 28–30 June 2023
- 22–26 August 2023

Additional Vantage Point and Transect Count monitoring was conducted near the identified Martial Eagle nest to gain a better understanding of their flight behaviour adding approximately five more months to the dataset. These additional surveys were done to cover the expanded WEF and EGI development footprints as well as additional targeted Martial Eagle monitoring during which time all other bird species were also recorded across the entire project site. The five additional surveys were conducted during the following time envelopes:

- 17–22 October 2023
- 15–23 November 2023
- 30 November–05 December 2023
- 17–22 January 2024
- 14–20 February 2024

In addition, from December 2024 to February 2025 additional targeted wetland surveys were conducted with special focus on the Sensitive Species 23 to gain a better understanding of the species' habitat preferences and movement patterns, and again all other bird species were also recorded across the entire project site during this time.

Monitoring is being conducted in the following manner:

- Two (2) drive transects were identified totalling 15.3 km and 9.75 km respectively at the WEF Sites, and one drive transect at the Control Site with a total length of 10.5 km.
    - One monitor travelling slowly (± 10 km/h) in a vehicle records all birds on both sides of the transect. The observer stops at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects are counted three times per sampling session (i.e. three times per seasonal site visit).
- Nine (9) walk transects of 1 km each were identified at the WEF sites, and two at the Control Site,
    - Each walk transect is counted 4 times per sampling season. (i.e. four times per seasonal site visit).
    - All birds are recorded during walk transects.
- The following variables were recorded during drive transect and walk transect sampling:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Estimated distance from transect;
    - Wind direction;
    - Wind strength (estimated Beaufort scale);
    - Weather (sunny, cloudy, partly cloudy, rain, mist);
    - Temperature (cold, mild, warm, hot);
    - Behaviour (flushed, flying-display, perched, perched-calling, perched-hunting, flying-foraging, flying-commute, foraging on the ground); and
    - Co-ordinates (priority species only).

The aim with drive transects is primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects are primarily aimed at recording small passerines. The primary objective of the transect monitoring is to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities.

- Twelve (12) vantage points (VPs) were identified from which the majority of the proposed development area can be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables are recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny, cloudy, partly cloudy, rain, mist);
    - Temperature (cold, mild, warm, hot);
    - Flight altitude (high i.e. >300 m; medium i.e. 30 m – 300 m; low i.e. <30 m)
    - Flight mode (soar; flap; glide; kite; hover) and
    - Flight time (in 15 second intervals).

Each VP is surveyed for a total of 12 hours per sampling season, with the intention of obtaining a total of 48 hours of sampling effort per VP once all four seasons have been completed. The objective of vantage point counts is to measure the potential collision risk with the turbines.

Three focal points (FP) of bird activity were identified:

- FP1: A large farm dam in a drainage line. This FP is surveyed once during each survey.
- FP2: Southern Bald Ibis colony (26°37'20.82" South, 30°18'36.43" East)
- FP3: Southern Bald Ibis colony (26°38'28.47" South, 30°17'37.67" East)

Nest searches. Dedicated searchers for priority species nests were carried out during each seasonal survey to search for raptor nests in all suitable habitat types.

There is also a large dam at the Control Site which is counted as part of the control drive transect.

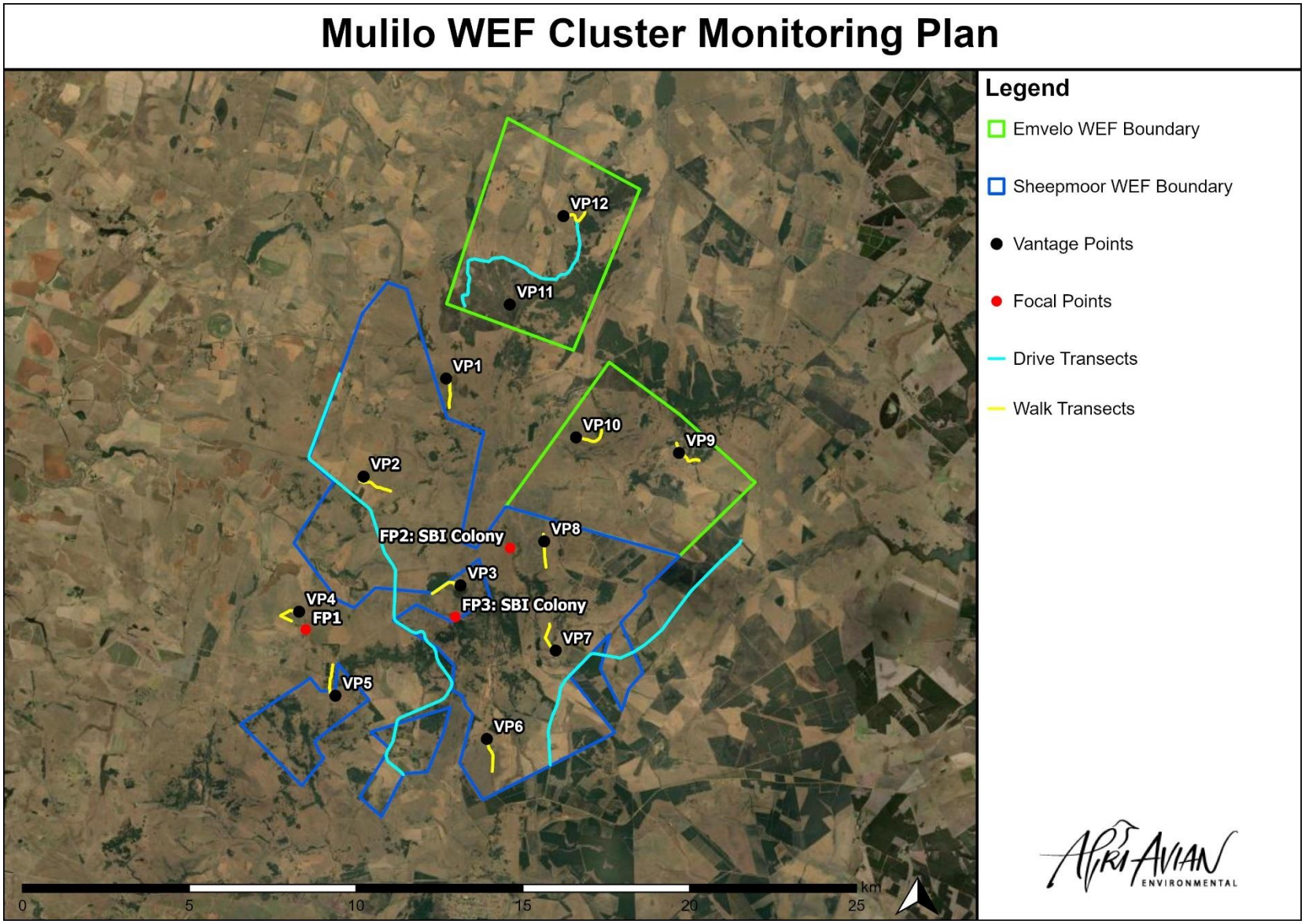


Figure 1: Locations of Focal Points, Vantage Points, Walk Transects and Drive Transects where Pre-Construction Monitoring took place.

APPENDIX 4: BIRD HABITAT



Figure 1: Grassland habitat in the Project Site.



Figure 2: A stand of alien trees in the Project Site.

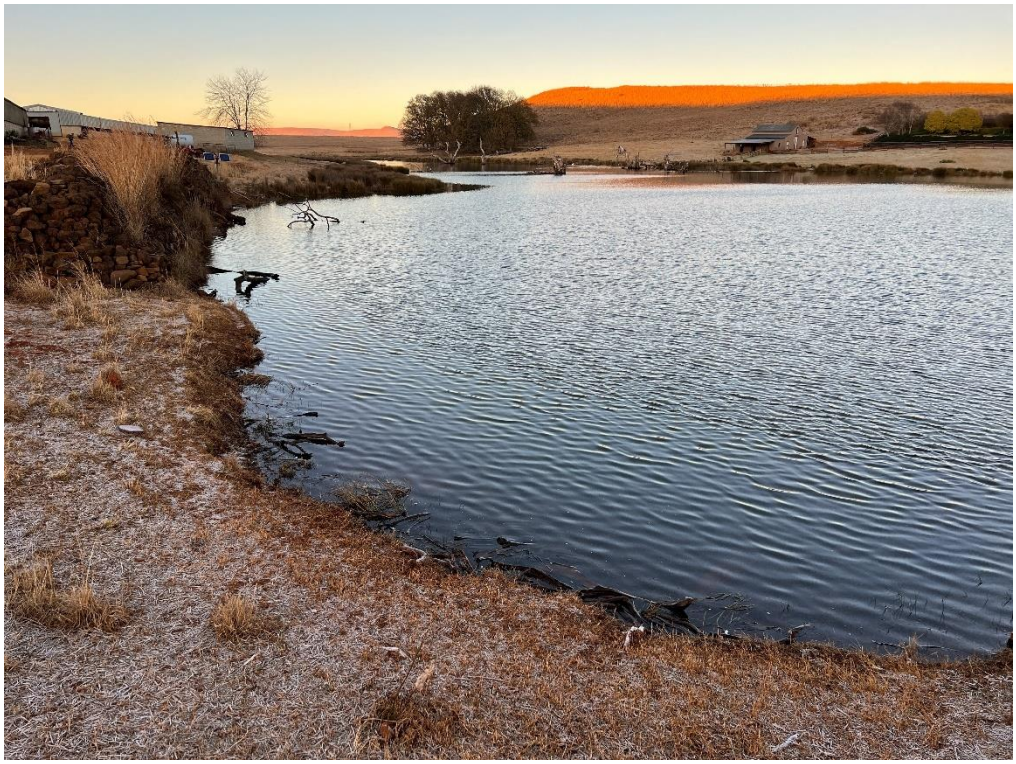


Figure 3: Large dam in the Project Site.



Figure 4: Agriculture in the Project Site.

APPENDIX 5: SABAP2 SPECIES LIST FOR THE BROADER AREA

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
African Black Duck	*Anas sparsa*	4,47	0,00	
African Black Swift	*Apus barbatus*	2,23	0,46	
African Darter	*Anhinga rufa*	14,53	3,21	x
African Dusky Flycatcher	*Muscicapa adusta*	1,12	0,00	
African Firefinch	*Lagonosticta rubricata*	16,20	2,75	x
African Fish Eagle	*Haliaeetus vocifer*	7,26	0,92	x
African Goshawk	*Accipiter tachiro*	0,56	0,00	x
African Harrier-Hawk	*Polyboroides typus*	15,64	2,29	x
African Hoopoe	*Upupa africana*	15,64	1,38	x
African Jacana	*Actophilornis africanus*	2,79	1,38	
African Marsh Harrier	*Circus ranivorus*	4,47	0,46	x
African Olive Pigeon	*Columba arquatrix*	1,12	0,00	x
African Palm Swift	*Cypsiurus parvus*	1,68	0,00	
African Paradise Flycatcher	*Terpsiphone viridis*	13,97	2,75	x
African Pipit	*Anthus cinnamomeus*	77,65	13,30	x
African Rail	*Rallus caerulescens*	6,15	0,46	x
African Reed Warbler	*Acrocephalus baeticatus*	2,23	0,46	
African Sacred Ibis	*Threskiornis aethiopicus*	37,43	5,50	x
African Snipe	*Gallinago nigripennis*	13,41	1,38	x
African Spoonbill	*Platalea alba*	22,91	1,83	x
African Stonechat	*Saxicola torquatus*	87,15	17,89	x
African Swamphen	*Porphyrio madagascariensis*	6,15	2,75	
African Wattled Lapwing	*Vanellus senegallus*	34,08	3,21	x
African Yellow Warbler	*Iduna natalensis*	11,73	1,83	x
Alpine Swift	*Tachymarptis melba*	0,56	0,00	
Amethyst Sunbird	*Chalcomitra amethystina*	19,55	1,83	x
Amur Falcon	*Falco amurensis*	26,26	9,63	x
Ant-eating Chat	*Myrmecocichla formicivora*	91,62	15,60	x
Banded Martin	*Riparia cincta*	56,98	5,50	x
Barn Swallow	*Hirundo rustica*	49,72	11,01	x
Barratt's Warbler	*Bradypterus barratti*	5,59	0,46	x
Bar-throated Apalis	*Apalis thoracica*	16,76	3,21	x
Black Crake	*Zapornia flavirostra*	9,50	0,92	
Black Cuckoo	*Cuculus clamosus*	2,79	0,00	x
Black Harrier	*Circus maurus*	0,00	0,46	

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Black Heron	*Egretta ardesiaca*	0,56	0,00	
Black Saw-wing	*Psalidoprocne pristoptera*	5,03	0,00	x
Black Sparrowhawk	*Accipiter melanoleucus*	15,08	1,38	x
Black-backed Puffback	*Dryoscopus cubla*	1,68	0,00	x
Black-bellied Bustard	*Lissotis melanogaster*	4,47	0,00	x
Black-chested Prinia	*Prinia flavicans*	13,41	1,38	x
Black-chested Snake Eagle	*Circaetus pectoralis*	4,47	0,46	x
Black-collared Barbet	*Lybius torquatus*	13,41	0,00	x
Black-crowned Tchagra	*Tchagra senegalus*	5,59	0,00	x
Black-headed Heron	*Ardea melanocephala*	50,28	2,75	x
Black-headed Oriole	*Oriolus larvatus*	32,96	3,21	x
Black-necked Grebe	*Podiceps nigricollis*	0,56	0,46	
Black-rumped Buttonquail	*Turnix nanus*	2,79	0,00	
Blacksmith Lapwing	*Vanellus armatus*	57,54	8,26	x
Black-throated Canary	*Crithagra atrogularis*	66,48	5,96	x
Black-winged Kite	*Elanus caeruleus*	65,92	14,22	x
Black-winged Lapwing	*Vanellus melanopterus*	21,23	1,38	x
Black-winged Stilt	*Himantopus himantopus*	4,47	0,46	
Blue Crane	*Grus paradisea*	12,85	0,46	x
Blue Korhaan	*Eupodotis caerulescens*	0,56	0,00	
Blue Waxbill	*Uraeginthus angolensis*	6,15	0,92	x
Blue-billed Teal	*Spatula hottentota*	0,56	0,00	
Bokmakierie	*Telophorus zeylonus*	74,30	9,17	x
Bronze Mannikin	*Spermestes cucullata*	0,56	0,92	x
Brown Snake Eagle	*Circaetus cinereus*	2,79	0,00	x
Brown-backed Honeybird	*Prodotiscus regulus*	1,12	0,00	x
Brown-throated Martin	*Riparia paludicola*	46,37	6,42	x
Buff-streaked Chat	*Campicoloides bifasciatus*	7,82	0,00	x
Buffy Pipit	*Anthus vaalensis*	0,00	0,00	x
Bush Blackcap	*Sylvia nigricapillus*	1,68	0,00	x
Cape Batis	*Batis capensis*	4,47	0,00	x
Cape Bunting	*Emberiza capensis*	14,53	0,46	x
Cape Canary	*Serinus canicollis*	82,68	11,93	x
Cape Crow	*Corvus capensis*	12,85	0,00	
Cape Eagle-Owl	*Bubo capensis*	-[11]	-	x

[11] No Reporting Rate as this species was recorded during monitoring only and not through SABAP2.

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Cape Grassbird	*Sphenoeacus afer*	32,40	5,96	x
Cape Longclaw	*Macronyx capensis*	89,94	14,22	x
Cape Robin-Chat	*Cossypha caffra*	70,39	9,63	x
Cape Shoveler	*Spatula smithii*	15,08	0,46	x
Cape Sparrow	*Passer melanurus*	68,72	6,42	x
Cape Starling	*Lamprotornis nitens*	2,79	0,00	
Cape Teal	*Anas capensis*	0,56	0,00	
Cape Turtle Dove	*Streptopelia capicola*	92,18	18,35	x
Cape Vulture	*Gyps coprotheres*	3,35	0,00	x
Cape Wagtail	*Motacilla capensis*	77,10	10,09	x
Cape Weaver	*Ploceus capensis*	42,46	4,13	x
Cape White-eye	*Zosterops virens*	44,13	5,05	x
Capped Wheatear	*Oenanthe pileata*	6,70	0,00	x
Cardinal Woodpecker	*Dendropicos fuscescens*	13,41	1,83	x
Cinnamon-breasted Bunting	*Emberiza tahapisi*	1,12	0,00	x
Cloud Cisticola	*Cisticola textrix*	10,06	0,92	x
Common Buttonquail	*Turnix sylvaticus*	3,35	0,00	
Common Buzzard	*Buteo buteo*	39,11	16,97	x
Common Greenshank	*Tringa nebularia*	5,03	0,00	
Common House Martin	*Delichon urbicum*	6,15	0,00	x
Common Moorhen	*Gallinula chloropus*	29,61	4,13	x
Common Myna	*Acridotheres tristis*	12,29	0,92	
Common Ostrich	*Struthio camelus*	20,67	2,29	x
Common Quail	*Coturnix coturnix*	34,64	4,13	x
Common Sandpiper	*Actitis hypoleucos*	0,56	0,00	
Common Swift	*Apus apus*	1,12	0,00	
Common Waxbill	*Estrilda astrild*	66,48	12,84	x
Crested Barbet	*Trachyphonus vaillantii*	1,68	0,00	x
Crowned Lapwing	*Vanellus coronatus*	53,07	5,50	x
Cuckoo Finch	*Anomalospiza imberbis*	0,56	0,00	
Dark-capped Bulbul	*Pycnonotus tricolor*	68,72	10,55	x
Denham's Bustard	*Neotis denhami*	5,03	0,00	x
Diederik Cuckoo	*Chrysococcyx caprius*	31,28	5,50	x
Drakensberg Prinia	*Prinia hypoxantha*	43,58	5,96	x
Dusky Indigobird	*Vidua funerea*	4,47	0,00	x
Eastern Clapper Lark	*Mirafra fasciolata*	14,53	0,46	x
Eastern Long-billed Lark	*Certhilauda semitorquata*	8,38	1,38	x

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Egyptian Goose	*Alopochen aegyptiaca*	69,27	9,63	x
Emerald-spotted Wood Dove	*Turtur chalcospilos*	0,56	0,00	
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	0,56	0,00	
European Bee-eater	*Merops apiaster*	1,68	0,00	x
Fan-tailed Widowbird	*Euplectes axillaris*	46,37	4,13	x
Fiery-necked Nightjar	*Caprimulgus pectoralis*	1,12	0,00	
Fiscal Flycatcher	*Melaenornis silens*	26,26	2,29	x
Fork-tailed Drongo	*Dicrurus adsimilis*	30,73	1,38	x
Forest Buzzard	*Buteo trizonatus*	-	-	x
Fulvous Whistling Duck	*Dendrocygna bicolor*	0,00	0,46	
Giant Kingfisher	*Megaceryle maxima*	7,82	0,46	x
Glossy Ibis	*Plegadis falcinellus*	4,47	0,92	x
Golden-breasted Bunting	*Emberiza flaviventris*	19,55	0,92	x
Golden-tailed Woodpecker	*Campethera abingoni*	1,12	0,00	x
Goliath Heron	*Ardea goliath*	1,68	0,00	
Great Egret	*Ardea alba*	8,94	1,38	x
Greater Flamingo	*Phoenicopterus roseus*	1,68	0,00	x
Greater Honeyguide	*Indicator indicator*	4,47	0,92	x
Greater Striped Swallow	*Cecropis cucullata*	67,04	13,76	x
Grey Crowned Crane	*Balearica regulorum*	15,64	0,46	x
Grey Heron	*Ardea cinerea*	20,67	1,83	x
Grey-headed Bushshrike	*Malaconotus blanchoti*	1,12	0,00	
Grey-headed Gull	*Chroicocephalus cirrocephalus*	1,12	0,46	
Grey-winged Francolin	*Scleroptila afra*	15,08	0,00	x
Groundscraper Thrush	*Turdus litsitsirupa*	3,91	0,00	
Hadada Ibis	*Bostrychia hagedash*	83,24	12,84	x
Hamerkop	*Scopus umbretta*	16,76	0,46	x
Helmeted Guineafowl	*Numida meleagris*	54,19	3,67	x
Horus Swift	*Apus horus*	1,12	0,00	
House Sparrow	*Passer domesticus*	12,85	0,00	x
Intermediate Egret	*Ardea intermedia*	16,76	1,83	x
Jackal Buzzard	*Buteo rufofuscus*	32,40	8,72	x
Karoo Thrush	*Turdus smithi*	2,79	0,00	x
Kittlitz's Plover	*Charadrius pecuarius*	5,03	0,46	
Klaas's Cuckoo	*Chrysococcyx klaas*	1,12	0,46	x
Kurrichane Thrush	*Turdus libonyana*	17,32	0,92	x
Lanner Falcon	*Falco biarmicus*	12,85	0,46	x

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Laughing Dove	*Spilopelia senegalensis*	35,20	5,05	x
Lazy Cisticola	*Cisticola aberrans*	7,82	0,00	
Lesser Flamingo	*Phoeniconaias minor*	1,12	0,00	
Lesser Honeyguide	*Indicator minor*	1,68	0,00	x
Lesser Moorhen	*Paragallinula angulata*	0,56	0,46	
Lesser Striped Swallow	*Cecropis abyssinica*	2,79	1,38	x
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	8,38	0,46	
Levaillant's Cisticola	*Cisticola tinniens*	84,92	13,76	x
Little Egret	*Egretta garzetta*	1,68	0,92	
Little Grebe	*Tachybaptus ruficollis*	51,96	5,96	x
Little Rush Warbler	*Bradypterus baboecala*	10,06	0,92	x
Little Stint	*Calidris minuta*	1,12	0,00	
Little Swift	*Apus affinis*	10,06	2,75	x
Long-crested Eagle	*Lophaetus occipitalis*	13,97	14,22	x
Long-tailed Widowbird	*Euplectes progne*	82,68	16,06	x
Malachite Kingfisher	*Corythornis cristatus*	12,85	0,92	x
Malachite Sunbird	*Nectarinia famosa*	16,76	0,92	x
Marsh Owl	*Asio capensis*	1,68	0,46	x
Marsh Warbler	*Acrocephalus palustris*	2,23	0,00	x
Martial Eagle	*Polemaetus bellicosus*	5,59	0,00	x
Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*	1,12	0,00	
Mountain Wheatear	*Myrmecocichla monticola*	2,79	0,00	
Namaqua Dove	*Oena capensis*	5,03	0,46	
Natal Spurfowl	*Pternistis natalensis*	6,15	0,92	x
Neddicky	*Cisticola fulvicapilla*	24,02	4,13	x
Nicholson's Pipit	*Anthus nicholsoni*	7,26	0,46	x
Northern Black Korhaan	*Afrotis afraoides*	0,56	0,00	
Olive Bushshrike	*Chlorophoneus olivaceus*	8,38	0,92	x
Olive Thrush	*Turdus olivaceus*	1,68	0,00	x
Orange-breasted Waxbill	*Amandava subflava*	15,64	1,83	x
Pale-crowned Cisticola	*Cisticola cinnamomeus*	30,17	3,21	x
Pied Avocet	*Recurvirostra avosetta*	1,68	0,00	
Pied Crow	*Corvus albus*	11,73	3,67	x
Pied Kingfisher	*Ceryle rudis*	11,73	1,38	x
Pied Starling	*Lamprotornis bicolor*	62,01	12,84	x
Pin-tailed Whydah	*Vidua macroura*	72,07	8,26	x
Plain-backed Pipit	*Anthus leucophrys*	1,12	0,00	

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Purple Heron	*Ardea purpurea*	10,06	0,00	x
Quailfinch	*Ortygospiza atricollis*	57,54	4,59	x
Red-backed Shrike	*Lanius collurio*	2,79	0,46	
Red-billed Quelea	*Quelea quelea*	44,13	5,50	x
Red-billed Teal	*Anas erythrorhyncha*	21,79	2,29	x
Red-capped Lark	*Calandrella cinerea*	59,22	6,42	x
Red-chested Cuckoo	*Cuculus solitarius*	11,73	0,92	x
Red-chested Flufftail	*Sarothrura rufa*	3,91	0,46	x
Red-collared Widowbird	*Euplectes ardens*	31,28	4,13	x
Red-eyed Dove	*Streptopelia semitorquata*	73,18	15,14	x
Red-faced Mousebird	*Urocolius indicus*	0,56	0,00	x
Red-headed Finch	*Amadina erythrocephala*	0,56	0,00	
Red-knobbed Coot	*Fulica cristata*	58,10	8,26	x
Red-throated Wryneck	*Jynx ruficollis*	36,31	3,21	x
Red-winged Francolin	*Scleroptila levaillantii*	32,96	3,67	x
Red-winged Starling	*Onychognathus morio*	5,59	1,83	x
Reed Cormorant	*Microcarbo africanus*	56,98	6,88	x
Rock Dove	*Columba livia*	1,68	0,00	
Rock Kestrel	*Falco rupicolus*	7,26	0,92	
Rock Martin	*Ptyonoprogne fuligula*	8,38	1,38	x
Ruff	*Calidris pugnax*	2,23	0,46	
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	1,68	0,00	x
Rufous-naped Lark	*Mirafra africana*	10,61	1,38	x
Sand Martin	*Riparia riparia*	1,68	0,46	
Secretarybird	*Sagittarius serpentarius*	24,02	2,29	x
Sedge Warbler	*Acrocephalus schoenobaenus*	0,56	0,00	
South African Cliff Swallow	*Petrochelidon spilodera*	37,99	4,13	x
South African Shelduck	*Tadorna cana*	30,73	4,59	x
Southern Bald Ibis	*Geronticus calvus*	26,82	4,13	x
Southern Black Flycatcher	*Melaenornis pammelaina*	2,23	0,00	x
Southern Boubou	*Laniarius ferrugineus*	53,63	5,96	x
Southern Fiscal	*Lanius collaris*	93,85	19,72	x
Southern Grey-headed Sparrow	*Passer diffusus*	74,30	9,17	x
Southern Masked Weaver	*Ploceus velatus*	88,83	12,39	x
Southern Pochard	*Netta erythrophthalma*	3,91	0,00	x
Southern Red Bishop	*Euplectes orix*	86,03	21,10	x
Speckled Mousebird	*Colius striatus*	26,26	0,92	x

Species Name	Scientific Name	SABAP2 Reporting Rate %		Recorded During Monitoring
		Full Protocol	Ad Hoc Protocol	
Speckled Pigeon	*Columba guinea*	54,75	3,21	x
Spike-heeled Lark	*Chersomanes albofasciata*	49,72	5,50	x
Spotted Eagle-Owl	*Bubo africanus*	11,73	1,38	x
Spotted Flycatcher	*Muscicapa striata*	2,79	0,46	
Spotted Thick-knee	*Burhinus capensis*	6,15	0,46	
Spur-winged Goose	*Plectropterus gambensis*	57,54	5,50	x
Squacco Heron	*Ardeola ralloides*	1,12	0,00	
Streaky-headed Seedeater	*Crithagra gularis*	16,76	1,83	x
Swainson's Spurfowl	*Pternistis swainsonii*	63,13	5,05	x
Tawny-flanked Prinia	*Prinia subflava*	6,15	0,46	x
Three-banded Plover	*Charadrius tricollaris*	34,08	2,29	x
Village Weaver	*Ploceus cucullatus*	9,50	0,92	x
Wailing Cisticola	*Cisticola lais*	10,61	0,46	x
Western Barn Owl	*Tyto alba*	5,03	0,92	
Western Cattle Egret	*Bubulcus ibis*	34,08	6,88	x
Western Osprey	*Pandion haliaetus*	0,56	0,00	
Whiskered Tern	*Chlidonias hybrida*	24,58	7,34	x
White Stork	*Ciconia ciconia*	10,61	2,29	x
White-backed Duck	*Thalassornis leuconotus*	5,59	0,46	x
White-bellied Bustard	*Eupodotis senegalensis*	12,29	0,00	x
White-breasted Cormorant	*Phalacrocorax lucidus*	8,94	1,38	x
White-faced Whistling Duck	*Dendrocygna viduata*	1,68	0,00	
White-rumped Swift	*Apus caffer*	36,87	4,13	x
White-throated Swallow	*Hirundo albigularis*	38,55	4,59	x
White-winged Tern	*Chlidonias leucopterus*	5,59	0,00	
Willow Warbler	*Phylloscopus trochilus*	13,97	1,38	x
Wing-snapping Cisticola	*Cisticola ayresii*	62,57	10,55	x
Wire-tailed Swallow	*Hirundo smithii*	0,56	0,00	
Wood Sandpiper	*Tringa glareola*	5,03	0,00	x
Yellow Canary	*Crithagra flaviventris*	11,73	0,92	x
Yellow-billed Duck	*Anas undulata*	60,89	6,88	x
Yellow-billed Kite	*Milvus aegyptius*	3,91	0,46	x
Yellow-breasted Pipit	*Anthus chloris*	1,12	0,00	x
Yellow-crowned Bishop	*Euplectes afer*	44,69	7,34	x
Yellow-fronted Canary	*Crithagra mozambica*	21,23	1,38	x
Yellow-throated Bush Sparrow	*Gymnoris superciliaris*	4,47	0,46	x
Zitting Cisticola	*Cisticola juncidis*	55,87	8,72	x

SPECIES RECORDED DURING PRE-CONSTRUCTION MONITORING

Priority Species Common Name	Scientific Name	Transects WEF Site	Transects Control Site	Focal Points	Vantage Points WEF	VP Control	Incidentals
African Fish Eagle	*Haliaeetus vocifer*						*
African Harrier-Hawk	*Polyboroides typus*	*	*	*	*	*	*
African Marsh Harrier	*Circus ranivorus*				*		*
Amur Falcon	*Falco amurensis*	*	*		*	*	*
Black Sparrowhawk	*Accipiter melanoleucus*	*	*	*	*		*
Black-Bellied Korhaan	*Lissotis melanogaster*	*					
Black-chested Snake Eagle	*Circaetus pectoralis*		*		*	*	
Black-winged Kite	*Elanus caeruleus*	*	*		*	*	*
Black-winged Lapwing	*Vanellus melanopterus*	*			*		*
Blue Crane	*Grus paradisea*	*			*		*
Brown Snake Eagle	*Circaetus cinereus*				*		*
Buff-streaked Chat	*Campicoloides bifasciatus*	*		*	*		*
Cape eagle-owl	*Bubo capensis*			*			
Cape Vulture	*Gyps coprotheres*				*		
Common Buzzard	*Buteo buteo*	*	*		*	*	*
Denham's Bustard	*Neotis denhami*	*		*	*		*
Forest Buzzard	*Buteo trizonatus*						*
Greater Flamingo	*Phoenicopterus roseus*				*		
Grey Crowned Crane	*Balearica regulorum*	*			*		*
Grey-winged Francolin	*Scleroptila afra*	*					*
Jackal Buzzard	*Buteo rufofuscus*	*	*	*	*		*
Lanner Falcon	*Falco biarmicus*	*		*	*		*
Long-crested Eagle	*Lophaetus occipitalis*	*		*	*		*
Marsh Owl	*Asio capensis*						*
Martial Eagle	*Polemaetus bellicosus*				*		*
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*				*		*
Secretarybird	*Sagittarius serpentarius*	*	*		*		*
Southern Bald Ibis	*Geronticus calvus*	*	*	*	*		*
Spotted Eagle-Owl	*Bubo africanus*						*
White Stork	*Ciconia ciconia*	*					*
White-Bellied Korhaan	*Eupodotis senegalensis*	*			*		*
Yellow-breasted Pipit	*Anthus chloris*						*

Non-Priority Species Common Name	Scientific Name	Transects WEF Site	Transects Control Site	Focal Points			
African Darter	*Anhinga rufa*	*	*	*			
African Firefinch	*Lagonosticta rubricata*	*					
African Goshawk	*Accipiter tachiro*			*			
African Hoopoe	*Upupa africana*	*					
African Olive Pigeon	*Columba arquatrix*	*					
African Paradise Flycatcher	*Terpsiphone viridis*	*					
African Pipit	*Anthus cinnamomeus*	*	*	*			
African quail-finch	*Ortygospiza atricollis*	*	*				
African Rail	*Rallus caerulescens*	*					
African Sacred Ibis	*Threskiornis aethiopicus*	*	*	*			
African Snipe	*Gallinago nigripennis*	*		*			
African Spoonbill	*Platalea alba*	*	*	*			
African Stonechat	*Saxicola torquatus*	*	*	*			
African Wattled Lapwing	*Vanellus senegallus*	*					
Amethyst Sunbird	*Chalcomitra amethystina*	*	*				
Ant-eating Chat	*Myrmecocichla formicivora*	*	*				
Banded Martin	*Neophedina cincta*	*	*	*			
Barn Swallow	*Hirundo rustica*	*	*	*			
Barratt's Warbler	*Bradypterus barratti*	*		*			
Bar-throated Apalis	*Apalis thoracica*	*					
Black Cuckoo	*Cuculus clamosus*	*					
Black Saw-wing	*Psalidoprocne pristoptera*	*					
Black-backed Puffback	*Dryoscopus cubla*	*					
Black-chested Prinia	*Prinia flavicans*	*	*	*			
Black-collared Barbet	*Lybius torquatus*		*				
Black-crowned Tchagra	*Tchagra senegalus*	*					
Black-headed Heron	*Ardea melanocephala*	*	*	*			
Black-headed Oriole	*Oriolus larvatus*	*					
Blacksmith Lapwing	*Vanellus armatus*	*	*	*			
Black-throated Canary	*Crithagra atrogularis*	*	*				
Blue Waxbill	*Uraeginthus angolensis*	*					
Bokmakierie	*Telophorus zeylonus*	*	*	*			
Brimstone Canary	*Crithagra sulphurata*	*					
Bronze Mannikin	*Lonchura cucullata*	*					
Brown-backed Honeybird	*Prodotiscus regulus*	*					
Brown-hooded Kingfisher	*Halcyon albiventris*	*					
Brown-throated Martin	*Riparia paludicola*	*	*	*			
Buffy Pipit	*Anthus vaalensis*	*					
Bush Blackcap	*Lioptilus nigricapillus*	*					
Cape Batis	*Batis capensis*	*					

Cape Bunting	*Emberiza capensis*		*				
Cape Canary	*Serinus canicollis*	*	*	*			
Cape Grassbird	*Sphenoeacus afer*	*	*	*			
Cape Longclaw	*Macronyx capensis*	*	*	*			
Cape Robin-Chat	*Cossypha caffra*	*	*	*			
Cape Shoveler	*Anas smithii*		*	*			
Cape Sparrow	*Passer melanurus*	*	*	*			
Cape turtle dove	*Streptopelia capicola*	*	*	*			
Cape Wagtail	*Motacilla capensis*	*	*	*			
Cape Weaver	*Ploceus capensis*	*	*	*			
Cape White-eye	*Zosterops virens*	*	*				
Capped Wheatear	*Oenanthe pileata*	*	*				
Cardinal Woodpecker	*Dendropicos fuscescens*	*	*				
Cinnamon-breasted Bunting	*Emberiza tahapisi*	*	*				
Cloud Cisticola	*Cisticola textrix*	*	*				
Common House Martin	*Delichon urbicum*		*				
Common Moorhen	*Gallinula chloropus*	*		*			
Common Ostrich	*Struthio camelus*	*	*				
Common Quail	*Coturnix coturnix*	*	*				
Common Waxbill	*Estrilda astrild*	*	*	*			
Crested Barbet	*Trachyphonus vaillantii*		*				
Crowned Lapwing	*Vanellus coronatus*	*	*				
Dark-capped Bulbul	*Pycnonotus tricolor*	*	*	*			
Dark-capped Yellow Warbler	*Iduna natalensis*	*					
Desert Cisticola	*Cisticola aridulus*	*					
Diederik Cuckoo	*Chrysococcyx caprius*	*	*	*			
Drakensberg Prinia	*Prinia hypoxantha*	*	*	*			
Dusky Indigobird	*Vidua funerea*	*					
Eastern Clapper Lark	*Mirafra fasciolata*	*	*				
Eastern Long-billed Lark	*Certhilauda semitorquata*	*					
Egyptian Goose	*Alopochen aegyptiaca*	*	*	*			
European Bee-eater	*Merops apiaster*	*					
Fan-tailed Widowbird	*Euplectes axillaris*	*	*				
Fiscal Flycatcher	*Melaenornis silens*	*	*				
Fork-tailed Drongo	*Dicrurus adsimilis*	*	*				
Giant Kingfisher	*Megaceryle maxima*	*		*			
Glossy Ibis	*Plegadis falcinellus*		*				
Golden-breasted Bunting	*Emberiza flaviventris*	*					
Golden-tailed Woodpecker	*Campethera abingoni*	*					
Great Egret	*Ardea alba*	*	*				
Greater Double-collared Sunbird	*Cinnyris afer*	*					
Greater Honeyguide	*Indicator indicator*	*					
Greater Striped Swallow	*Cecropis cucullata*	*	*	*			
Green Wood Hoopoe	*Phoeniculus purpureus*	*					
Grey Heron	*Ardea cinerea*	*	*	*			

Groundscraper Thrush	*Turdus litsitsirupa*	*					
Hadeda	*Bostrychia hagedash*	*	*	*			
Hamerkop	*Scopus umbretta*	*		*			
Helmeted Guineafowl	*Numida meleagris*	*	*	*			
House Sparrow	*Passer domesticus*	*					
Karoo Thrush	*Turdus smithi*	*					
Klaas's Cuckoo	*Chrysococcyx klaas*	*					
Kurrichane Thrush	*Turdus libonyana*	*					
Laughing Dove	*Spilopelia senegalensis*	*	*				
Lesser Honeyguide	*Indicator minor*	*					
Lesser Striped Swallow	*Cecropis abyssinica*		*				
Levaillant's Cisticola	*Cisticola tinniens*	*	*	*			
Little Grebe	*Tachybaptus ruficollis*	*	*	*			
Little Rush Warbler	*Bradypterus baboecala*	*					
Little Swift	*Apus affinis*	*					
Long-tailed Widowbird	*Euplectes progne*	*	*	*			
Malachite Kingfisher	*Corythornis cristatus*	*		*			
Malachite Sunbird	*Nectarinia famosa*	*	*	*			
Marsh Warbler	*Acrocephalus palustris*	*					
Namaqua Dove	*Oena capensis*	*					
Natal Spurfowl	*Pternistis natalensis*	*					
Neddicky	*Cisticola fulvicapilla*	*					
Nicholson's Pipit	*Anthus nicholsoni*	*	*				
Olive Bushshrike	*Chlorophoneus olivaceus*	*					
Olive Thrush	*Turdus olivaceus*	*					
Orange-breasted Waxbill	*Amandava subflava*	*					
Pale-crowned Cisticola	*Cisticola cinnamomeus*	*	*				
Pied Crow	*Corvus albus*	*					
Pied Kingfisher	*Ceryle rudis*	*		*			
Pied Starling	*Lamprotornis bicolor*	*	*	*			
Pin-tailed Whydah	*Vidua macroura*	*	*	*			
Plain-backed Pipit	*Anthus leucophrys*	*					
Purple Heron	*Ardea purpurea*	*					
Red-billed Quelea	*Quelea quelea*	*	*				
Red-billed Teal	*Anas erythrorhyncha*	*	*	*			
Red-capped Lark	*Calandrella cinerea*	*	*				
Red-chested Cuckoo	*Cuculus solitarius*	*		*			
Red-chested Flufftail	*Sarothrura rufa*	*					
Red-collared Widowbird	*Euplectes ardens*	*	*	*			
Red-eyed Dove	*Streptopelia semitorquata*	*	*	*			
Red-faced Mousebird	*Urocolius indicus*	*	*				
Red-knobbed Coot	*Fulica cristata*	*	*	*			
Red-throated Wryneck	*Jynx ruficollis*	*	*	*			
Red-winged Francolin	*Scleroptila levaillantii*	*	*				
Red-winged Starling	*Onychognathus morio*	*		*			

Reed Cormorant	*Microcarbo africanus*	*	*	*			
Rock Kestrel	*Falco rupicolus*	*					
Rock Martin	*Ptyonoprogne fuligula*	*					
Rufous-naped Lark	*Mirafra africana*	*					
South African Cliff Swallow	*Petrochelidon spilodera*	*	*				
South African Shelduck	*Tadorna cana*	*	*	*			
Southern Black Flycatcher	*Melaenornis pammelaina*	*					
Southern Boubou	*Laniarius ferrugineus*	*	*				
Southern Fiscal	*Lanius collaris*	*	*	*			
Southern Grey-headed Sparrow	*Passer diffusus*	*	*	*			
Southern Masked Weaver	*Ploceus velatus*	*	*	*			
Southern Pochard	*Netta erythrophthalma*		*				
Southern Red Bishop	*Euplectes orix*	*	*	*			
Speckled Mousebird	*Colius striatus*	*	*				
Speckled Pigeon	*Columba guinea*	*	*	*			
Spike-heeled Lark	*Chersomanes albofasciata*	*	*				
Spur-winged Goose	*Plectropterus gambensis*	*	*	*			
Streaky-headed Seedeater	*Crithagra gularis*	*					
Swainson's Spurfowl	*Pternistis swainsonii*	*	*	*			
Swee Waxbill	*Coccopygia melanotis*	*					
Tawny-flanked Prinia	*Prinia subflava*	*					
Three-banded Plover	*Charadrius tricollaris*	*		*			
Village Weaver	*Ploceus cucullatus*	*					
Wailing Cisticola	*Cisticola lais*	*	*				
Western Cattle Egret	*Bubulcus ibis*	*	*	*			
Whiskered Tern	*Chlidonias hybrida*	*	*	*			
White-backed Duck	*Thalassornis leuconotus*		*				
White-breasted Cormorant	*Phalacrocorax lucidus*		*				
White-rumped Swift	*Apus caffer*	*	*	*			
White-throated Swallow	*Hirundo albigularis*	*	*				
White-winged Widowbird	*Euplectes albonotatus*	*	*				
Willow Warbler	*Phylloscopus trochilus*	*	*				
Wing-snapping Cisticola	*Cisticola ayresii*	*	*	*			
Wood Sandpiper	*Tringa glareola*	*					
Yellow Bishop	*Euplectes capensis*	*	*				
Yellow Canary	*Crithagra flaviventris*		*				
Yellow-billed Duck	*Anas undulata*	*	*	*			
Yellow-Billed Egret	*Ardea intermedia*	*	*				
Yellow-billed Kite	*Milvus aegyptius*	*					
Yellow-crowned Bishop	*Euplectes afer*	*	*	*			
Yellow-fronted Canary	*Crithagra mozambica*	*					
Yellow-Throated Petronia	*Gymnoris superciliaris*	*					
Zitting Cisticola	*Cisticola juncidis*	*	*	*			
173		161	101	68			

APPENDIX 6: ASSESSMENT CRITERIA

Where significant environmental aspects are present, significant environmental impacts ***may*** result. The significance of the impacts associated with the significant aspects can be determined by considering the risk:

Significance of Environmental Impact (Risk) = Probability x Consequence

The consequence of impacts can be described by considering the severity, spatial extent, and duration of the impact.

1 Severity of Impacts

Table 1-1 presents the ranking criteria that were used to determine the severity of impacts on priority species.

Table 1: Criteria for ranking the *Severity* of negative impacts on priority species

Environment	**Ranking Criteria**		
	Low (L-)	**Medium (M-)**	**High (H-)**
Ecology (Plant and animal life)	Disturbance of areas that are degraded, have little conservation value. Minor change in species variety or prevalence.	Disturbance of areas that have some conservation value. Complete change in species variety or prevalence.	Disturbance of areas that are pristine, have conservation value. Destruction of rare or endangered species.

2 Spatial Extent and Duration of Impacts

The duration and spatial scale of impacts were ranked using the criteria in Table 2 below:

Table 2: Ranking the *Duration* and *Spatial Scale* of impacts

	Ranking Criteria		
	L	**M**	**H**
Duration	Quickly reversible Less than the project life Short-term	Reversible over time/life of the project Medium-term	Permanent Beyond closure Long-term
Spatial Scale	Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/national

3 Consequence of Impacts

Having ranked the severity, duration and spatial extent, the overall consequence of impacts was determined using the guidelines in Table 3 below.

Table 3: Ranking the *Consequence* of an impact

			SEVERITY = L		
DURATION	Long-term	**H**			
	Medium-term	**M**			**MEDIUM**
	Short-term	**L**	**LOW**		
			SEVERITY = M		
DURATION	Long-term	**H**			**HIGH**
	Medium-term	**M**		**MEDIUM**	
	Short-term	**L**	**LOW**		
			SEVERITY = H		
DURATION	Long-term	**H**			
	Medium-term	**M**			**HIGH**
	Short-term	**L**	**MEDIUM**		
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/national
			SPATIAL		

4 Overall Significance of Impacts

Combining the consequence of the impact and the probability of occurrence, as shown by Table 4, provided the overall significance (risk) of impacts.

Table 4: Ranking the *Overall Significance* of impacts

PROBABILITY	Definite Continuous	**H**	**MEDIUM**		**HIGH**
	Possible Frequent	**M**		**MEDIUM**	
	Unlikely Seldom	**L**	**LOW**		**MEDIUM**
			L	**M**	**H**
			CONSEQUENCE (from Table 3)		

The overall significance ranking of the negative environmental impacts provides the guidelines in Table 5 for decision making.

Table 5: Guidelines for decision-making

Overall Significance Ranking	**Nature of Impact**	**Decision Guideline**
High	Unacceptable impacts.	Likely to be a fatal flaw.
Medium	Noticeable impact.	These are unavoidable consequence, which will need to be accepted if the project
Low	Minor impacts.	These impacts are not likely to affect the project decision.

APPENDIX 7: ENVIRONMENTAL MANAGEMENT PLAN FOR THE WEF

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE TURBINES					
Mortality of priority avifauna due to collisions with the wind turbines	Prevent mortality of priority avifauna	The results of the pre-construction monitoring must guide the layout of the turbines, especially as far as the identified Turbine Exclusion Zones are concerned. No turbines must be constructed in the buffer zones which were identified based on the results of the Collision Risk Modelling using pre-construction monitoring, with a specific view to limiting the risk of collisions to a variety of birds, including several Red Data species. **No WEF infrastructure to be placed in All Infrastructure Exclusion Zones** (No-Go Zones) as indicated in Section 6.5 of this report. **No turbines (including the rotor swept area) should be located in the Turbine Exclusion Zones** as indicated in Section 6.5 of this report. **All authorised wind turbines** must have at least **one blade painted according to a CAA approved pattern** to reduce the risk of raptor	1. Avoid All Infrastructure Exclusion Zones as indicated in Section 6.5 of this report. 2. No turbines (including the rotor swept area) should be located in the Turbine Exclusion Zones as indicated in Section 6.5 of this report. 3. Design the facility with buffers around drainage lines as per the Aquatic Specialist Assessment undertaken for this facility, and 110 m buffers around wetland no-go zones. 4. Implement the modelled high risk turbine exclusion zone around the Martial Eagle nest and roost.	Once-off during the planning phase.	Project Developer

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		collisions (Blade Patterning Guidelines 2024). See Appendix 12 of this report.			
AVIFAUNA: MORTALITY DUE TO ELECTROCUTION ON 33 kV NETWORK					
Electrocution of raptors on the internal 33 kV poles	Prevent electrocutions	1. Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due technical (not financial) constraints. 2. Where the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted to ensure that a bird-friendly pylon design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g. insulation of live components to prevent electrocutions on terminal structures and pole transformers.	1. Design the facility with underground cabling. 2. Consult with Avifaunal Specialist during the design phase of the overhead lines.	Once-off during the planning phase.	Project Developer

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of priority avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations of the terrestrial biodiversity including animal and plant species specialist studies must be strictly implemented pertaining to the limitation and rehabilitation of the development footprint. 6. No construction activities within 2.5 km of the Martial Eagle nest (coordinates on request) should	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Repor and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		take place in the period March to December, which is the breeding season for these eagles.	site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
AVIFAUNA: DISPLACEMENT DUE TO HABITAT TRANSFORMATION					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the wind turbines and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	1. Removal of indigenous vegetation must be restricted to a minimum within the approved development footprint and must be rehabilitated to its former state where possible after construction. 2. Eradication and effective control of alien invasive species must be undertaken according to the approved Alien Invasive Plant Species Management Plan during all phases of the proposed development.	1. As indicated 2. Implement Alien Invasive Plant Species Management Plan 3. As indicated 4. Appointment of rehabilitation specialist to develop Habitat Restoration Plan (HRP). 5. Site inspections to monitor	1. Once-off 2. To be implemented during all phases of the Project	1. Operations Manager 2. SHE Manager 3. SHE Manager 4. Operations Manager

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		3. Should agricultural activities continue during WEF operations, proper grazing management systems should be implemented to prevent overgrazing, limit trampling and improve soil condition of grassland and wetland habitats across the project site. Controlled burns or prescribed fires are essential in managing grassland and wetland biodiversity and ecosystem health and should be implemented during WEF operations according to an approved Fire Management Plan. 4. Develop a Habitat Restoration Plan (HRP) and ensure that it is approved. 5. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance. 6. Vehicle and pedestrian access to the site should be controlled and restricted to the facility footprint as much as possible to prevent unnecessary destruction of vegetation.	progress of HRP.		
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH 33 KV NETOWORK					

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Mortality of avifauna due to collisions with the 33 kV OHL.	Reduction of avian collision mortality	1. Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due technical (not financial) constraints. 2. Bird flight diverters should be installed on all 33 kV overhead lines on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds, respectively. These devices must be installed as soon as the conductors are strung. Design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings.	Fit Eskom approved Bird Flight Diverters on the earthwire at the demarcated sections of the OHL.	Once-off	Contractor

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE WIND TURBINES					
Bird collisions with the wind turbines	Prevention of collision mortality on the wind turbines.	1. No turbines (including the rotor swept area) should be located in Turbine Exclusion Zones as indicated in Section 6.5 and Figure 35 of this report. 2. Diurnal and nocturnal Automated Shut Down on Demand (SDoD) (camera and radar) to accommodate low light conditions and night flying species, with Observer-led SDoD as additional mitigation, as well as diurnal proactive curtailment based on environmental and weather conditions conducive to bird flight activity must be fully implemented on all authorised wind turbines located in both 'high risk zones' and 'medium risk zones' throughout the lifespan of the proposed WEF. Analysis of Martial Eagle tracking data has revealed strong correlations between flight activity and variables such as time of day, wind speed, and temperature. These correlations will be	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. Design and implement mitigation measures if mortality thresholds are exceeded. 4. Additional mitigation measures, when required during operations, must be implemented timeously in accordance with the practicality and associated ease of implementation. All revised mitigation measures should be implemented within a time period	1. Once-off 2. Yearly, for the operational lifetime of the WEF.	1. Operations Manager 2. Operations Manager 3. Operations Manager 4. Operations Manager

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		further refined prior to the WEF becoming operational – also see Section 5.8.7.1 for more information. 3. SDoD and radar technology must be in operation at the onset of commercial operation date (COD). 4. SDoD success must be monitored throughout the lifetime of the WEF, where monitoring data during operation will continuously inform the SDoD needs for each turbine. 5. The SDoD programme must be developed and included in the approved EMPr, post-EA (should such EA be granted) during the detailed design phase prior to construction. Specific details of the SDoD programme will be included in a comprehensive Biodiversity Management Plan (BMP) which will be developed and implemented prior to the commercial operational date of the WEF. 6. Sensitive Species 23: All wind turbines located within the modelled medium risk zone traversing Species 23 habitat	of maximum six (6) months. 5. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures. 6. Annual independent audits of the WEF including operational phase EMPr compliance and implementation of the Avifaunal Biodiversity Management Plan must be undertaken by an Environmental Control Officer (ECO) during the operational phase throughout the lifespan of the facility. It is advisable that the operational phase EMPr, specifically		

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		connectivity corridors (see Section 6.5 and Figure 32) must implement dynamic, real-time nocturnal curtailment i.e., from dawn to dusk for the duration of the summer season. The following turbines at each facility are affected: WTGs 5, 13, 15, 19, 20, 23 and 25. 7. Dynamic real-time habitat mapping and assessment for the species will need to be conducted every 7-14 days (semi-monthly) from October onward, using the latest satellite imagery, supplemented with on-site weather station rainfall and soil moisture data. This near real-time, dynamic modelling will generate a habitat suitability index by integrating rainfall (water levels), wetland saturation, and vegetation state. Vegetation state will consider both structural components influenced by grazing and burning, as well as seasonal productivity measured through remotely sensed habitat suitability time-series analysis. Note that the	the mitigation actions included in the Avifaunal Biodiversity Management Plan should be reviewed at least every five years. Stakeholders should be provided an opportunity to provide input into any changes.		

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		satellite imagery is updated weekly, therefore the frequency of checking these datasets cannot be increased; however, the proposed mitigation strategy prescribes the onsite implementing of hydrometric equipment that would measure the ambient conditions (such as soil moisture, temperature, etc.) on an hourly basis. Therefore, changes in the local weather parameters will be detected much more frequently than at a 7-14 day interval. Also, wetland monitoring at the onset of spring / summer will be conducted more frequently, and regional rainfall patterns will also be monitored in order to determine when conditions become or are likely to become suitable for the species. Structural assessments will be conducted using drone-derived Digital Terrain Model (DTMs), while productivity trends will be monitored across the growing season to capture phenological and productivity changes. When			

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		the dynamic habitat suitability index indicates favourable habitat conditions following the onset of late spring-early summer (October) rainfall, wind turbines located in the medium risk mitigation zone must be curtailed at night (from dusk until dawn) for the duration of the summer season. Habitat condition thresholds (favourable/unfavourable) derived from the dynamic habitat suitability index has been calibrated using observed species presence-absence datasets. This habitat condition tracking tool can be deployed in near real time and will issue notifications to the designated avifaunal specialist if favourable conditions are triggered via an online webapp. 8. Live-bird monitoring and carcass searches should be implemented in the operational phase to assess collision rates, as per the most recent edition of the Best Practice Guidelines at the time			

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		(Jenkins et al. 2015). Given the sensitivity of the site, live-bird monitoring should be conducted for at least the first 5 years of operation and be reassessed thereafter to determine the continued frequency of such monitoring as informed by a site-specific Biodiversity Management Plan. Carcass searches must be conducted annually for the lifespan of the facility to assess collision rates. 9. All authorised wind turbines must have at least one blade painted according to a CAA approved pattern to reduce the risk of raptor collisions (Blade Patterning Guidelines 2024). See Appendix 12. 10. Fatality thresholds must be monitored on an annual basis for the lifespan of the WEF. The ratio of predicted annual fatalities (based on Collision Risk Modelling (CRM) values that take the effectiveness of avoidance and mitigation measures into account) to allowable Potential Biological Removals (PBR) is expressed as a percentage annual			

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		fatality threshold for each priority species per site, which serves as a practical trigger for additional mitigation. If operational monitoring indicates that annual fatalities are approaching or exceeding PBR-based thresholds, this will trigger an immediate review and escalation of mitigation measures, such as extending curtailment periods or adjusting SDOD protocols. This framework ensures that mitigation is responsive, data-informed, and conservation-aligned, with threshold exceedance serving as a clear and proactive management trigger. 11. Additional mitigation measures, when required during operations, must be implemented timeously in accordance with the practicality and associated ease of implementation. All revised mitigation measures should be implemented within a time period of maximum six (6) months.			

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE ASSOCIATED WITH THE DISMANTLING ACTIVITIES					
The noise and movement associated with the de-commissioning activities at the WEF footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the EMPr.	A site-specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction. The EMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			5. Ensure that the footprint area is demarcated and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		

APPENDIX 8: ENVIRONMENTAL MANAGEMENT PLAN FOR THE GRID CONNECTION

Management Plan for the Planning and Design Phase Grid Connection

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
None					

Management Plan for the Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads, where possible; 3. Measures to control noise and dust according to latest best practice;	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
AVIFAUNA: MORTALITY DUE TO COLLISION WITH THE 132KV OHL					
Mortality of avifauna due to collisions with the 132 kV OHL.	Reduction of avian collision mortality	The entire OHL to be marked with Eskom approved Bird Flight Diverters (BFDs). Design specification should conform to types of devices that will be visible at night e.g. LED type bird flight diverters, especially in high-risk areas such as wetlands, watercourse and drainage line crossings.	1. Fit Eskom approved Bird Flight Diverters on the earthwire of the OHL.	1. Once-off	1. Contractor and ECO

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO HABITAT TRANSFORMATION IN THE SUBSTATION COMPLEX					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented where possible by an appropriately qualified rehabilitation specialist, according	1. Develop an Alien Vegetation Management Plan (AVMP), a Fire Management Plan (FMP) and a Habitat Restoration Plan (HRP) and ensure that these are approved.	1. Appointment of an ecological/botanical and rehabilitation specialist to develop the AVMP, FMP and HRP.	1. Once-off 2. Once a year 3. As and when required	5. Facility Operator

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
clearance in the onsite substations.	to the recommendations of the botanical specialist study.	2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.	2. Site inspections to monitor progress of the AVMP, FMP and HRP. 3. Adaptive management to ensure the AVMP, FMP and HRP goals are met.		
AVIFAUNA: MORTALITY OF AVIFAUNA DUE TO COLLISION WITH THE 132KV OHL					
Mortality of avifauna due to collisions with the 132 kV OHL.	Reduction of avian collision mortality	1. Monitor the collision mortality on the OHL. 2. Apply additional BFDs if collision hotspots are discovered.	1. Avifaunal specialist to conduct quarterly inspections of the OHL for a period of two years. 2. Apply additional BFDs if collision hotspots are discovered.	1. Quarterly 2. As and when required	1. Facility operator
AVIFAUNA: MORTALITY OF AVIFAUNA DUE TO ELECTROCUTION ON THE GRID INFRASTRUCTURE					
Mortality of avifauna due to electrocutions in the substation complex	Reduction of avian electrocution mortality	1. A bird-friendly pylon design should be used. 2. Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles is recommended. 3. Monitor the electrocution mortality in the substations. 4. Apply mitigation if any Species of Conservation Concern are electrocuted.	1. The construction of a single circuit powerline using the approved bird-friendly pole/tower design D-DT-7649 in accordance with the Distribution Technical Bulletin titled Refurbishment of 66/88 kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467 will eliminate the	1. Once-off 2. Weekly	1. Contractor 2. Facility operator

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			electrocution risk. The configuration of the insulators and the clearance distances between the live and earthed components on this structure can comfortably accommodate a perching vulture. However, if the OHL will be built on lattice structures, it is imperative that there is a minimum clearance of 1.8 m between the jumper cables and/or insulators and the horizontal earthed component on the lattice structure. 2. Regular inspections of the substation yard		

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE					

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
The noise and movement associated with the decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Decommissioning EMPr.	A site-specific Decommissioning EMPr (EMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during decommissioning. The EMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property; 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	1. Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance 2. Ensure that decommissioning personne are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

APPENDIX 9: OPERATIONAL MONITORING PLAN WEF

1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed WEF must be conducted in accordance with the latest version (2015) of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* (Jenkins *et al*. 2011)[12].

2 AIM OF POST-CONSTRUCTION MONITORING

The avifaunal post construction monitoring aims to assess the impact of the WEF by comparing pre- and post-construction monitoring data and to measure the extent of bird fatalities caused by the WEF. Post-construction monitoring is therefore necessary to:

- Confirm as far as possible what the actual impacts of the WEF are on avifauna; and
- Determine what mitigation is required if need be (adaptive management).

The proposed post-construction monitoring can be divided into three categories:

- Habitat classification;
- Quantifying bird numbers and movements (replicating baseline pre-construction monitoring)
- Quantifying bird mortalities.

Post-construction monitoring will aim to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- How many birds collide with the turbines? And are there any patterns to this?
- What mitigation is necessary to reduce the impacts on avifauna?

3 TIMING

Post-construction monitoring should commence as soon as possible after the first turbines become operational to ensure that the immediate effects of the facility on resident and passing birds are recorded, before they have time to adjust or habituate to the development. However, it should be borne in mind that it is also important to obtain an understanding of the impacts of the facility as they would be over the lifespan of the facility. Over time the habitat within the WEF may change, birds may become habituated to or learn to avoid the facility. It is therefore necessary to monitor over a longer period than just an initial one year.

4 DURATION

Monitoring should take place in Year 1 and 2 of the operational phase and then repeated in Year 5 and every five years after that. After the first year of monitoring, the programme should be reviewed in order to incorporate

[12] Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

significant findings that have emerged. This may entail the revision of the number of turbines to be searched, and the size of the search plots, depending on the outcome of the first year of monitoring. If significant impacts are observed, i.e. exceeding predetermined thresholds, and mitigation is required, the matter should be taken up with the operator to discuss potential mitigation. In such instances the scope of monitoring could be reduced to focus only on the impacts of concern.

5 HABITAT CLASSIFICATION

Any observed changes in bird numbers and movements at a WEF may be linked to changes in the available habitat. The avian habitats available must be mapped at least once a year (at the same time every year), using the same methods which were used during pre-construction.

6 BIRD NUMBERS AND MOVEMENTS

In order to determine if there are any impacts relating to displacement and/or disturbance, all methods used to estimate bird numbers and movements during baseline monitoring must be applied as far as is practically possible in the same way to post-construction work in order to ensure maximum comparability of these two data sets. This includes sample counts of small terrestrial species, counts of large terrestrial species and raptors, focal site surveys and vantage point surveys according to the current best practice.

7 COLLISIONS

The collision monitoring must have three components:

- Experimental assessment of search efficiency and scavenging rates of bird carcasses on the site.
- Regular searches in the immediate vicinity of the wind farm turbines for collision casualties.
- Estimation of collision rates.

Live-bird monitoring and carcass searches should be implemented in the operational phase to assess collision rates, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins et al. 2015). Given the sensitivity of the site, live-bird monitoring should be conducted annually for at least the first 5 years of operation and be reassessed thereafter to determine the continued frequency of such monitoring as informed by a site-specific Biodiversity Management Plan. In addition, carcass searches should be tailored to detect fatalities for Sensitive Species 23 and other small species (e.g., Yellow-breasted Pipit) in addition to large birds, and should also be designed to detect displacement, disturbance, and habitat alteration for priority species. Furthermore, carcass searches must be conducted annually for the lifespan of the facility to assess and evaluate SDoD and curtailment effectiveness.

8 SEARCHER EFFICIENCY AND SCAVENGER REMOVAL

The value of surveying the area for collision victims is only valid if some measure of the accuracy of the survey method is developed. The probability of a carcass being detected and the rate of removal/decay of the carcass must be accounted for when estimating collision rates and when designing the monitoring protocol. This must be done in the form of searcher and scavenger trails at least twice a year.

9 COLLISION VICTIM SURVEYS

9.1 Aligning search protocols

The search protocol must be agreed upon between the bat and bird specialists to constitute an acceptable compromise between the current best practice guidelines for bird and bat monitoring.

Searches must begin as early in the mornings as possible to reduce carcass removal by scavengers. A carcass searcher must walk in straight line transects, 6 m apart, covering 3 m on each side. A team of searchers and one supervisor must be trained to implement the carcass searches. The searchers must have a vehicle available for transport per site. The supervisor must assist with the collation of the data at each site and to provide the data to the specialist in electronic format on a weekly basis. The specialists must ensure that the supervisor is completely familiar with all the procedures concerning the management of the data. The following must be sent to the specialist on a weekly basis:

- Carcass fatality data (hardcopy and scans as well as data entered into Excel spreadsheets);
- Pictures of any carcasses, properly labelled;
- GPS tracks of the search plots walked; and
- Turbine search interval spreadsheets.

When a carcass is found, it must be bagged, labelled, and kept refrigerated for species confirmation when the specialist visits the site.

9.2 Estimation of collision rates

Observed mortality rates need to be adjusted to account for searcher efficiency and scavenger removal. There have been many different formulas proposed to estimate mortality rates. The available methodologies must be investigated, and an appropriate method will be applied. The current method which is used widely is the GenEst method.

10 DELIVERABLES

10.1 Annual audits

Annual independent audits of the WEF including operational phase EMPr compliance and implementation of the Avifaunal Biodiversity Management Plan must be undertaken by an Environmental Control Officer (ECO) during the operational phase throughout the lifespan of the facility. It is advisable that the operational phase EMPr, specifically the mitigation actions included in the Avifaunal Biodiversity Management Plan should be reviewed annually. Stakeholders should be provided an opportunity to provide input into any changes.

10.2 Annual report

An operational monitoring report must be completed at the end of each year of operational monitoring for the lifespan of the WEF. As a minimum, the report must attempt to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number birds and species composition changed?
- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- What are the likely drivers of any changes observed?
- How many, and which species of birds collided with the turbines and
- associated infrastructure? And are there any patterns to this?
- What is the significance of any impacts observed?
- What mitigation measures are required to reduce the impacts?

10.3 Quarterly reports

Concise quarterly monitoring reports with basic statistics and any issues that need to be addressed must be made publicly available and be shared with all relevant authorities and NGO's such as BirdLife South Africa (BLSA) and the Endangered Wildlife Trust (EWT) during the operational phase throughout the lifespan of the WEF.

APPENDIX 10: SITE SENSITIVITY VERIFICATION WEF

RECONNAISSANCE REPORT
(IN TERMS OF PART B OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

INTRODUCTION

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a reconnaissance visit has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

SITE SENSITIVITY VERIFICATION

The following methods and sources were used to compile this report:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), to ascertain which species occur within the **Broader Area** i.e. within a block consisting of 12 pentads. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 9 km. From 2007 to date, a total of 179 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 218 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2022.2) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF project site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2023) was used in order to view the Broader Area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind energy developments were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the WEF and Grid project site.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of a pre-construction programme conducted over four seasons (2022–2023) at the proposed Mulilo WEF Cluster (Emvelo WEF and Sheepmoor WEF project sites). The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **Appendix 3** for a detailed explanation of the monitoring methods).
- Information gained from pre-construction monitoring at four potential wind farm sites in close proximity to the current site, namely Ujekamanzi WEFs 1–2 and Camden WEFs 1–2 also assisted in providing a

comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.

OUTCOME OF SITE RECONNAISSANCE

The WEF Project Site is situated in the Grassland Biome, in the Mesic Highveld Grassland Bioregion (Mucina & Rutherford 2006). The proposed site is comprised of undulating grassland plains, with small, scattered patches of dolerite outcrops in areas, low hills, pan depressions and drainage lines with associated wetland areas. Vegetation on site consists predominantly of Wakkerstroom Montane Grassland and Eastern Highveld Grassland. Wakkerstroom Montane Grassland comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* (ouhout) thickets occurring along steep, mainly east-facing slopes, and drainage areas (Mucina & Rutherford 2006). Eastern Highveld Grassland vegetation is comprised of a short, closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn (Mucina & Rutherford 2006). The black wattle *Acacia mearnsii* is an aggressive invader of riparian areas. Stands of alien *Eucalyptus* and *Pinus* species are scattered throughout the proposed development area.

Ermelo has a temperate climate. January is the warmest month with a maximum temperature of 24.4 C°. June and July are the coldest months, with a minimum temperature of 0.2 C°. The driest month is June with an average of 3 mm of precipitation. Most of the precipitation falls in December, averaging 151 mm. The average annual precipitation is around 756 mm (Climate – data.org 2021). The topography in the project area is characterised by gentle undulating plains. The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. The livestock in the study area is a combination of mostly sheep and cattle, with a few horses.

Fourteen (14) wind energy development priority SCC have been recorded during the on-site field surveys. The recorded species are listed in the table below (NT = Near Threatened, VU = Vulnerable, EN = Endangered):

Species name	Scientific name	Global Conservation Status	Regional Conservation Status
African Grass Owl	*Tyto capensis*	-	VU
African Marsh Harrier	*Circus ranivorus*	-	EN
Blue Crane	*Grus paradisea*	VU	NT
Cape Vulture	*Gyps coprotheres*	VU	EN
Denham's Bustard	*Neotis denhami*	NT	VU
Greater Flamingo	*Phoenicopterus roseus*	-	NT
Grey Crowned Crane	*Balearica regulorum*	EN	EN
Lanner Falcon	*Falco biarmicus*	-	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Secretarybird	*Sagittarius serpentarius*	EN	VU
Sensitive Species 23	*n/a*	CR	CR
Southern Bald Ibis	*Geronticus calvus*	VU	VU
White-bellied Bustard	*Eupodotis senegalensis*	-	VU
Yellow-breasted Pipit	*Anthus chloris*	VU	VU

NATIONAL ENVIRONMENTAL SCREENING TOOL

The WEF Project Site and immediate environment is classified as **Medium** and **High Sensitivity** for bird species according to the Animal Species Theme (**Figure 1**). The Medium and/or High sensitivity classification is linked to the potential occurrence of Denham's Bustard *Neotis denhami* (Globally Near-Threatened and Regionally Vulnerable), Secretarybird *Sagittarius serpentarius* (Globally Endangered and Regionally Vulnerable), Southern Bald Ibis *Geronticus calvus* (Globally and Regionally Vulnerable), African Grass Owl *Tyto capensis* (Regionally Vulnerable), Grey-crowned Crane *Balearica regulorum* (Globally and Regionally Endangered), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable).

The Project Site contains confirmed habitat for Species of Conservation Concern (SCC), primarily for Yellow-breasted Pipit and Southern Bald Ibis, 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, GN 1150 of 30 October 2020.

The WEF Project Site and immediate environment is classified as Medium Sensitivity for vultures according to the Vulture Species Theme (**Figure 2**). The Medium sensitivity is due the Project Site possibly affecting an area with between 5%–10% of the vulture population, according to the Screening Tool. During the pre-construction monitoring 48 minutes of Cape Vulture flights were recorded at medium height (i.e. within rotor-swept height). The passage rate for Cape Vultures after 756 hours of monitoring was 0.06 birds per day which amounts to about one Cape Vulture every two weeks. According to the Cervantes Population Utilization Distribution outputs the Emvelo WEF Project Site is rated low sensitivity (Cervantes et al 2023).

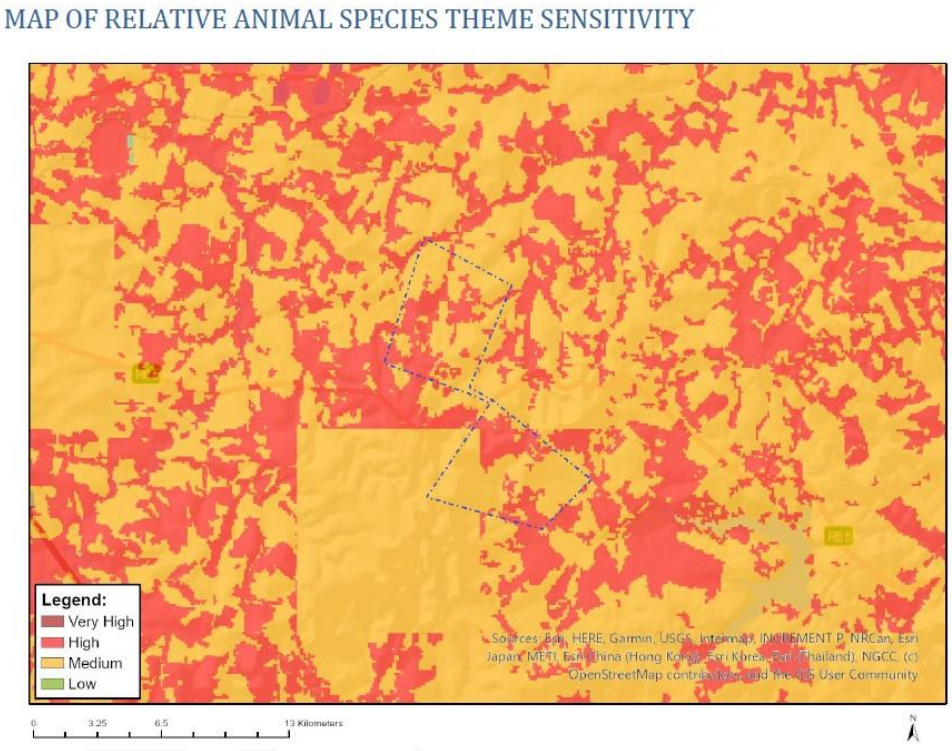


Figure 1: The classification of the Emvelo WEF Project Site according to the Animal Species Theme in the DFFE National Screening Tool.

MAP OF RELATIVE VULTURE SPECIES THEME SENSITIVITY

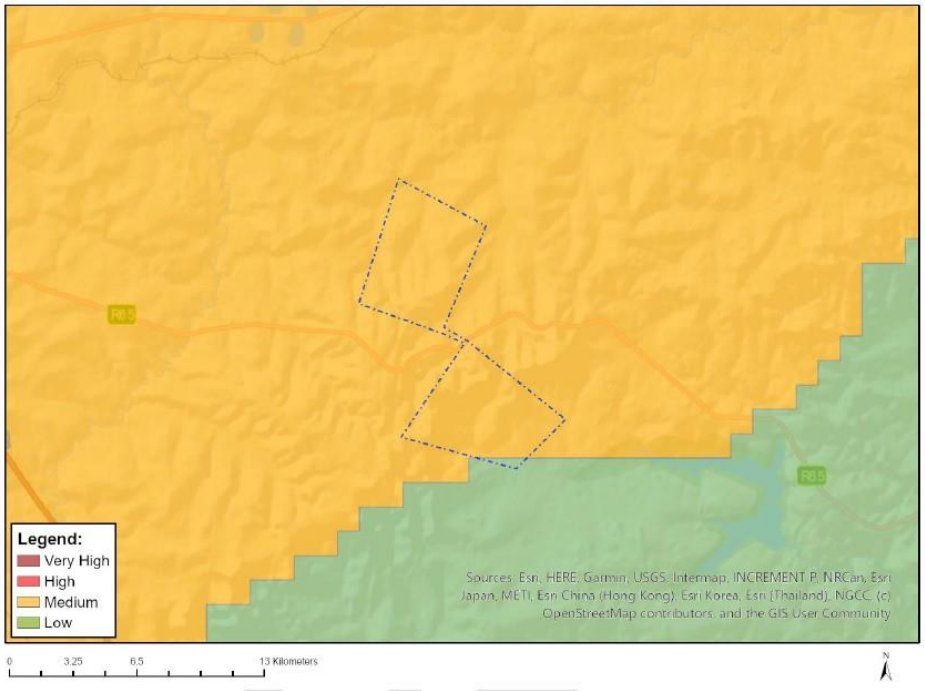


Figure 2: The classification of the Emvelo WEF Project Site according to the Vulture Species Theme in the DFFE National Screening Tool.

CONCLUSION

Based on the available SABAP2 data, the Site Sensitivity Verification survey, and the integrated pre-construction monitoring surveys conducted at the WEF Project Site, a classification of **High Sensitivity** for avifauna (for the **Animal Species Theme**) is confirmed for the Emvelo WEF and a classification of **Low Sensitivity** is substantiated for the **Vulture Species Theme** based on the low passage rate recorded during the site surveys.

APPENDIX 11: SITE SENSITIVITY VERIFICATION GRID CONNECTION

SITE SENSITIVITY VERIFICATION REPORT (IN TERMS OF THE PROCEDURES FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING ON IDENTIFIED ENVIRONMENTAL THEMES PUBLISHED IN GN 1150 ON 30 OCTOBER 2020)

INTRODUCTION

In accordance with the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site verification visit has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

SITE SENSITIVITY VERIFICATION

The following methods and sources were used to compile this report:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP2) was obtained from the University of Cape Town (https://sabap2.birdmap.africa/), to ascertain which species occur within the **Broader Area** i.e. within a block consisting of 12 pentads (**Table 3**, **Figure 1**). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 9 km. From 2007 to date, a total of 179 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 218 ad hoc protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2022.2) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation in the WEF project site was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2018) from the South African National Biodiversity Institute website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org).
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2023) was used in order to view the Broader Area on a landscape level and to help identify sensitive bird habitat.
- Priority species for wind energy developments were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the WEF and Grid project site.
- The primary source of information on avifaunal diversity, abundance and flight patterns at the site were the results of a pre-construction programme conducted over four seasons (2022–2023) at the proposed Mulilo WEF Cluster (Emvelo WEF and Sheepmoor WEF project sites). The primary methods of data capturing were walk transect counts, drive transect counts, focal point monitoring, vantage point counts and incidental sightings (see **Appendix 3** for a detailed explanation of the monitoring methods).
- Information gained from pre-construction monitoring at four potential wind farm sites in close proximity to the

current site, namely Ujekamanzi WEFs 1–2 and Camden WEFs 1–2 also assisted in providing a comprehensive picture of avifaunal abundance and diversity in the greater area, including the current study area.

OUTCOME OF SITE SENSITIVITY VERIFICATION

The Grid Connection Project Site is situated in the Grassland Biome, in the Mesic Highveld Grassland Bioregion (Mucina & Rutherford 2006). The proposed site is comprised of undulating grassland plains, with small, scattered patches of dolerite outcrops in areas, low hills, pan depressions and drainage lines with associated wetland areas. Vegetation on site consists predominantly of Wakkerstroom Montane Grassland and Eastern Highveld Grassland. Wakkerstroom Montane Grassland comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* (ouhout) thickets occurring along steep, mainly east-facing slopes, and drainage areas (Mucina & Rutherford 2006). Eastern Highveld Grassland vegetation is comprised of a short, closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn (Mucina & Rutherford 2006). The black wattle *Acacia mearnsii* is an aggressive invader of riparian areas. Stands of alien *Eucalyptus* and *Pinus* species are scattered throughout the proposed development area.

Ermelo has a temperate climate. January is the warmest month with a maximum temperature of 24.4 C°. June and July are the coldest months, with a minimum temperature of 0.2 C°. The driest month is June with an average of 3 mm of precipitation. Most of the precipitation falls in December, averaging 151 mm. The average annual precipitation is around 756 mm (Climate – data.org 2021). The topography in the project area is characterised by gentle undulating plains. The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. The livestock in the study area is a combination of mostly sheep and cattle, with a few horses.

NATIONAL ENVIRONMENTAL SCREENING TOOL

According to the DFFE national screening tool, the habitat within the Grid Connection PAOI is classified as **Medium** and **High** sensitivity for birds according to the Animal Species Theme (**Figure 1**). The Medium and/or High sensitivity classification is linked to the potential occurrence of Denham's Bustard *Neotis denhami* (Globally Near-Threatened and Regionally Vulnerable), Secretarybird *Sagittarius serpentarius* (Globally Endangered and Regionally Vulnerable), Southern Bald Ibis *Geronticus calvus* (Globally and Regionally Vulnerable), Grey-crowned Crane *Balearica regulorum* (Globally and Regionally Endangered), White-bellied Bustard *Eupodotis senegalensis* (Regionally Vulnerable), and Caspian Tern *Hydroprogne caspia* (Regionally Vulnerable). The PAOI contains confirmed habitat for Species of Conservation Concern (SCC), primarily for Southern Bald Ibis and Secretarybird (Globally Endangered and Regionally Vulnerable), 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).

Twelve (12) power line sensitive SCC have been recorded during the on-site field surveys. The recorded species are listed in the table below (NT = Near Threatened, VU = Vulnerable, EN = Endangered):

Species name	Scientific name	Global Conservation Status	Regional Conservation Status
African Marsh Harrier	*Circus ranivorus*	-	EN
Blue Crane	*Grus paradisea*	VU	NT
Cape Vulture	*Gyps coprotheres*	VU	EN

Denham's Bustard	*Neotis denhami*	NT	VU
Greater Flamingo	*Phoenicopterus roseus*	-	NT
Grey Crowned Crane	*Balearica regulorum*	EN	EN
Lanner Falcon	*Falco biarmicus*	-	VU
Martial Eagle	*Polemaetus bellicosus*	EN	EN
Secretarybird	*Sagittarius serpentarius*	EN	VU
Sensitive Species 23	*n/a*	CR	CR
Southern Bald Ibis	*Geronticus calvus*	VU	VU
White-bellied Bustard	*Eupodotis senegalensis*	-	VU

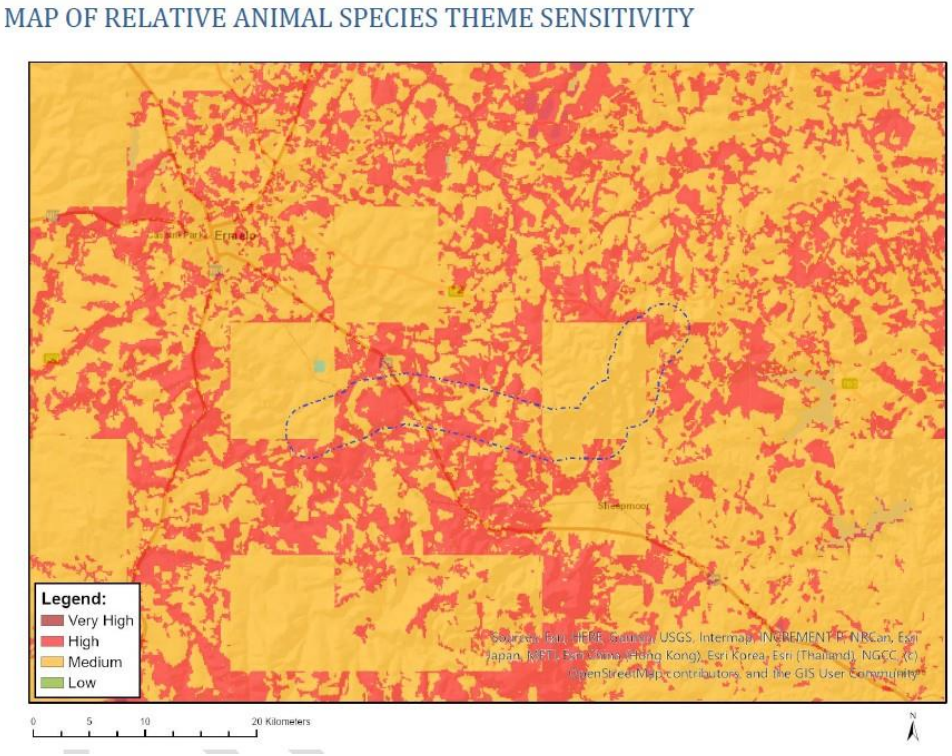
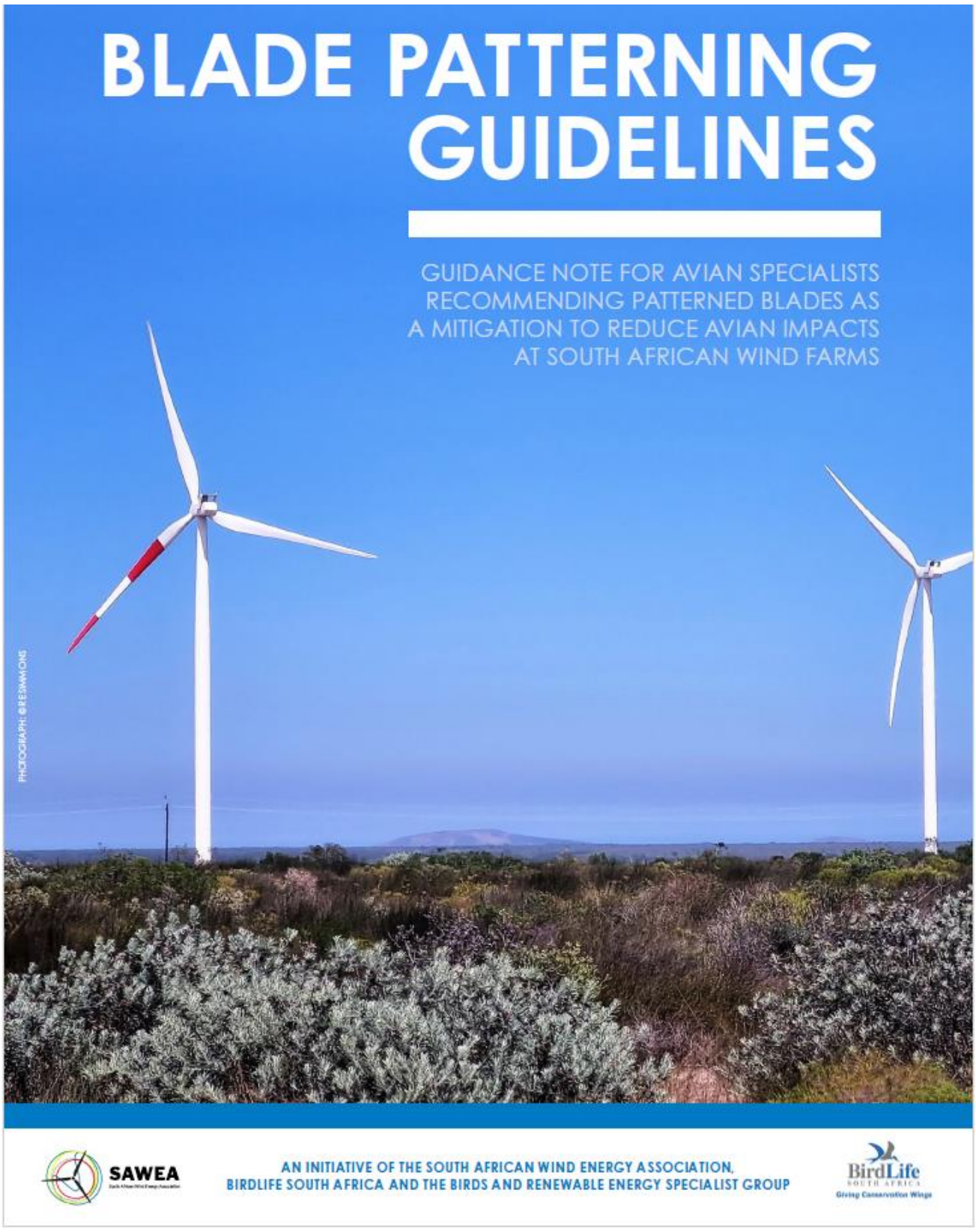


Figure 1: The National Web-Based Environmental Screening Tool map of the Grid PAOI, indicating sensitivities for the Animal Species Theme.

CONCLUSION

Based on the Site Sensitivity Verification survey and the integrated pre-construction monitoring conducted at the Project Site, the classification of **High Sensitivity** for avifauna is supported for the Emvelo WEF Grid Connection PAOI.

APPENDIX 12: BLADE PATTERNING GUIDELINES



1. AIM

This document provides guidance to avian specialists wishing to recommend blade patterning to mitigate bird strikes, especially raptors, at South African wind farms. It aims to promote consistency in the application of blade patterning by Independent Power Producers (IPPs), Eskom and their designated avian specialists within South Africa, based on the latest avian scientific research and the requirements of the South African Civil Aviation Authority's (SACAA) Alternative Means of Compliance (AMoC)[1].

In practice, the patterning design and the number of blades to be patterned at a particular site should be determined by an appointed Avifaunal Specialist (registered with the South African Council of Natural Scientific Professions (SACNASP)), taking into consideration site-specific requirements, species present on site, site-specific avifaunal risks and the latest scientific evidence regarding patterning, augmented by results from patterning tests at operational wind farms across South Africa.

The patterning recommended here is based on published international studies regarding birds and their ability to see and avoid turbines with high-contrast colours applied to white turbine blades, as well as a pilot project undertaken in South Africa (2023 – 2024) (Birds & Bats Unlimited 2024). As a new field of passive mitigation, it is important that avian specialists use evidence-based best practices to mitigate avian fatalities by recommending appropriate colours and patterns for turbine blades.

2. BACKGROUND

Following a SAWEA briefing note on Considerations for Blade Patterning as a Mitigation Measure to Reduce Avifaunal Collisions with Wind Turbines in South Africa[2] (Morkel et al. 2023), SAWEA motivated to the SACAA for a blanket approval to allow all wind farms an AMoC to pattern blades. This request was approved by the SACAA on 18 January 2024, allowing IPPs to deviate from white (as required by the current regulations[3]) and apply a "different colour" to their turbine blades to reduce bird strikes.

Condition 5.1 of the AMoC approval requires that "the final designs of the alternative markings must be submitted to the SACAA for consideration and approval, prior to implementation". The SACAA have indicated that final designs must be accompanied by a full motivation of such markings from a SACNASP-registered avifaunal specialist ensuring that the markings achieve the purpose of the AMoC approval.

Recognising the benefit of standardising submissions to the SACAA, this paper has been drafted to assist avian specialists in recommending designs appropriate to reducing bird strikes based on the best available science in this field.



PHOTOGRAPH: ©ALBERTFRONEMAN

3. RATIONALE

Birds, particularly raptors, are highly susceptible to impacts by spinning turbine blades (Thaxter et al. 2017, Perold et al. 2020). Experiments in the lab indicate that increasing contrast by painting one turbine blade black increases the chances that raptors will react to spinning blades. The single blade is assumed to reduce "motion smear" (lack of reaction on the retina to a fast-spinning blade: Hodos 2003) by breaking up the "blur".

By experimenting with different patterns, McIsaac (2001) found that two large black stripes across a blade were more conspicuous to raptors in the lab than plain white, plain grey, multiple zebra stripes or longitudinal stripes. This was confirmed in the first field trial several years later in Norway by May et al. (2020), which significantly reduced all bird fatalities by 72% by painting two-thirds of one blade solid black at four turbines. Umoya Wind Farm near Hopefield, Western Cape, employing patterns (i.e. two stripes) rather than a solid design, released preliminary, but promising results in July 2024, complementing these studies (Birds & Bats Unlimited 2024).

Further trials involving different species, environments and blade patterns are encouraged to determine this new mitigation's general applicability and effectiveness.

72 The percentage by which bird fatalities were reduced when painting two-thirds of one blade solid black in a field trial.

[1] The AMoC application was submitted in terms of Civil Aviation Regulation (CAR) 11.04.6, read with CAR 11.04.2 and 11.04.3, for turbine blades at wind farms not conforming strictly with CATS 139.01.30 (3) (b), in which SAWEA sought approval for deviation. [2] https://www.birdlife.org.za/wp-content/uploads/2023/09/SAWEA-BirdLife-BARESG-Blade-Patterning-Media-Briefing-Note_Final_14092023.pdf [3] CATS 139.01.30 (3)(b) requires that rotor blades, nacelle and the upper 2/3 of the supporting mast of a wind turbine shall be painted white, unless otherwise indicated by an aeronautical study.

4. GUIDELINES FOR BLADE PATTERNING

The following guidelines for patterning turbine blades are understood to be acceptable to the SACAA[4]:

4.1. Colours

■ The turbine blade should be painted Red to comply with the SACAA regulations, and both the front and back of the blade must coloured[5].

4.2. Number of blades patterned

■ A single turbine blade patterned in accordance with the terms of the AMoC approval is currently considered the best means of reducing motion smear (Hodos 2003). However, if multiple blades are patterned, the pattern must be asymmetrical (**see Figure 3 below**). That is, the pattern on the following blade must be positioned in different sections of the blade to produce a flicker effect[6] to increase conspicuousness (Martin and Banks 2023).

4.3. Patterning

■ The pattern should be either (i) alternating red-white-red-white bands from the blade tip to the base, with each band representing 25% of the blade's length (**Figure 1**) or (ii) three quarters (¾) of the blade painted solid red (**Figures 2**).

■ A striped patterning design (like Hopefield) and a solid pattern (like Smøla) may give different results, but both are acceptable designs.

■ While no field tests of thermal load have been undertaken, a patterned design, as opposed to a solid design, may reduce any differential heating of the blade (because the white sections will reflect light). Thus, wind farms in hot environments might prefer a pattern to a solid colour.

■ Alternative approaches to blade patterning that do not align with the above guidance are not recommended as suitable avian mitigation. For example, simply painting turbine blades with a colour other than those stipulated above, especially just the tips, is not recommended.

Similarly, all three blades should not be patterned identically; this approach is unlikely to break up motion smear and does not guarantee that birds will see and avoid them. "Aviation Stripes" used on some turbines, for example, in China, were not designed to be more visible to birds. They are designed to warn pilots of distances to the closest airports or to warn pilots of nearby wind farms. These are not recommended for bird mitigation (**see Figure 4**).

■ Applying a narrow strip on the leading edge of turbine blades un-patterned (i.e. white) for Leading Edge Protection (LEP) is sometimes unavoidable and required by the manufacturer. This is not expected to reduce the effectiveness of blade patterning, provided it does not exceed 1-2% of the blade width.

4.4. Number of patterned turbines within the wind farm

The number of turbines patterned within the wind farm can be approached in two ways:

■ Some turbines can be left un-patterned to act as controls as part of a nation-wide experiment to test the effectiveness of blade-patterning for different species in different environments (without controls, background fatality rates are difficult to determine), or

■ All turbines can be patterned to minimise conservation concerns. This approach is unlikely to contribute to any experimental verification (because of the lack of control turbines), but it may be necessary where the wind farm occurs near particularly sensitive sites.

VISUAL ILLUSTRATION OF BLADE PATTERNING

FIGURE 1



Alternating red-white-red-white bands from the blade tip to the base, with each band representing 25% of the blade's length are acceptable.

FIGURE 2



Red paint covering two-thirds of an entire blade in a solid design, as shown, is also an acceptable pattern.

FIGURE 3



Two blades patterned in an asymmetrical fashion are acceptable.

FIGURE 4



Aviation stripes on blades cover ~20% of the surface and are not recommended as an avian mitigation. They have not been tested on birds and are unlikely to disrupt "motion smear" as the pattern occurs on all three blades

[4] Based on the approved AMoC application which was submitted by SAWEA in terms of Civil Aviation Regulation (CAR) 11.04.6, read with CAR 11.04.2 and 11.04.3, for turbine blades at wind farms not conforming strictly with CATS 139.01.30 (3) (b). [5] As the colour 'red' aligns with colours referenced within the CAA regulations and AMoC approval, and that 'red' provides enough of a contrast from white to be visible to birds, this guidance note speaks only to the use of the colour red. Other colours, which may be deemed acceptable from an avifaunal perspective, such as black, would be subject to a separate application for AMoC with the SACAA. [6] Not to be confused with 'shadow flicker' which is the repetitive casting of shadows from turbine blades as they pass between the line of sight between a receiver and the sun.

4.4.1. Experimentation

Because only two field tests have been undertaken utilising patterned blade mitigation (one in Norway: May et al. 2020, and one in South Africa: Birds & Bats Unlimited 2024), BirdLife South Africa and BARESG encourages IPPs to help test blade patterning for effectiveness as a mitigation in different environments. To this end, half turbines in medium to low risk areas (or for operational farms, high fatality turbines) should be patterned, and the other half left un-patterned as controls. The same approach should be applied to low-risk areas (or low fatality turbines) with half to be patterned, and half as controls.

It is for the appointed SACNASP registered Avifaunal Specialist (in consultation with a recognised statistician, if required) to advise on the experimental/statistical design for a programme of blade patterning and associated carcass monitoring at the wind farm. Taking account of all relevant site, species and project specific factors, appropriate statistical tests must be applied to the fatality results to evaluate the effectiveness of the mitigation over a 24-month period. This experimentation may involve different (but appropriate) patterning designs applied to single and/or multiple blades as, detailed above.

4.4.2. All turbines patterned

In cases where wind farms are planned or operational near high-risk areas for threatened species, BirdLife South Africa and BARESG do not recommend the experimental approach. High risk areas are defined for some species by specific guidelines (e.g. Pfeifer and Ralston-Paton 2018, Simmons et al. 2020, Ralston-Paton and Murgatroyd 2021), VERA modelling (Murgatroyd et al. 2020) or Flight Risk/Collision Risk Modelling (Colyn and Froneman 2023). Wherever roosts, breeding colonies, or other sensitive areas for red data birds occur within the home range of that species, all blades should be patterned. Killing such species at control turbines is not acceptable and will incur future costs for additional tiers of mitigation. In these cases, BirdLife South Africa and BARESG suggest that all turbines should be patterned for conservation purposes. However, avoidance of High-Risk areas should first be prioritised and blade patterning should be complemented with additional mitigation until blade patterning as a stand-alone mitigation has been proven to be effective.

5. CONCLUSION

The methods presented above provide a simple yet robust set of guidelines to standardise appropriate blade patterns, colour, and number of patterned turbines within South African wind farms, based on the available science and existing approvals with regard to the AMoC.

It is for the appointed SACNASP registered Avifaunal Specialist, taking full responsibility for the careful consideration of these guidelines, to determine the appropriate mitigation for the applicable site, and to avoid inappropriate actions that could undermine the concept and potential of this promising mitigation measure.

This document should be appended to the avian specialist's letter of endorsement which needs to accompany all final designs of the alternative markings submitted to the SACAA for the final design approval as per condition 5.1 of the AMoC.

REFERENCES

References

Birds & Bats Unlimited 2024. First annual report on effects of Patterned blades on avian fatalities at the Umoya Wind farm, Hopefield. Unpublished report to Umoya Energy. Birds & Bats Unlimited, Cape Town.

Colyn R, Froneman A. 2023. Avian Risk Modelling For Renewable Energy Facilities. Presentation to the Birds and Renewable Energy Forum 2023. https://www.birdlife.org.za/wp-content/uploads/2023/10/BAREF-2023-proceedings.pdf

Hodos, W. 2003. Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines. National Renewable Energy Laboratory. NREL/SR-500-33249

Jenkins AR, van Rooyen CS, Smallie JJ, Harrison JA, Diamond M, Smit-Robinson HA, Ralston S. 2015. Birds and Wind–Energy Best Practice Guidelines 3rd edition. Birdlife South Africa, Endangered Wildlife Trust.

Martin GR. Banks AN. 2023 Marine birds: Vision-based wind turbine collision mitigation. Global Ecology and Conservation 42 (2023) e02386

May R, Nygård T, Falkdalen U, Åström J, Hamre Ø, Stokke B. 2020. Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities. Ecology and Evolution. Ecol Evol. 2020:00:1–9. https://doi.org/10.1002/ece3.6592

McIsaac H.P. 2001. Raptor acuity and wind turbine blade conspicuity. Proceedings of National Avian-Wind Power Planning Meeting IV, 59-87. https://www.osti.gov/servlets/purl/822422

Morkel D, Cervantes F, Clarke C, Ralston-Paton S, Scott-Shaw L, Simmons RE, Taylor S. 2023. Considerations for Blade Patterning as a Mitigation Measure to Reduce Avifaunal Collisions with Wind Turbines in South Africa. SAWEA and Birdlife South Africa https://sawea.org.za/sawea-birdlife-baresg-blade-patterning-media-briefing-note/

Murgatroyd M, Bouten W, Amar A. 2020. A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor. J Appl Ecol. 2020:00:1–12. https://doi.org/10.1111/1365-2664.13799

Perold V, Ralston-Paton S, Ryan P. 2020. On a collision course? The large diversity of birds killed by wind turbines in South Africa. Ostrich. https://doi.org/10.2989/00306525.2020.1770889

Pfeiffer M, Ralston Paton S. 2021 Cape Vulture and Wind Farms: Guidelines for Impact assessment, monitoring, and mitigation Birdlife South Africa. https://www.birdlife.org.za/wp-content/uploads/2020/03/BLSA-Guidelines-Cape-Vulture.pdf

Ralston Paton S, Murgatroyd M. 2021 Verreaux's Eagle and Wind Farms Guidelines for Impact assessment, monitoring, and mitigation. BirdLife South Africa https://www.birdlife.org.za/wp-content/uploads/2022/08/Verreaux-Eagle-and-Wind-Energy-2021-2nd-edition.pdf

Simmons RE, Ralston-Paton S, Colyn R and Garcia-Heras M-S. 2020. Black Harriers and Wind Energy: Guidelines for Impact assessment, monitoring, and mitigation https://www.birdlife.org.za/wp-content/uploads/2020/09/BLSA-Guidelines-Black-Harrier.pdf

Thaxter CB et al. 2017 Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment. Proc. R. Soc. B 284: 20170829. http://dx.doi.org/10.1098/rspb.2017.0829

Document finalised September 2024 following review by SAWEA, BLSA and BARESG committees with input from, inter alia: Dr Rob Simmons (Birds & Bats Unlimited) • Sam Ralston-Paton (Birdlife SA) • John Gibbs (Birdlife SA) • Caryn du Rand (nee Clarke) (SAWEA Project Development SC/G7 Renewable Energies) • Matthew Law (SAWEA Project Development SC/ Red-Cap Energy) • Shaun Taylor (SAWEA Project Development SC/ Mainstream Renewable Power) • Dr Meg Murgatroyd (HawkWatch International) • Andrea Gibb (SAWEA Project Development SC/ Globeleq) • Santosh Sookgrim (SAWEA)

APPENDIX 13: SPECIALIST DECLARATION OF INDEPENDENCE

forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE

Proposed construction of the Emvelo Wind Energy Facility and associated grid infrastructure, near Ermelo, Mpumalanga Province, South Africa

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with *'the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)'*, where applicable.

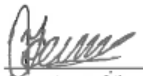
1. SPECIALIST INFORMATION

Title of Specialist Assessment	Avifaunal Assessment
Specialist Company Name	AfriAvian Environmental
Specialist Name	Albert Froneman
Specialist Identity Number	730815 5080 081
Specialist Qualifications:	M.Sc. Conservation Biology
Professional affiliation/registration:	SACNASP – Zoological Science 400177/09
Physical address:	28 San Henrique 2 Rosewood Rd Broadacres 2055
Postal address:	Box 2676 Fourways 2055
Postal address	Box 2676 Fourways 2055
Telephone	082 901 4016
Cell phone	082 901 4016
E-mail	albert@afriavian.com



I, Albert Froneman declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
    - any decision to be taken with respect to the application by the competent authority; and;
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

AfriAvian Environmental

Name of Company:

03 Oct 2024

Date



3. UNDERTAKING UNDER OATH/ AFFIRMATION

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

Signature of the Specialist

AfriAvian Environmental

Name of Company

03 Oct 2024

Date

Signature of the Commissioner of Oaths

2024 -10- 03

Date

BRUCE MORRISON C. A. (S. A.)
COMMISSIONER OF OATHS
1995-12-05
REF: 9/1/8/2 SPRINGS (A3)
79 FIFTH STREET, SPRINGS

APPENDIX 14: ESTIMATED ANNUAL FATALITY THRESHOLDS

WEF Site	Species	Red Data Status	PBR	Scenario	CRM estimate	% PBR	Fatality Threshold (birds/year)
Emvelo	Martial Eagle	EN	5.22	Original layout Revised layout: Avoidance Revised layout: Avoidance & Mitigation	1.134 0.203 0.065	21.75 3.88 1.25	1.25
Emvelo	Cape Vulture	EN	59.85	Original layout Revised layout: Mitigation	0.144 0.035	0.24 0.06	0.06
Emvelo	Southern Bald Ibis	VU	104.71	Original layout Revised layout: Avoidance Revised layout: Avoidance & Mitigation	0.654 0.251 0.056	0.62 0.24 0.05	0.05
Emvelo	African Marsh Harrier	EN	57.86	Original layout Revised layout: Mitigation	0.187 0.056	0.32 0.10	0.10
Emvelo	Denham's Bustard	VU	65.86	Original layout Revised layout: Mitigation	0.023 0.010	0.04 0.02	0.02
Emvelo	Secretarybird	EN	31.53	Original layout Revised layout: Mitigation	0.052 0.015	0.17 0.05	0.05
Emvelo	African Harrier-Hawk	LC	86.96	Original layout Revised layout: Mitigation	0.161 0.043	0.19 0.05	0.05
Emvelo	Amur Falcon	LC	13525.19	Original layout Revised layout: Mitigation	0.076 0.023	0.00 0.00	0.00
Emvelo	Black-chested Snake Eagle	LC	430.06	Original layout Revised layout: Mitigation	0.028 0.008	0.01 0.00	0.00
Emvelo	Black-winged Kite	LC	193.51	Original layout Revised layout: Mitigation	0.370 0.093	0.19 0.05	0.05
Emvelo	Black-winged Lapwing	LC	255.17	Original layout Revised layout: Mitigation	0.139 0.039	0.05 0.02	0.02
Emvelo	Black Sparrowhawk	LC	111.37	Original layout Revised layout: Mitigation	0.029 0.009	0.03 0.01	0.01
Emvelo	Common Buzzard	LC	4162.83	Original layout Revised layout: Mitigation	0.094 0.024	0.00 0.00	0.00
Emvelo	Jackal Buzzard	LC	571.54	Original layout Revised layout: Mitigation	2.424 0.643	0.42 0.11	0.11

APPENDIX 15: POTENTIAL BIOLOGICAL REMOVAL METHODOLOGY

Potential biological removal (PBR) is an estimate of the number of additional anthropogenically-caused fatalities that can be sustained by a population each year (Wade 1998). The PBR can be used as a management tool to compare estimated fatality probabilities (e.g. collision risk modelling outputs) and assess if a species may be over-exploited in a certain site (Dillingham & Fletcher 2008).

The PBR is calculated using a maximum annual recruitment rate (Rmax), a recovery factor specific to each species (f), and a conservative estimate of population size (Nmin) that represents the lower bound a 60% confidence interval (Wade 1998; Niel & Lebreton 2005, Equation 1). Depending on the population estimate used in the question, the PBR can be relevant for regional, national, or global level applications. We attempted to calculate PBR values for each priority species identified within the Amsterdam WEF Cluster site at a national level (i.e. we used South African population estimates). The values used in the equations can be found in Appendix 14. Some species did not have a PBR estimate due to the lack of appropriate survival rates and breeding ages.

$$\mathrm{PBR} = \frac{1}{2} R_{\max} N_{\min} f \quad \text{(Equation 1)}$$

We calculated Rmax for each species using estimates of adult survival rate and age of first breeding (Niel & Lebreton 2005). Detailed information for each species' life history is often unavailable although these population metrics can usually either be directly obtained from the literature or reasonably estimated from similar species (Dillingham & Fletcher 2008). We assigned values to each species based on available literature. If ranges were provided for age and survival rates, we used the older age and lower survival rate respectively (conservative estimates).
We used the R package "popharvest" (Devaux et al. 2025) to calculate the Rmax value (Equation 2). This equation is appropriate for long-lived species.

$$\lambda_{max} \approx \frac{(s\alpha - s + \alpha + 1) + \sqrt{(s - s\alpha - \alpha - 1)^2 - 4s\alpha^2}}{2\alpha} \quad \text{(Equation 2)}$$

We generated our Nmin value using the lower regional population estimate of mature individuals for each species multiplied by a factor of 0.66. This estimate captures both the conservative population estimate and an uncertainty value.

The recovery factor (f) was assigned to each species based on a sliding scale (Dillingham & Fletcher 2008). Bird species are assigned a threatened status based on their population values maintained by the International Union for the Conservation of Nature and Natural Resources (IUCN 2025). We assigned the following recovery factors to each class: f = 0.5 (Least concern species), f = 0.3 (Near threatened species), and f = 0.1 (Vulnerable, Endangered, and Critically Endangered species).

The PBR value can be used to interpret the significance of predicted fatalities obtained from collision-risk models at each proposed site. I.e. what proportion of the national PBR would each facility absorb. This comparison may assist management authorities to consider mitigation or avoidance systems to lower their impact on the PBR. We calculated the percentage of national PBR used per species per site by dividing by the median collision-risk probability by the PBR for each species. The CRM values predicted for each species were calculated for various scenarios including the "original layout" of the proposed wind turbine site, "mitigation approaches" (i.e. Shutdown on Demand), and "avoidance approaches" (i.e. buffer zones around critical habitat). The percentage of PBR used can be interpreted as follows: <10% Minimal concern;10–50% Moderate concern – consider mitigation;

>50–100% High concern – mitigation required; >100% Unacceptable – redesign or offset needed. It is important to consider the impacts that other human activities (i.e. poisoning incidents, electrocutions etc.) pose to each species, and that the PBR for a species may already be exceeded based on the cumulative impacts of human disturbance.

For example:

If the CRM analysis produced a median fatality estimate of one Cape Vulture per year, it would constitute 1.75% of the national PBR (57). However, given extensive existing fatalities related to power line collisions, electrocutions, poisoning incidents and other anthropogenic related mortality recorded across the country, it is assumed the PBR of 57 is already exceeded.

References

Devaux, T., Eraud, C., Francesiaz, C., 2025. popharvest: popharvest : Assessing the sustainability of harvesting regimes of bird populations. R package version 1.0.0, commitfed4fd11ba00c79629ae6fb58a3f5410b34a8fc0, https://github.com/popharvest/popharvest>.

Dillingham, P.W., Fletcher, D., 2008. Estimating the ability of birds to sustain additional human-caused mortalities using a simple decision rule and allometric relationships. Biological Conservation 141, 1783-1792.

Niel, C., Lebreton, J.-D., 2005. Using demographic invariants to detect overharvested bird populations from incomplete data. Conservation Biology 19, 826–835.

IUCN, 2025. The IUCN Red List of Threatened Species. Version 2025-1. https://www.iucnredlist.org.

Wade, P.R., 1998. Calculating limits to the allowable human caused mortality of cetaceans and pinnipeds. Marine Mammal Science 14, 1–37.

Mulilo Renewable Energy Developments (Pty) Ltd

EMVELO AND SHEEPMOOR BIODIVERSITY

Offset Report



4110-REP-00001
JULY 2025

CONFIDENTIAL

Mulilo Renewable Energy Developments (Pty) Ltd

EMVELO AND SHEEPMOOR BIODIVERSITY

Offset Report

REPORT (DRAFT) CONFIDENTIAL

PROJECT NO. 4110

OUR REF. NO. 4110-REP-00001

DATE: JULY 2025

WSP

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Phone: +27 11 254 4800

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft			
Date	July 2025			
Prepared by	Rudolph Greffrath			
Signature				
Checked by	Ashlea Strong			
Signature				
Authorised by	Ashlea Strong			
Signature				
Project number	4110			
Report number	4110-REP-00001			
File reference	4110-REP-00001 Mulilo Emvelo and Sheepmoor BOR			

CONTENTS

1 INTRODUCTION 1

1.1 TERMS OF REFERENCE 1
1.2 PROJECT LOCATION AND EXTENT 2
1.3 STUDY AREA 2

2 APPLICABLE LEGISLATION, POLICY AND STANDARDS 4

3 TERRESTRIAL BIODIVERSITY OVERVIEW 5

3.1 CONSERVATION CONTEXT 5
3.1.1 TERRESTRIAL CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAS) 5
3.1.2 PRIORITY AREAS FOR PROTECTED AREA EXPANSION 6
3.1.3 PROTECTED AREAS 6
3.1.4 INDIGENOUS FORESTS 6
3.2 VEGETATION AND FLORA 10
3.2.1 ECOLOGICAL IMPORTANCE OF VEGETATION COMMUNITIES IN THE LSA 10
3.2.2 FLORA SPECIES OF CONSERVATION CONCERN 18
3.3 FAUNA 18
3.3.1 BIRDS 20
3.3.2 FLIGHT RISK MODELLING 20
3.3.3 ENVIRONMENTAL SENSITIVITIES – WEF 21
3.3.4 BATS 22

5 AQUATIC BIODIVERSITY OVERVIEW 24

5.1 CONSERVATION CONTEXT 24
5.1.1 PRESENT ECOLOGICAL STATE 25

6 APPLICATION OF THE MITIGATION HIERARCHY 28

6.1 BIODIVERSITY MITIGATION MEASURES 28
6.1.1 IMPACTS AND MITIGATION MEASURES 28
6.1.2 FLORA 28
6.1.3 FAUNA 30
6.1.4 NO GO ALTERNATIVE 31

8 RESIDUAL IMPACTS REQUIRING OFFSET 32

9 TARGETS FOR OFFSET 37

9.1 TERRESTRIAL HABITAT 37

10 CANDIDATE OFFSET SITES 39

10.1 SIGNED LEASE AGREEMENTS 42
10.2 OFFSITE ACTIONS FOR PRIORITY BIRD SPECIES 43
10.3 CONCEPTUAL MANAGEMENT MEASURES AND PROGRAMME 43

11 RECOMMENDED CONDITIONS FOR ENVIRONMENTAL AUTHORISATION 45

12 REFERENCES 46

TABLES

Table 3-1 – Ecological importance of mapped vegetation communities in LSA 10
Table 6-1 – Significant residual impact summary for Emvelo and Sheepmoor WEF's 32
Table 7-1 – Basic and adjusted biodiversity offset ratios for terrestrial habitats 37
Table 7-2 – Terrestrial habitat offset targets 38
Table 8-1 – Conceptual offset management measures and programme for implementation 43

FIGURES

Figure 1-1 – Locality map of the proposed Sheepmoor and Emvelo WEFs. 3

Figure 3-1 - Mpumalanga Biodiversity Sector Plan 7

Figure 3-2 - Land Cover dataset for LSA (GTI, 2020) 8

Figure 3-3 - LSA in relation to National Protected Area Expansion Strategy 9

Figure 3-4 – Regional Vegetation Types (Mucina and Rutherford 2006) 13

Figure 3-5 – Sheepmoor WEF Mapped vegetation communities 14

Figure 3-6 - Emvelo WEF Mapped vegetation communities 15

Figure 3-7 - Sheepmoor Vegetation Sensitivity 16

Figure 3-8 - Emvelo Vegetation Sensitivity 17

Figure 3-9 - Fauna Sensitivity 20

Figure 4-1 - FEPA Sub catchment 26

Figure 4-2 – NFEPA Wetlands 27

Figure 5-1 - The mitigation hierarchy (DFFE, 2022) 28

Figure 8-1 - Emvelo Disturbed Habitat 41

Figure 8-2 - Sheepmoor Disturbed Habitat 42

APPENDICES

APPENDIX A

AFFECTED TERRESTRIAL HABITATS

1 INTRODUCTION

Sheepmor Wind Energy Facility (Pty) Ltd and Emvelo Wind Energy Facility (Pty) Ltd ('the Project Applicants') are applying for Environmental Authorisation (EA) to construct and operate the up to 260 MW Sheepmoor and up to 260MW Emvelo Wind Energy Facilities (WEF's) and their auxiliary infrastructure. Each WEF includes one on-site substation (consisting of a switching station and an IPP substation), with capacity of up to 132 kV, to facilitate the connection between the WEF's and the electricity grid, as well as an up to 132 kV over-head powerline of approximately 23 km (300 m corridor), traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the Camden B Main Transmission Substation (MTS).

South Africa's National Biodiversity Offset Guideline was gazetted in 2023. It sets out the requirements for the development of a Biodiversity Offset Report (BOR) in support of an application for Environmental Authorisation (EA). The proposed Sheepmoor and Emvelo WEF's are considered highly likely to require a Biodiversity Offset, effectively as a result of its location in an area that supports extensive areas of natural wetland and grassland habitat, some of which has been defined as Critical Biodiversity Areas (CBAs) in the Mpumalanga Biodiversity Sector Plan (MBSP), as well as populations of bird species of conservation concern (SCC), many of which are at risk of collision with project infrastructure such as powerlines. The anticipated Project interaction with these features (habitat loss, collision mortality of bird species of concern) factors are expected to result in significant residual impacts, which would then require an offset. WSP's proposed approach to the development of the BOR to accompany the EA application is set out in this document.

This Biodiversity Offset Report has been prepared to address the cumulative biodiversity impacts associated with the development of the two proposed Wind Energy Facilities. The offset strategy has been designed to be applicable and implementable irrespective of whether one or both projects proceed to approval. As such, the full extent of the report remains relevant and valid under all approval scenarios.

1.1 TERMS OF REFERENCE

South Africa's draft National Biodiversity Offset Guideline was published for public consultation on 25 March 2022, which sets out the requirements for the development of a Biodiversity Offset Report (BOR) in support of an application for Environmental Authorisation (EA). This report was compiled based on the guidance set out in the draft guideline, and follows the requirements for preparation of the BOR set out in the guideline as follows:

'*Where the biodiversity offset site cannot be identified before the decision-making phase, Biodiversity Offset Reports must, as a minimum, specify the following':*

- That the mitigation hierarchy, including due consideration of project alternatives to avoid or minimise impacts, has been appropriately applied before considering biodiversity offsetting.
- The degree of risk that negative residual impacts cannot be offset (i.e. negative residual impacts on irreplaceable biodiversity and/or major constraints on finding suitable biodiversity offset sites to meet the offset requirements) and how the risk is to be addressed or mitigated.
- A measure of significant residual negative biodiversity impacts which must be offset. The applicable biodiversity offset ratios for impacted ecosystems.

- Any other considerations which are relevant to determining the size and characteristics of the biodiversity offset (for example, impacts on species of conservation concern with specific habitat requirements, impacts on ecological corridors and connectivity in the landscape, and impacts on important ecological infrastructure), and how the size of offset is to be adjusted to take these considerations into account.
- An explicit statement on the required size of the biodiversity offset to remedy the residual negative biodiversity impacts, applying the basic offset ratio and adjustments as appropriate
- The portfolio of candidate biodiversity offset sites, including the likelihood of each site's availability and feasibility. (this level of detail is not yet available for inclusion into this report)
- The required biodiversity outcomes on each of the candidate biodiversity offset sites identified in the Biodiversity Offset Report. (this level of detail is not yet available for inclusion into this report)
- The management measures that would need to be employed as part of the biodiversity offset for a defined period, for which the applicant would be responsible. Typically, this period is not less than 30 years, and is longer if the impacting activity, or activities, will last beyond 30 years.

1.2 PROJECT LOCATION AND EXTENT

Sheepmor Wind Energy Facility (Pty) Ltd and Emvelo Wind Energy Facility (Pty) Ltd is proposing the development of a commercial wind farm cluster, the Amsterdam WEF Cluster, that is expected to comprise two separate Wind Energy Facilities (WEFs) namely, the Sheepmoor WEF (up to 260 MW) and the Emvelo WEF (up to 260 MW). Each WEF will apply for its own grid connection route to connect to the newly proposed Camden B substation, via 132 kV overhead transmission powerlines of approximately 20–32 km in length.

The proposed WEF development sites are located east of Ermelo and falls within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province (Figure 1-1). The entire WEF site was regarded as the 'study area' for this specialist assessment.

1.3 STUDY AREA

The study area for the Project was defined as follows:

- Local Study Area (LSA): The proposed development footprint plus all areas encompassed by the project site boundary, within which direct and indirect impacts on terrestrial and aquatic biodiversity receptors (i.e. direct habitat loss, fauna mortality) could occur;
- Regional Study Area (RSA): The quaternary catchments within which the proposed development is situated which is considered to be an ecologically appropriate area of analysis, within which indirect and/or induced impacts on biodiversity receptors (e.g. dust deposition, sensory disturbance, hydrological changes) could occur.

The LSA and RSA are shown on Figure 1-1, this includes the WEF areas.

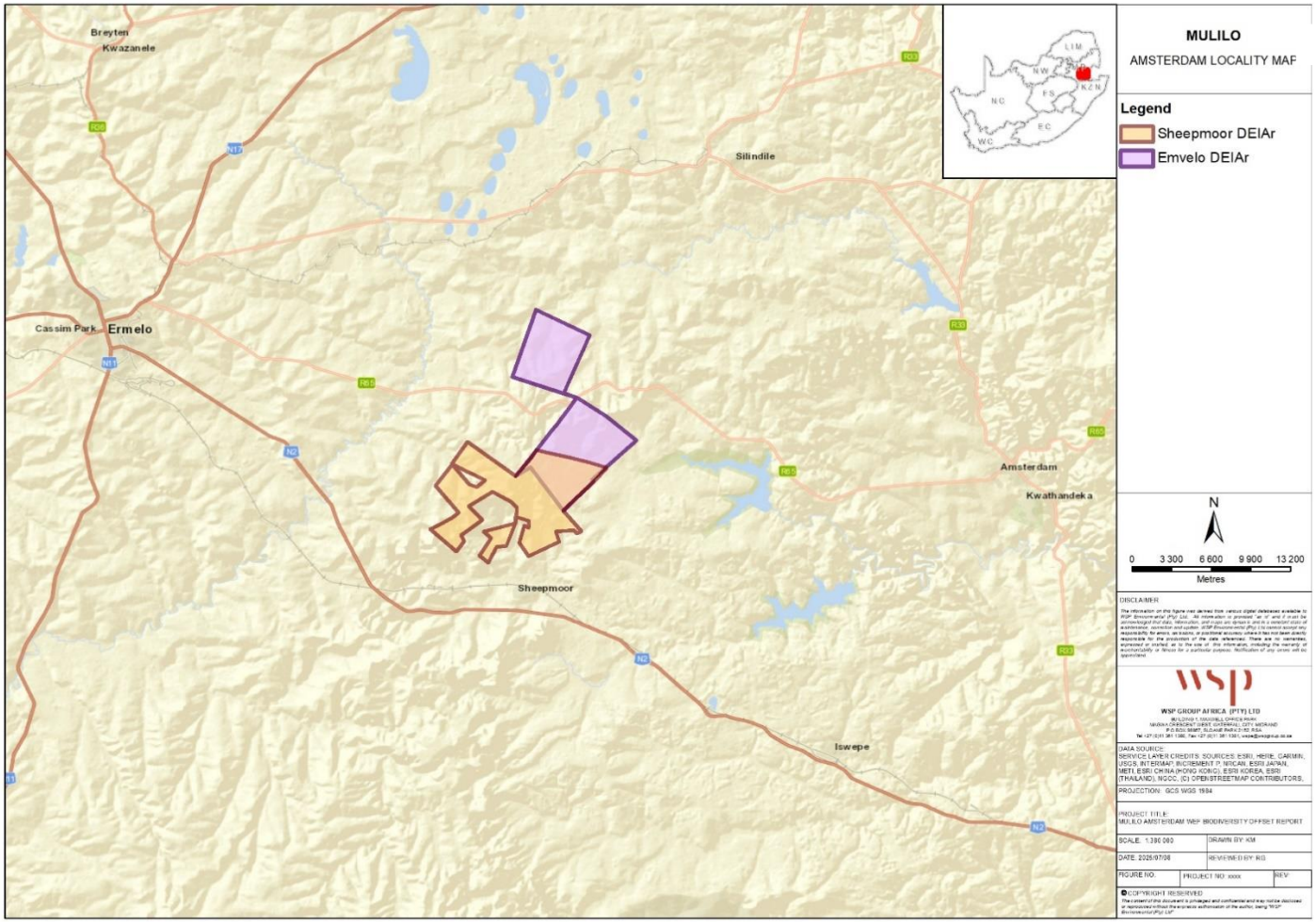


Figure 1-1 – Locality map of the proposed Sheepmoor and Emvelo WEFs.

2 APPLICABLE LEGISLATION, POLICY AND STANDARDS

Applicable national and provincial legislation, associated regulations and policies that are pertinent to biodiversity, which were used to guide the EIA, include:

- National Environmental Management Act (NEMA) (Act No. 107 of 1998) including Section 24, concerning Procedures for the assessment and minimum criteria for reporting on identified themes in terms of Sections 24(5)(a) and (h) and 44 of the NEMA, when applying for environmental authorisation;
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity; and
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity;
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), specifically:
  - Threatened or Protected Species (ToPS) – National lists of critically endangered, endangered, vulnerable and protected species (2007);
  - National list of threatened terrestrial ecosystems for South Africa (2011) (NEMBA Threatened Ecosystems, 2011);
  - National list of alien and invasive species (2016);
- Environment Conservation Act (Act No. 73 of 1989), specifically the Lists of declared weeds and invader plants (CARA, 1983);
- National Water Act (Act No. 36 of 1998);
- Mpumalanga Nature Conservation Act (Act No. 10 of 1998);
- Mpumalanga Biodiversity Sector Plan (Lötter, 2015).
- National Protected Area Expansion Strategy (2016).

Recent, relevant South African national policies and guidance were also taken into consideration, in the development of the baseline description and impact assessment process, including:

- Draft National Biodiversity Offset Policy (2017);
- Draft National Biodiversity Offset Guideline (2022);
- Species Environmental Assessment Guideline (SANBI, 2020); and
- Wetland offsets: a best-practice guideline for South Africa (Macfarlane et al., 2014).

3 TERRESTRIAL BIODIVERSITY OVERVIEW

The local study area is situated in a landscape that is characterised by rolling high-altitude grassland interspersed by rocky outcrops, with extensive hillslope seep and valley bottom wetlands, and farmlands that are cultivated to varying degrees, but largely consist of secondary grasslands.

3.1 CONSERVATION CONTEXT

3.1.1 TERRESTRIAL CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAS)

The LSA was compared to relevant available spatial biodiversity planning datasets, i.e. the Mpumalanga Biodiversity Sector Plan (2019) (Figure 3-1), in order to assess the local and regional biodiversity context of the site.

The Mpumalanga Biodiversity Sector Plan (MBSP) technical report (Lotter, 2015) defines five categories of conservation focus; protected areas, critical biodiversity areas (CBA), ecological support areas (ESA), other natural areas, and modified habitats. Definitions for each are listed below. These areas present risks to the Project in terms of impact, as well as opportunities for contribution to achieving provincially-set targets for biodiversity conservation, through focused biodiversity management planning and adherence to the mitigation hierarchy at EIA stage:

- **Protected Areas**: protected areas recognised in terms of the National Environmental Management Protected Areas Act, No. 57 of 2003, that are currently considered to meet biodiversity targets in the MBSP.
- **Critical Biodiversity Area**: areas (outside of Protected Areas) that are required to meet biodiversity targets for biodiversity pattern (species and ecosystems) and ecological processes. They should remain in a natural state that is maintained in good ecological condition.
- **Ecological Support Area**: play an important role in supporting the ecological functioning of critical biodiversity areas or for generating or delivering important ecosystem services. They support landscape connectivity and resilience to climate change adaptation. They need to be maintained in at least an ecologically functional state.
- **Other Natural Areas**: often retain much of their natural character and may contribute significantly to maintenance of viable species populations and natural ecosystem functioning and may provide important ecological infrastructure and ecosystem services. They are not, however, prioritized for immediate conservation action in the MBSP.
- **Modified**: often referred to as transformed, these areas have lost a significant proportion (or all) of their natural biodiversity and in which ecological processes have broken down (in some cases irretrievably), as a result of biodiversity-incompatible land-use practices such as ploughing, hardening of surfaces, mining, cultivation and the construction of houses or other built infrastructure.

Intact vegetation (less disturbed and not transformed) within the LSA and surroundings are considered to be of conservation value, whereby these areas are generally designated either MBSP CBA Irreplaceable or Optimal from a coarse scale provincial mapping perspective. Other Natural Area (ONA) tend to be more associated with transformed (cultivated) land, and less with remnant Eastern Highveld Grassland.

The degraded, secondary vegetation (old lands) and cultivated areas are generally not designated a CBA status but in some cases are designated ESA: local corridor or ESA: species specific.

Much of the LSA is mapped as CBAs and ESAs, which are largely aligned with grassland and wetland layers presented in the national landcover dataset (GTI, 2020) (Figure 3-2). These datasets are based on satellite imagery interpretation and as such the data may be aged and in-field verification that was completed is considered more accurate.

The main outcome of the vegetation and flora baseline study which was conducted during the flowering season (late June 2023 and December 2024) is the vegetation map of the LSA (Figure 3-5), which defines the location and extent of natural and modified vegetation communities. This assessment is considered an accurate depiction of the current state of the vegetation and habitat types. Important vegetation and habitat types as delineated by provincial coarse scale mapping was found to be interspersed and under direct threat from disturbed and transformed vegetation types of present, ie. cultivated areas, alien invasive tree stands and over grazed areas, the latter being managed from a livestock production motivation and not conservation.

3.1.2 PRIORITY AREAS FOR PROTECTED AREA EXPANSION

The LSA coincides with areas that have been identified as Priority Focus Areas as part of the National Protected Area Expansion Strategy (PAES) (2016) (Figure 3-3), which are aligned with the MBSP CBAs and ESAs (Figure 3-1).

3.1.3 PROTECTED AREAS

The South Africa Protected Areas Database (SAPAD) database, a comprehensive database of various protected area categories, is updated on a quarterly basis, and provides a comprehensive source of all national and private nature reserves, world heritage sites and other formal legally protected conservation areas situated within South Africa. Protected areas in the vicinity include the Chrissiesmeer Protected Environment & Jericho Dam Nature Reserve within 5 km of the site and Langcarel Private Nature Reserve just over 10 km from the site. All remaining protected areas are in excess of 20 km of the site and no National Parks are located within 100km of the site. No other protected areas are situated within 10 km of the site. NPAES designated Priority Focus Area does overlap with a large portion of the site.

No protected areas nor any terrestrial ecological processes associated with them are likely to be affected significantly by the proposed WEF Cluster project other than some transient faunal species (including birds), and ecological connectivity with the Chrissiesmeer protected environment as well as other nearby protected areas. NPAES areas are indicated for all CBA and ESA designated areas in the latest draft NPAES (2018). The footprint or risk is not expected to be significant.

3.1.4 INDIGENOUS FORESTS

No indigenous forests occur in the study area. The study area is dominated by cultivated fields and tracts of natural grassland and wetland habitat. Indigenous forests are therefore not included as receptor for the impact assessment, or considered further in this report (Pote, 2025a).

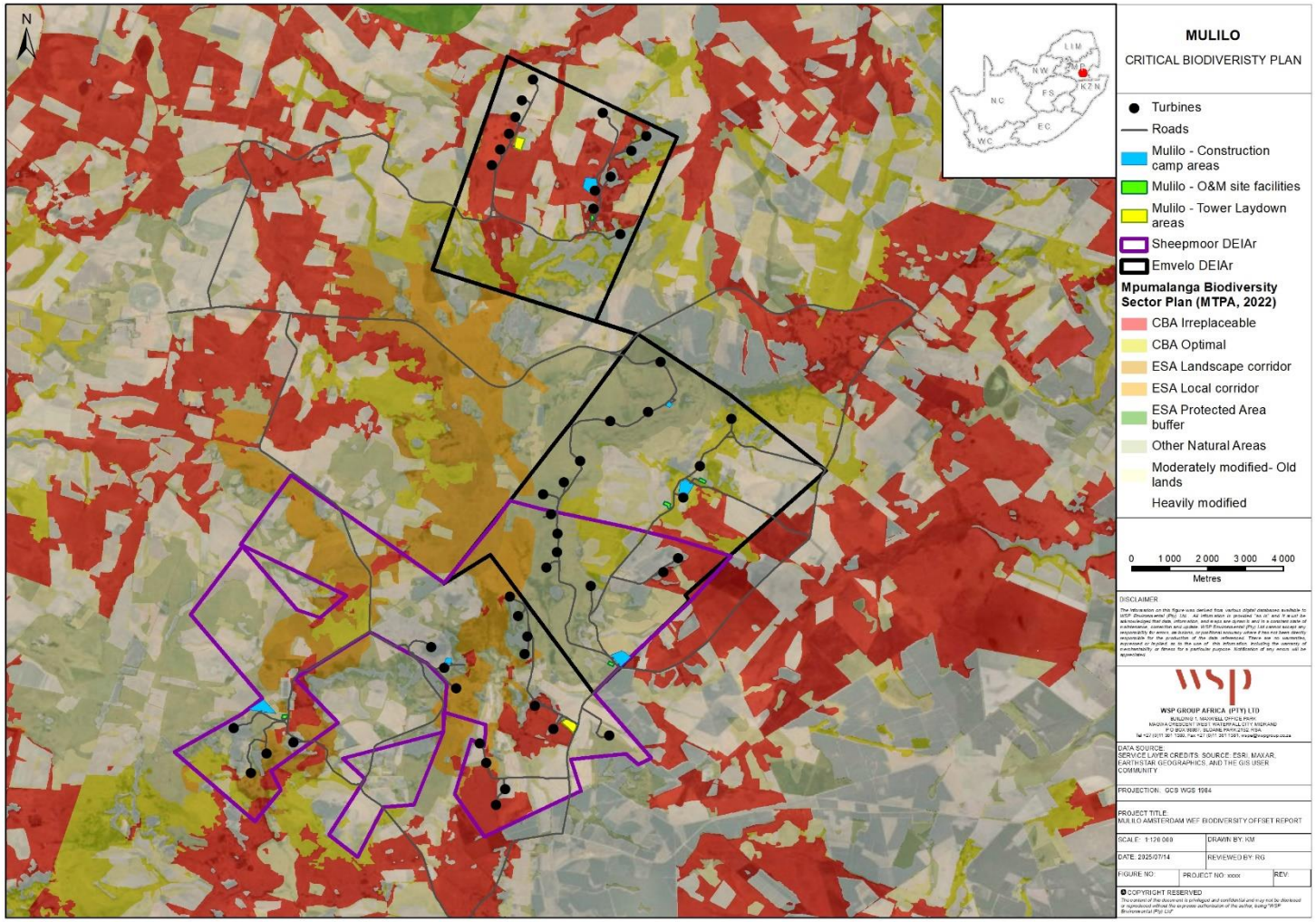


Figure 3-1 - Mpumalanga Biodiversity Sector Plan

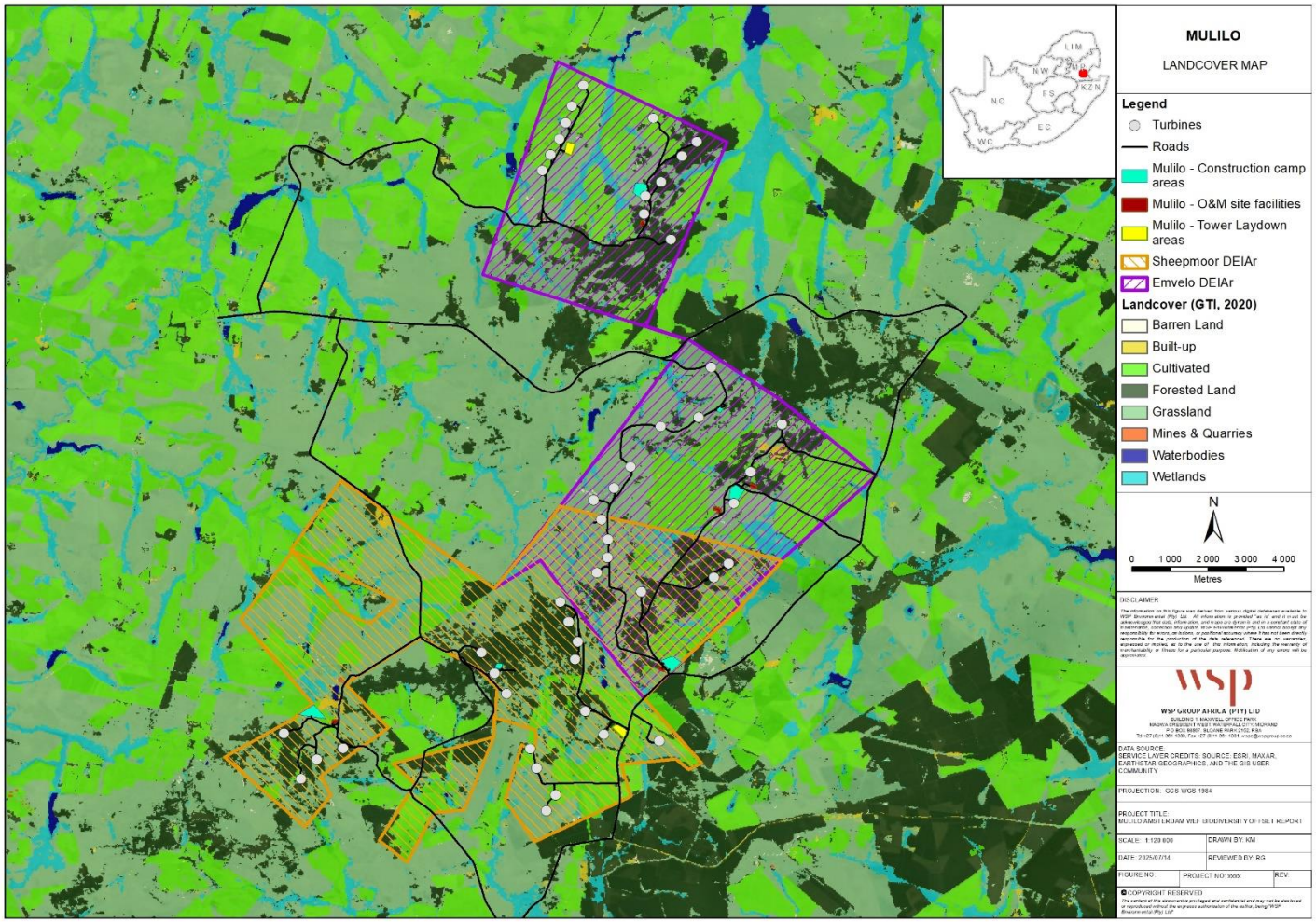


Figure 3-2 - Land Cover dataset for LSA (GTI, 2020)

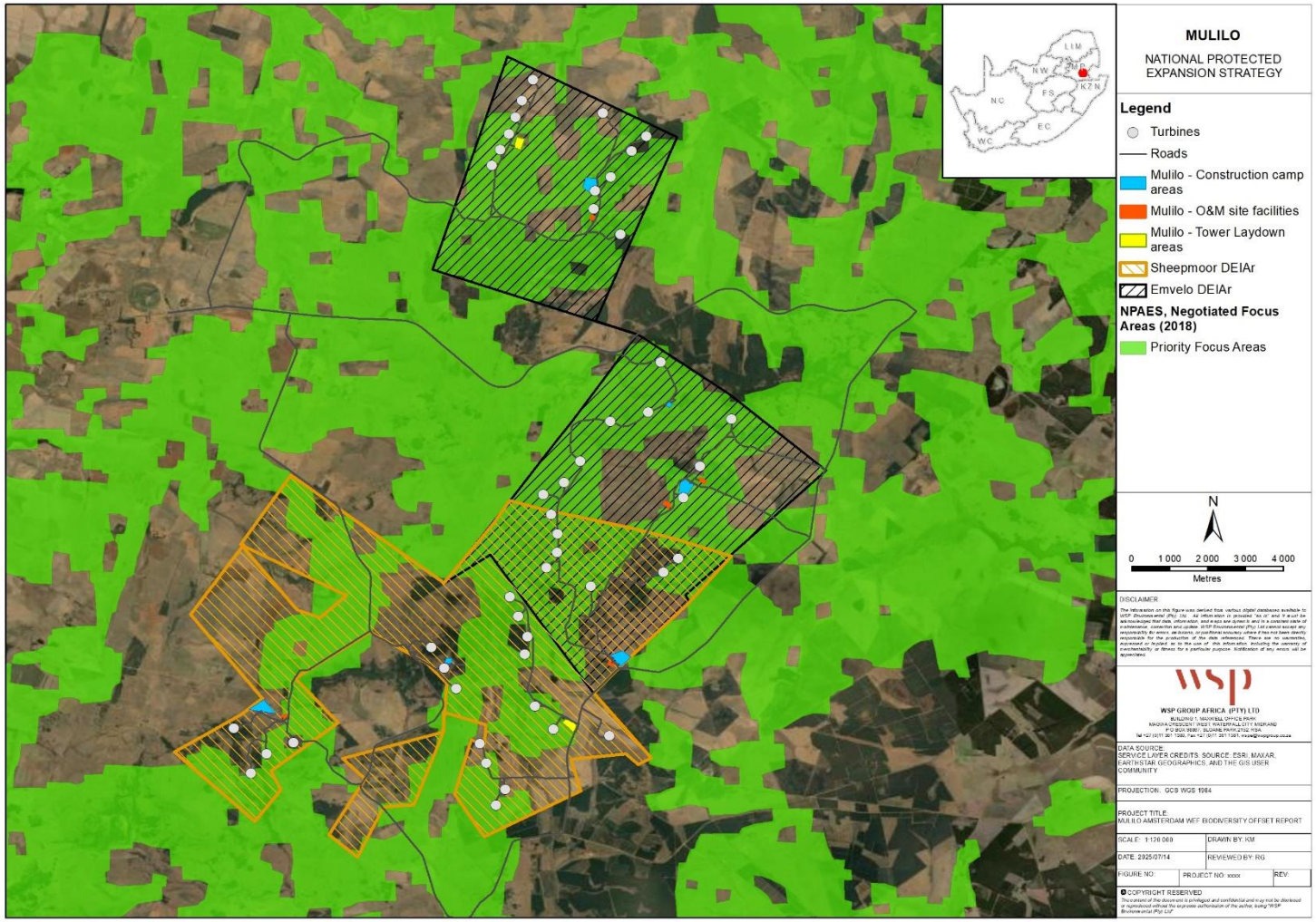


Figure 3-3 - LSA in relation to National Protected Area Expansion Strategy

3.2 VEGETATION AND FLORA

Two major vegetation types occur across the LSA; these include Eastern Highveld Grassland and Wakkerstroom Montane Grassland (Figure 3-4). Eastern Highveld Grassland and Wakkerstroom Montane Grassland are listed as endangered and least concerned respectively, as per NEMBA Threatened Ecosystems (2021).

Two vegetation units (Figure 3-4) are primarily affected by the proposed project (Mucina & Rutherford, 2006). The site is located within Eastern Highveld Grassland (currently having an Endangered conservation status) and Wakkerstroom Montane Grassland (currently having a Least Concern conservation status). The Eastern Highveld Grassland tends to be associated with lower lying relatively flat areas, while the Wakkerstroom Montane Grassland is associated with higher elevation mountainous areas, particularly towards the central and south-east of the WEF cluster formed by a series of mountainous ridges as well as the eastern portions of the southern grid connection routes. Being situated on relatively flat areas with good soils and rainfall, the eastern highveld grassland has been subject to significant historical clearing for agricultural activities including pastures, fodder and crops. The site covers a small area of the original extent and remining extent of the vegetation units that are represented within the site (Eastern Highveld Grassland & Wakkerstroom Montane Grassland).

3.2.1 ECOLOGICAL IMPORTANCE OF VEGETATION COMMUNITIES IN THE LSA

The ecological importance of identified vegetation communities mapped in the LSA during baseline studies is summarised in Table 3-1. Natural vegetation communities mapped within the LSA are considered sensitive to development, and where these coincide with CBAs, and project infrastructure, offsets will typically be required according to the draft biodiversity offset guideline. Mapped vegetation units are displayed in Figure 3-5 and Figure 3-6, with the corresponding vegetation sensitivity displayed in Figure 3-7 and Figure 3-8.

Table 3-1 – Ecological importance of mapped vegetation communities in LSA

Vegetation Community	Analysis
Cultivated Fields	A modified vegetation community, that has been heavily impacted by anthropogenic activity. Extensive areas that have been transformed for agricultural use either as pastures or crops and are either currently in use or have been in use during the assessment period. No irrigated pivots are present and lack of a large water supply in the area suggests that these are mostly dryland crops (i.e., not irrigated). Extensive currently cultivated areas are present, predominantly maize but also with some areas that are pastures. Areas that are currently old lands, may be used in the future, as crop rotation does appear to occur in the area, based on analysis of historical aerial photographs. The ecological importance of this vegetation community is rated very low.
Transformed	Generally, where all indigenous vegetation has been removed and replaced with hardened surfaces such as houses, access roads, other infrastructure. Includes areas that are not currently used for agriculture. Transformed areas are present, including several dwellings.
Invaded Alien Tree Plantations	Areas having dense alien infestation where natural ecological processes are significantly altered, soil properties are often also altered and natural vegetation might be restricted to the occasional grass, herb or shrub scattered throughout

Vegetation Community	Analysis
	the dense thicket clump. In areas where less dense, typical grass fires tend to burn at a significantly higher temperature, which can slowly alter soil properties and promotes proliferation and ultimately densification of the invasives. Notwithstanding this functional attribute, the ecological importance of the Alien Tree Plantations vegetation community is rated very low.
Highveld Grassland	Natural/Near Natural Eastern Highveld Grassland at higher altitudes, mostly used for grazing and crops. Well-represented on the site, with some near natural to pristine remnant patches present, but most of the area has either been transformed or disturbed at some point historically, including areas that are mowed periodically for hay and other fodder resources. More natural habitat tends to be confirmed to slopes where utilisation is less. Rocky outcrops and rocky habitat tend to be uncommon but is present on some slopes and also occasionally present in flat areas where shallower soils are present. Rocky areas tend to not have the elevated diversity that is normally associated with fire refuge outcropping, most likely due to historical utilisation for grazing and possible fire management to promote grasses. Deemed no go where designated Irreplaceable as per regional planning
Degraded Montane Grassland	Areas of this unit that are distinctly degraded through historical use or have been transformed in the distant past where secondary vegetation is established and cannot be conclusively confirmed to be natural or secondary.
Degraded Highveld Grassland	Areas of the above unit that are distinctly degraded through historical use or has been transformed in the distant past where secondary vegetation is established and cannot be conclusively confirmed to be natural or secondary. Compaction tends to be elevated to some extent and areas with shallower soils.
Old Lands	Old lands or other disturbed areas, where grasses regenerate from the surrounding landscape. These areas typically have lower species diversity and often lack characteristic species found in natural and near natural habitat. Such areas would most likely be the most suitable for the proposed activity having lower conservation priority and most likely also having marginal or lower agricultural suitability (which would likely be why it is no longer used). This community is rated as having a medium/low functional integrity, but low conservation importance. The biodiversity importance of old lands community is thus low. Receptor resilience is rated high, resulting in an ecological importance rating of very low.
Montane Grassland	Natural/Near Natural Wakkerstroom Montane Grassland at higher altitudes and more prevalent in rocky mountainous areas, so transformation levels are significantly lower. Well-represented on the site, with near natural to pristine being present and common, although most areas show some level of historical utilisation for grazing and also high levels of localised alien tree infestation is prevalent. Rocky habitat including outcrops are present, often on slopes, plateaus and on edges of plateaus, with poor or shallow soils generally having an elevated presence of shrub and herbaceous species. The rocky shrub community is not well represented on the site, but generally has a higher overall non-graminoid diversity and is in a more pristine state in less accessible areas and where not having had dense alien infestations

Vegetation Community	Analysis
Riparian/Riverine	Natural vegetation surrounding watercourses and seeps, most likely having riparian elements with some seep functionality. Grassland vegetation typical of the surrounding units, but having riparian elements, but usually lusher with taller growth. These areas would not be suitable due to ecological importance and are considered no-go areas. This category overlaps with the aquatic assessment designated delineated rivers and floodplain and channelled valley-bottom wetland systems. The functional integrity and conservation importance of these areas and wetland are both rated high, resulting in a high biodiversity importance score. Receptor resilience is rated medium, and accordingly ecological importance is rated high.

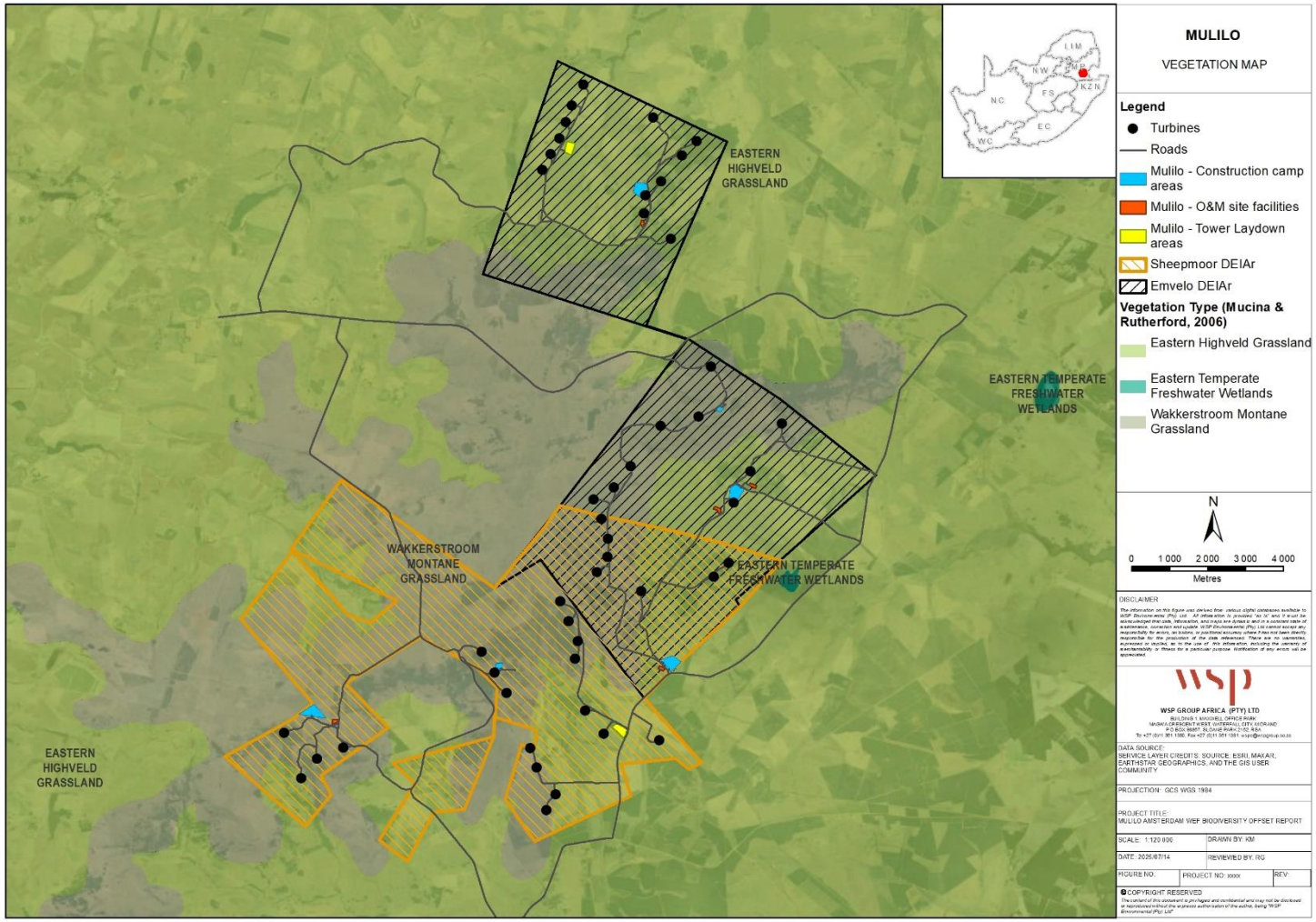


Figure 3-4 – Regional Vegetation Types (Mucina and Rutherford 2006)

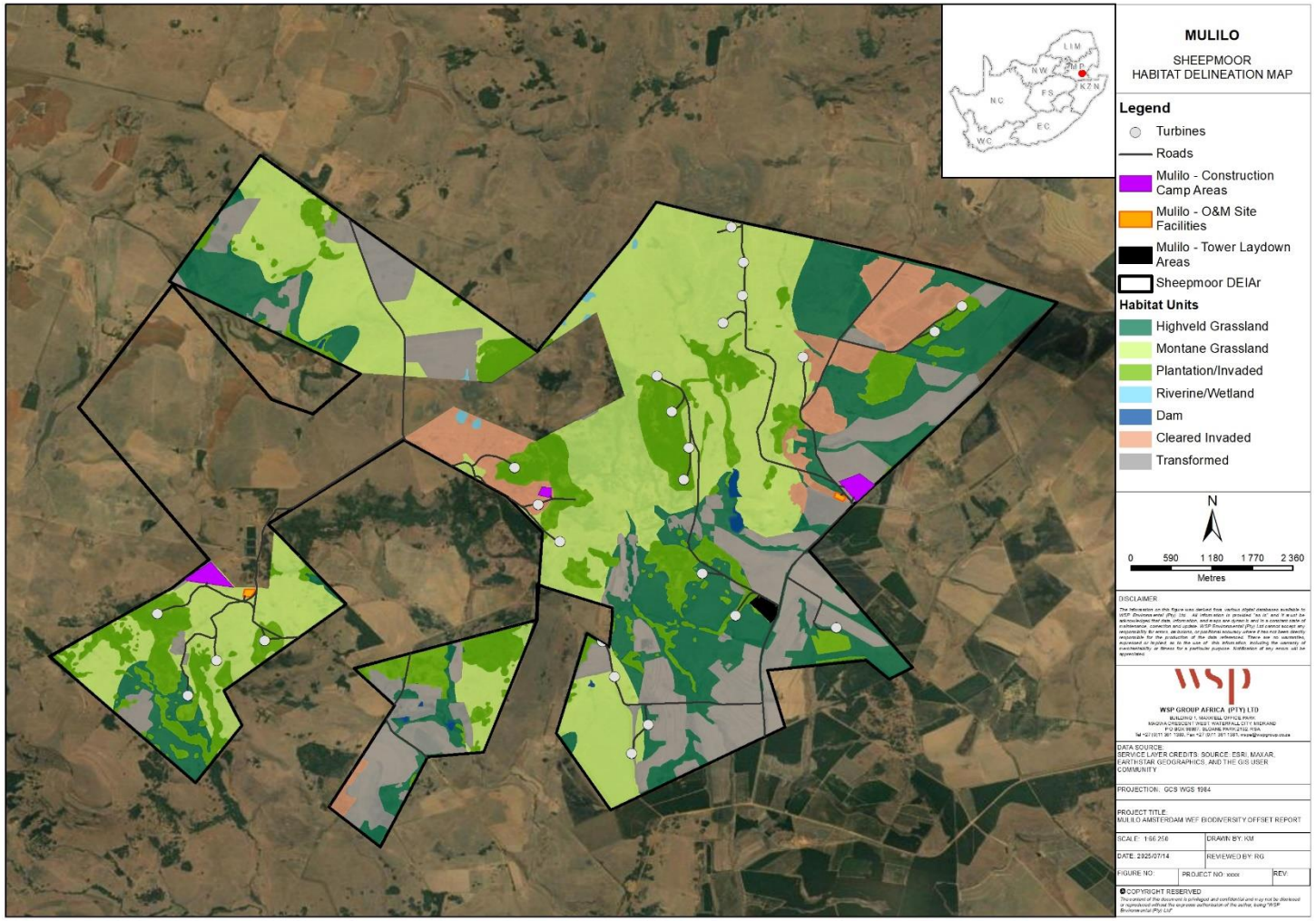


Figure 3-5 – Sheepmoor WEF Mapped vegetation communities



Figure 3-6 - Emvelo WEF Mapped vegetation communities

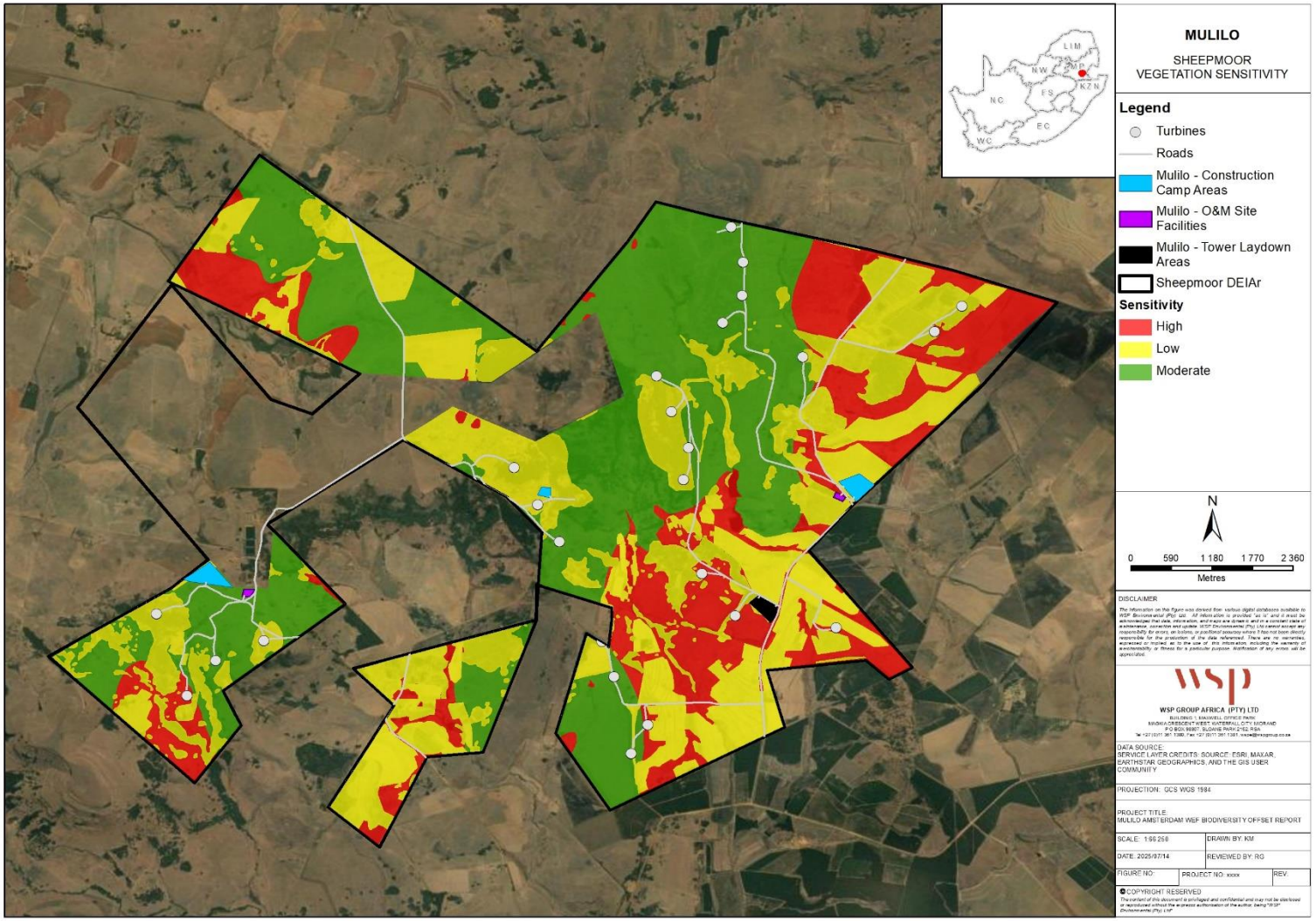


Figure 3-7 - Sheepmoor Vegetation Sensitivity

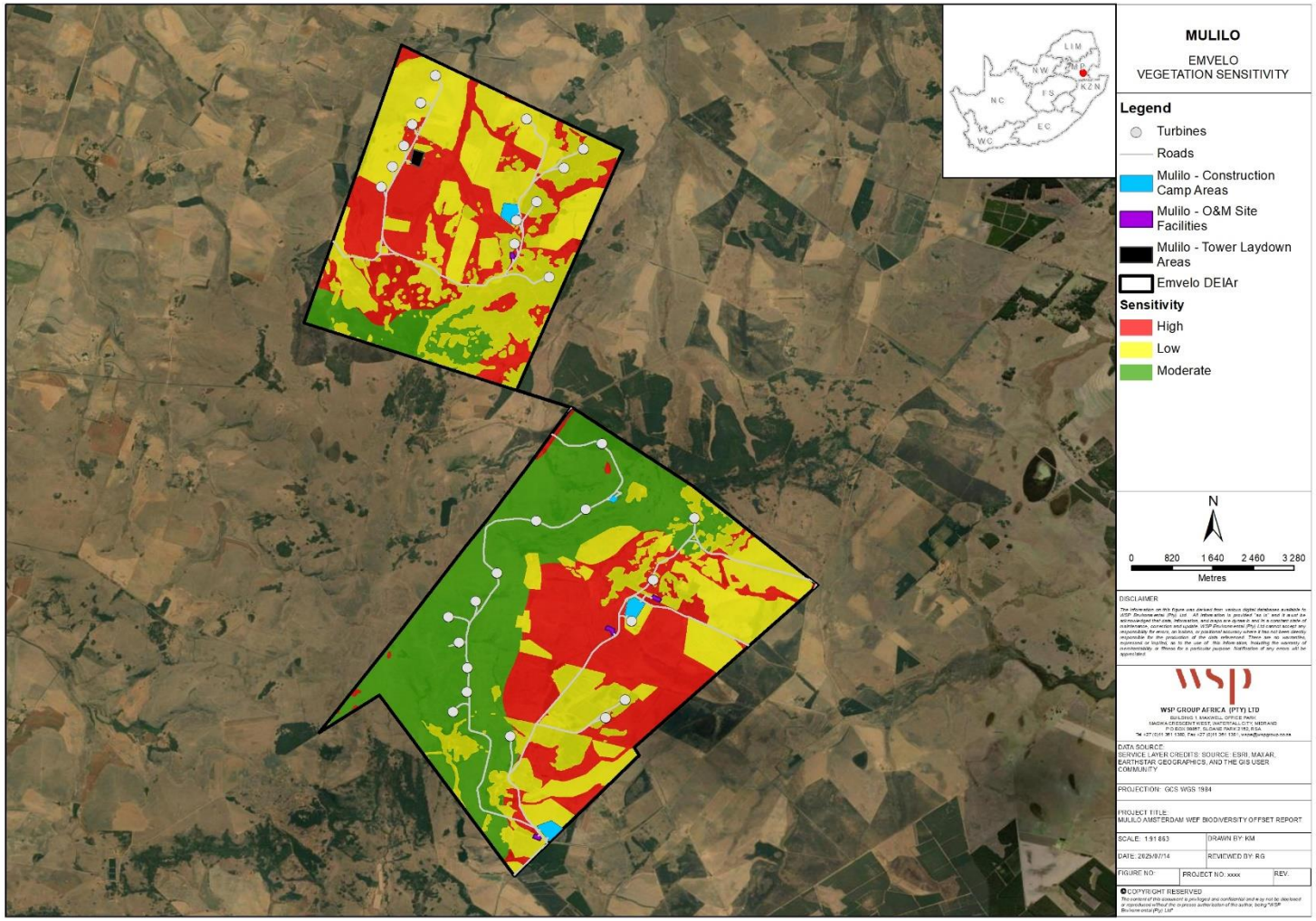


Figure 3-8 - Emvelo Vegetation Sensitivity

3.2.2 FLORA SPECIES OF CONSERVATION CONCERN

The National Web Based Screening Tool indicated that the majority of the LSA is considered to be of 'Low to Medium sensitivity' in terms of the Plant Species Theme on account of the low potential presence of flora species of conservation concern.

Several threatened or protected, endemic and range restricted species are known from the surrounding area. Due to the localised nature of the impact, as well as the level of degradation of the site, the risk of a species suffering any significant loss is low to medium. The preliminary site screening to not specifically assess species composition, being undertaken during the winter months.

Based on reviewed literature and data sources, 11 flora species that occur, or potentially occur in the study area are listed as threatened or Near Threatened on the national and/or provincial Red Lists.

No flora species listed as threatened or Near Threatened on the national Red List were recorded in the study area during the field survey.

Several flora species that are listed as protected at a provincial level according to Mpumalanga Nature Conservation Act (Act No. 10 of 1998) were recorded in the study area during the field survey, including *Aloe ecklonis, Cyrtanthus tuckii var. transvaalensis, Haemanthus humilis subsp. hirsutus, Eucomis bicolor, Kniphofia linearifolia.*

No flora species listed on the NEMBA ToPS (2007) List were recorded or potentially occur in the study area.

The site falls within the general distribution range of several endemic species and other species of conservation concern, some with a highly localised distribution and/or some of which may be Critically Endangered, Endangered, Vulnerable or Rare. Some of these species are also only from a single or a few populations. Critically Endangered flora species are likely not present, but Endangered species are known to occur in the vicinity and suitable habitat is present. It is likely that some sporadic clusters of species are present but will require specific footprint surveys during the final walkdown due the extent of the site. It is unlikely that the proposed WEF will pose any risk to Species of Conservation Concern as no substantial populations were found. Sensitive species names have not been included as per reporting protocols.

3.3 FAUNA

Fauna species confirmed in the LSA during field surveys conducted during 2024, as well as fauna SCC confirmed/expected to occur, are summarised in the sections that follow. The National Web Based Screening Tool indicated that the majority of the LSA is considered to be of 'Medium to High sensitivity' in terms of the Animal Species Theme on account of the relatively low potential presence of fauna species of conservation concern. Full details of the methods used, and survey results, are available in the terrestrial fauna specialist assessments (Pote, 2025) that accompany this EA application.

Invertebrate Species of Conservation Concern

Clonia lalandei (Saussure, 1888) Lalande's Black-winged Clonia

- This species of katydid is endemic to South Africa and has an IUCN Red List Category and Criteria of Vulnerable B1ab(i,iii) (Bazelet and Naskrecki, 2014). Within South Africa, the species has a broad distribution occurring across the central parts of South Africa, having been recorded from the Free State, KwaZulu-Natal, and Mpumalanga Provinces.

- It occurs in grassland and savanna habitats but has only been collected from four localities with almost nothing known about its specific habitat requirements or ecology.
- It has an estimated extent of occurrence of 15,397 km^2 and its estimated geographic range falls just outside of the project area, approximately 12 km to the east (Bazelet and Naskrecki, 2014).
- The species has not been recorded from the project area; the closest known record is approximately ~92 kms north-east for a specimen collected from Barberton Montane Grassland habitat.

Mammal SCC

Ourebia ourebi ourebi (Zimmermann, 1783) Oribi

- The oribi (*Ourebia ourebi*) is a small, territorial antelope that occurs throughout sub- Saharan Africa where it typically inhabits open temperate grasslands.
- Thirteen subspecies are currently recognised, with the South African subspecies O. ourebi ourebi recognised as genetically distinct from other subspecies to the north. As such, oribi in South Africa should be managed as a distinct conservation unit (Jansen van Vuuren, Rushworth and Montgelard, 2017).
- It has a 2016 Regional Red List Status of Endangered C2a(ii) and is considered as the most threatened antelope species in South Africa with a minimum estimated total of approximately 2000 mature individuals remaining (Conservation Breeding Specialist Group Southern Africa et al., 2006; Shrader et al., 2016).
- *Ourebia ourebi ourebi* populations have become restricted to small, isolated populations in grasslands in the eastern half of South Africa, occurring in grasslands in Mpumalanga, Eastern Cape and KwaZulu-Natal provinces. A few subpopulations in southern and north- eastern Free State, and southern Limpopo are also known.
- Fragmentation of populations and declining population numbers (~13% decline between 1996-2014) are the result of several anthropogenic factors, including hunting and poaching, habitat loss and fragmentation, and poor veld management (e.g. fencing, burning, overgrazing).
- Habitat requirements include both short grass for food and long grass for food and shelter. They are selective feeders with several species of grass making up most of their diet, (*Themeda triandra, Hyparrhenia hirta, Panicum natalense*, and *Andropogon chinensis*) (Shrader et al., 2016).
- They also appear to favour north and east facing slopes, with populations showing preferences for gentle slopes (less than ~10 degrees), gentle undulating plateaus, ridge tops, and spurs, and avoiding lowland areas (Conservation Breeding Specialist Group Southern Africa et al., 2006).
- Further loss of grasslands on flat and undulating terrain is considered a very real threat to the survival of this charismatic sub-species.
- Recent postings on iNaturalist indicate that Oribi are relatively frequently encountered within the broader grassland areas around the project site. For example, a 2020 photographic record form approximately 75 km south in Wakkerstroom Montane Grassland, a vegetation type found at the project site.

Based on the available ecosystem-level data for habitat and important biodiversity areas and from habitat assessment during the field site visit, the following constraints map showing areas of High faunal sensitivity was produced for the project site.

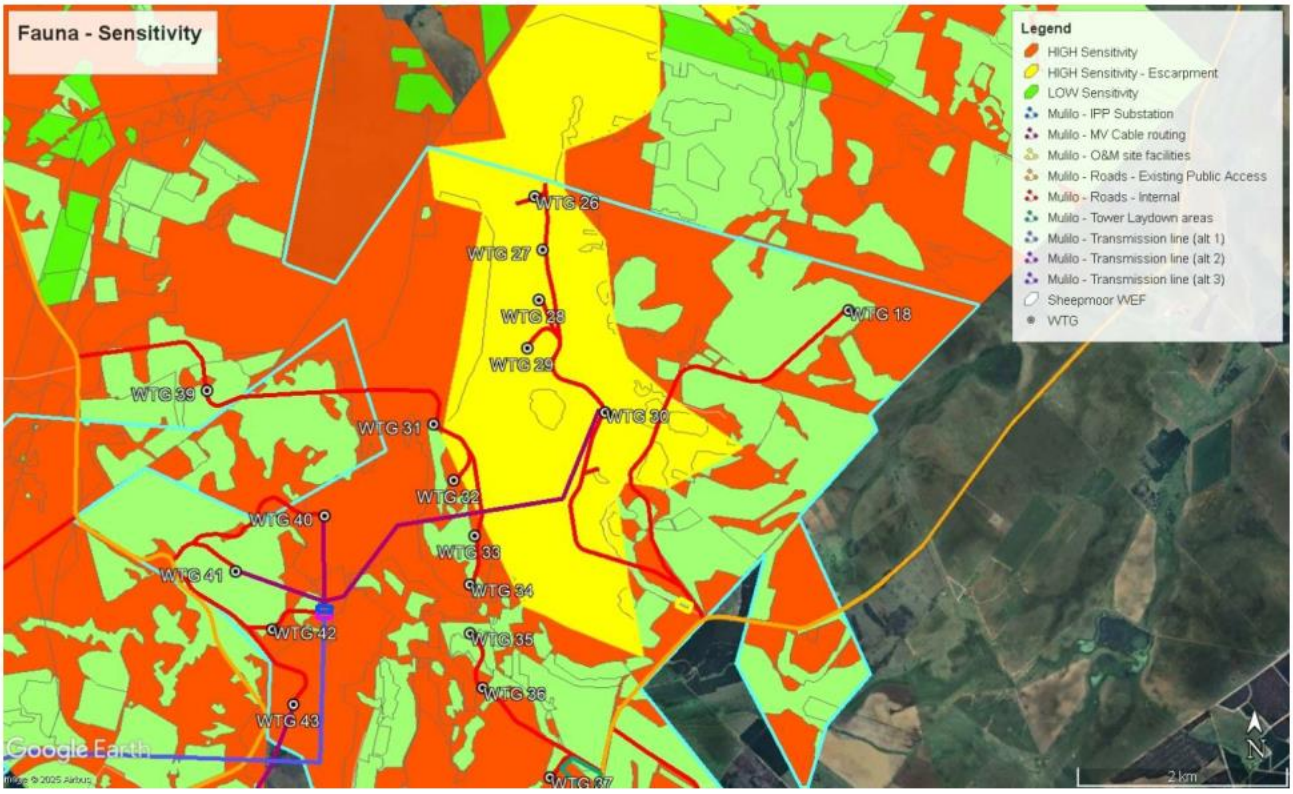


Figure 3-9 - Fauna Sensitivity

3.3.1 BIRDS

According to the Southern African Bird Atlas Project (SABAP2) a total of 253 bird species could potentially occur in the Broader Area where the proposed Sheepmor and Emvelo WEFInfrastructure are located. Of the 253 species, 38 species are classified as priority species for wind energy developments. Of the wind energy development priority species in the Broader Area, 32 have been recorded during the pre- construction monitoring conducted. Of the 253 species, 76 are considered powerline sensitive species of which 57 have been recorded during the pre-construction monitoring.

Fourteen (14) wind energy development priority SCC have been recorded during the on-site field surveys.

Three focal points (FP) of bird activity were identified:

- FP1: A large farm dam in a drainage line. This FP was surveyed once during each survey.
- FP2: Southern Bald Ibis colony (26°37'20.82" South, 30°18'36.43" East)
- FP3: Southern Bald Ibis colony (26°38'28.47" South, 30°17'37.67" East)

A Martial Eagle nest was discovered towards the end of the initial pre-construction monitoring campaign and subsequent additional monitoring effort was devoted to the nest to better understand the flight risk of the eagles around the nest.

3.3.2 FLIGHT RISK MODELLING

Due to the discovery of a Martial Eagle nest within the proposed Emvelo WEF project footprints, extensive additional monitoring was performed to collect flight data of the adult eagles and the juvenile in the area.

The flight risk model and sensitivity zonation for Martial Eagle were developed using a combination of tracking data, focused field observations, and high-resolution environmental predictor variables. While the model incorporates GPS data from one adult (13 months, 6380 transmitted locations) and one juvenile individual (5 months, ~1450 transmitted locations) at the project site, it also includes tracking data (12 months, ~5850 transmitted locations) from a second adult male Martial Eagle monitored at a comparable highland grassland site. This second dataset extended to approximately 12 months and exhibited a remarkably similar spatial use pattern, which is included in the figures reporting on space use. Together, these datasets provided a robust basis for assessing spatial flight activity in relation to nest proximity and landscape features.

In addition to the tracking data, over 37 hours of direct Martial Eagle flight observations were recorded near the nest site during 60 hours of targeted pre-construction surveys. This effort produced a substantial dataset of localized flight behavior, which was used to train a flight risk model (FRM) using an artificial neural network (ANN). The ANN was developed using a suite of predictor variables representing topography and focal site characteristics (distance from nest, perch sites, etc.). This enabled a data-driven approach to modelling spatial risk beyond traditional buffer methods.

3.3.3 ENVIRONMENTAL SENSITIVITIES – WEF

The following environmental sensitivities were identified from an avifaunal perspective for the proposed wind energy facility:

Very High Sensitivity – All Infrastructure Exclusion Zones (i.e, “No-go Area”)

- A 2.5 km No-Go zone around the identified Martial Eagle nest should be implemented and maintained to reduce the risk of collision mortality and displacement due to disturbance.
- All wetland No-Go areas as identified by the Aquatic Specialist should be buffered by an additional 91 on either side to reduce the risk of turbine collisions and to prevent the disturbance of priority species breeding and roosting in these areas. Priority species in this category include African Fish Eagle, African Grass Owl (recorded during dedicated wetland surveys), African Marsh Harrier, Black-winged Pratincole, Blue Crane, Grey Crowned Crane, Long-crested Eagle, Marsh Owl, and Sensitive Species Number 23.
- Sensitive Species 23 habitat – Fine scale habitat modelling and identification of wetland corridors for cryptic / low detection probability wetland species was conducted. High suitability wetland areas were identified by the habitat suitability model and further refined based on habitat surveys, which included the use of in-situ camera traps and microphones, conducted during December 2024 and January 2025.
- Modelled Yellow-breasted Pipit habitat areas are considered No-Go zones. These high-quality grassland areas were identified to prevent displacement of birds due to disturbance and habitat destruction. The Yellow-breasted Pipit model output represents the habitat patches most suitable for the species' using a multi-year assessment of imagery indices etc. spanning 2019–2023. This is to account for variability related to drivers of habitat suitability for grassland habitat specialist species such as these endemic pipits. Primary drivers of variability include seasonal rainfall across years, burning/fire, and grazing intensity. The model boundaries will extend beyond suitable habitat into other habitats (forest edge, roads, etc.) in some areas as we have accounted for typical blade swept area (SA) by buffering the habitat output. This output should be considered high sensitivity and avoided (no-go) given habitat loss/degradation is the primary issue. Currently Wind Turbine

Generators (WTGs) 21 and 23 are located within the All-Infrastructure Exclusion (i.e. No-Go) Zone. These WTGs need to micro-sited out of this zone or removed from the layout completely.

High Sensitivity – Turbine Exclusion Zones.

- A Martial Eagle nest is located in a stand of alien trees north-west of the Project Site (**pls note DEIAr avoids these areas**). The modelled No-turbine buffer zone must be implemented around the nest to reduce the risk of turbine collisions. Currently Wind Turbine Generators (WTGs) avoid the Turbine Exclusion Zone.
- There are two Southern Bald Ibis colonies located within the LSA. A shaped turbine exclusion zone has been delineated based on extensive and detailed modelled flight activity. The modelling workflow incorporated all the flight data collected within the area during the pre-construction monitoring, which included an additional 6-month focal point monitoring regime of the species interaction with the WEF Project Site area. The model identifies high risk flight areas by considering associations between the underlying habitat and topography in relation to the recorded Southern Bald Ibis flight data and proximity to roosts (**pls note WTG 25 moved away from this buffer. WTG and blade are outside of buffer**).
- High Sensitivity grassland habitat for Yellow-breasted Pipit.
- Sensitive Species 23 habitat defined through detailed habitat modelling and then appropriately buffered, movement corridors were determined and buffered to accommodate for nocturnal movement and migration for Sensitive Species 23 (as listed by the National Screening Tool). These habitats are wetlands and/or rank grasslands, and as such would also be important for other threatened wetland species (Striped Flufftail, African Grass Owl, etc.).

Medium Sensitivity – Mitigation Zones.

- A Martial Eagle nest is located in a stand of alien trees north-west of the Project Site. Pro- active mitigation in the form of Shutdown on Demand (SDoD) or automated curtailment must be implemented in the medium risk zones. There are several turbines located within this zone.
- There are two Southern Bald Ibis colonies located inside the Project Site. Pro-active mitigation in the form of Shutdown on Demand (SDoD) or automated curtailment must be implemented in the medium risk zones. There are several turbines located within this zone.
- Sensitive Species 23 habitat defined through detailed habitat modelling and then appropriately buffered by 250 m, movement corridors were determined and buffered to accommodate for nocturnal movement and migration for Sensitive Species 23.These habitats are wetlands and/or rank grasslands, and as such would also be important for other threatened wetland species (Striped Flufftail, African Grass Owl, etc)concern and although a few IBA trigger species are not included in this list the exclusion areas recommended for other similar species included as priority species offer adequate protection for these additional (particularly wetland associated) species. Of the wind energy development priority species in the Broader Area, 32 have been recorded during the pre-construction monitoring. Of the 253 species, 76 are considered powerline sensitive species of which 57 have been recorded during the pre-construction monitoring.

3.3.4 BATS

Bat roosting sites in the PAOI are relatively limited and unlikely to support large congregations of bats, with no underground sites (e.g., caves, mines, sinkholes) known to be present. The closest known major bat roost is approximately 70 km north of the PAOI. Although occasional ridges and rocky outcrops are features of the landscape (Mucina and Rutherford 2006) these are not extensive. Some

bat species could roost in these features. Bats are likely to roost in buildings associated with farmsteads within and bordering the AoI especially Cape Serotine and Egyptian Free-tailed Bat (Monadjem et al. 2020). Trees growing at these farmsteads and elsewhere on site where they form clumps, could also provide roosting spaces for bats, even though most are alien invasive species. Completed surveys of some buildings in the of the PAOI did not reveal the presence of roosting bats and as such were assessed as being of low relative suitability. However, these could be used by bats as night-roosts (locations used by bats to feed on captured prey, or to rest between foraging bouts) and should therefore still be considered, and avoided where possible, in the spatial planning.

Sensitive features in the PAOI at which bat foraging activity may be concentrated include farm buildings where they would forage for insects attracted to lighting (Rydell 1992, Jung and Kalko 2010), dams and wetland areas (Sirami et al. 2013), within and along the edge of woodland/tree patches, and over cultivated areas (Bohmann et al. 2011, Noer et al. 2012). Free- tailed bats (Molossidae) will fly at high altitudes, and their foraging habitat is essentially all airspaces (McCracken et al. 2008, Nguyen et al. 2019).

Based on current taxonomic information and bat occurrence data, 23 species could occur within the PAOI. The majority have a low likelihood of occurrence however the potential suite of species includes 10 high risk species, including fruit bats (Pteropodiae) and free-tailed bats (Molossidae) which are vulnerable to wind energy impacts in South Africa (MacEwan 2016, Aronson 2022).

5 AQUATIC BIODIVERSITY OVERVIEW

This baseline description was based on a summer and winter survey of the study area that spanned a total of two weeks and conducted in February / March 2022 (late summer) and a site-specific assessment in April (Autumn) & September (Later winter) 2023. The area typically receives majority of its rainfall in early January into February. The study area was dominated by a variety of aquatic features associated with catchments and rivers, characterized as follows:

- Mainstem Rivers: Floodplain dominated systems with floodplain wetlands. A few reaches did contain very narrow riparian zones, consisting mostly of a single row of willow trees associated with the Vaal River
- Valley Bottom Wetlands (Channelled and Unchanneled)
- Endorheic pans
- Seep wetlands.

5.1 CONSERVATION CONTEXT

The proposed Wind Energy Facility (WEF) is located in a portion of the Inkomati-Usuthu Water Management

Area, within the upper catchment of the Mpama River (SQ W53) and the Sandspruit (SQ W53A) and the proposed grid connection options are located in the Upper Vaal River (SQ C11B) in the Vaal Water Management Area. Thus, several permanent rivers and a variety of wetland hydrogeomorphic types are anticipated both associated with the riverine valleys and bench or plateaux areas located between river valleys on higher lying areas.

The study region is further characterised by several National Biodiversity Assessment (2018) Wetland Clusters, National Freshwater Ecosystem Area (NFEPAs) and Strategic Water Resources Areas. The geology is mostly shales or sandstone of the Vryhied Group, with several intrusions associated with dolerite sills and dykes in areas associated with the Karoo Supergroup. This typically allows for the development of riverine areas, some with floodplains, interspersed by the rocky inselbergs and small ridges and or bench / plateaus observed. Overall, these catchment and subsequent rivers / watercourses and wetlands range from a Largely Natural to transformed states. Current impacts occur in localised areas and included the following:

- Mining
- Large scale farming
- Forestry
- Erosion due small road crossings and tracks;
- Grazing; and
- Small to large river impoundments, and off channel farm dams.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the watercourses within the site have been assigned a condition score of C (Nel et al. 2011), indicating that they are Moderately Modified, but still have biological significance, while the NBA (2018) data indicated that most mainstem system near the WEF, had a River Conservation Score of B (Usuthu) and B on the Vaal River. These scores were substantiated by observations made in the field within the study area, and due to the impacts or disturbance observed these scores would be upheld. The final EIA report will be supplied with more detailed analysis of the respective systems once the

proposed layout has been refined, as there are just too many systems to assess individually at this stage. Any ratings will the also be substantiated with an assessment of the study area catchments linked to Critical Biodiversity Areas (CBA) and Ecological Support Areas, as shown in the Mpumalanga CBA spatial data.

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel et al., 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs). The study area falls within several FEPA and Upstream FEPA catchments associated with the Usuthu & Vaal River systems. This is large due to the presence of several important fish and aquatic invertebrate habitats that as well as the provision and maintenance of flows within the lower catchments.

5.1.1 PRESENT ECOLOGICAL STATE

The PES of a river 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 current models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The current PES system also 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 updated 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.

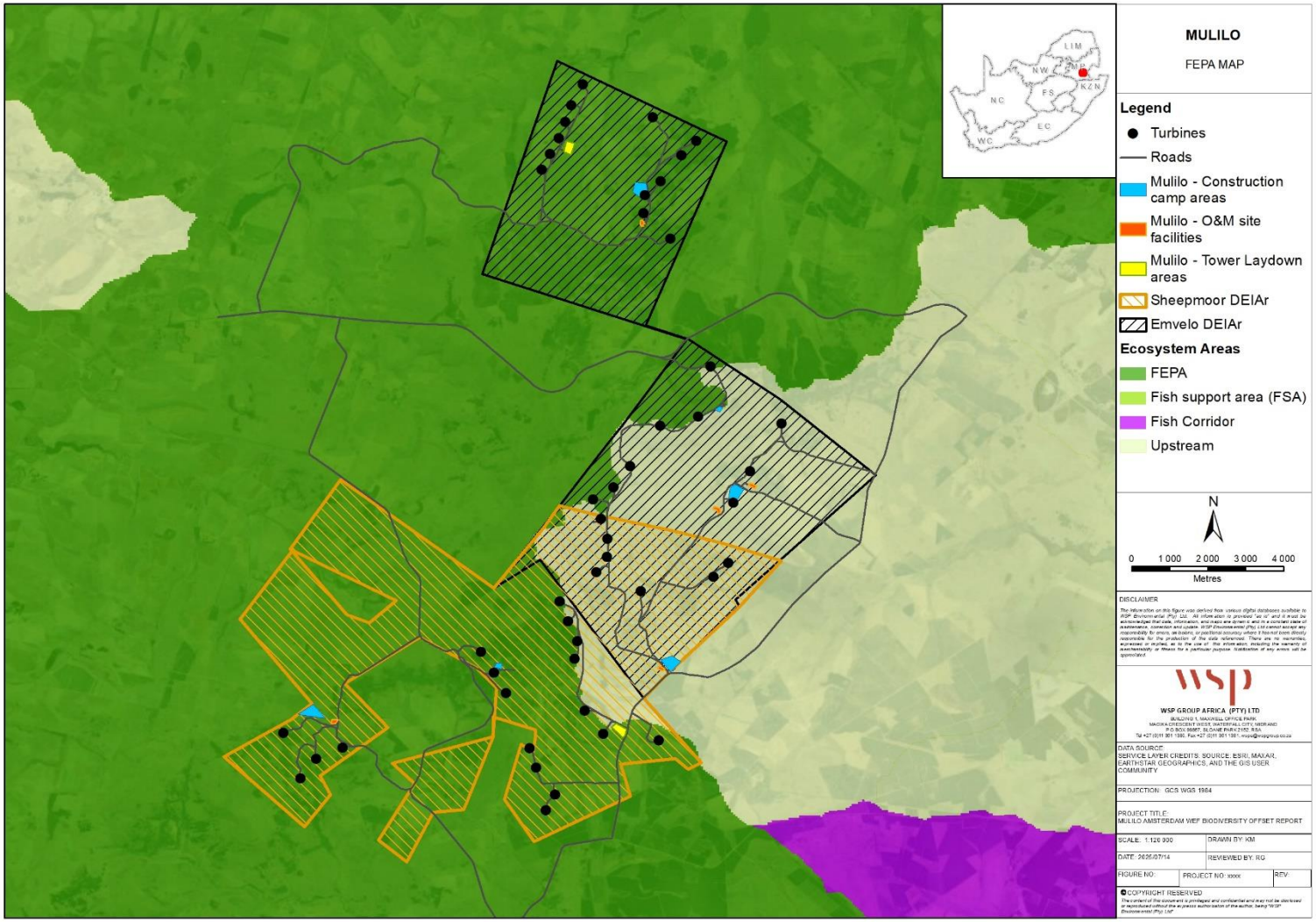


Figure 5-1 - FEPA Sub catchment

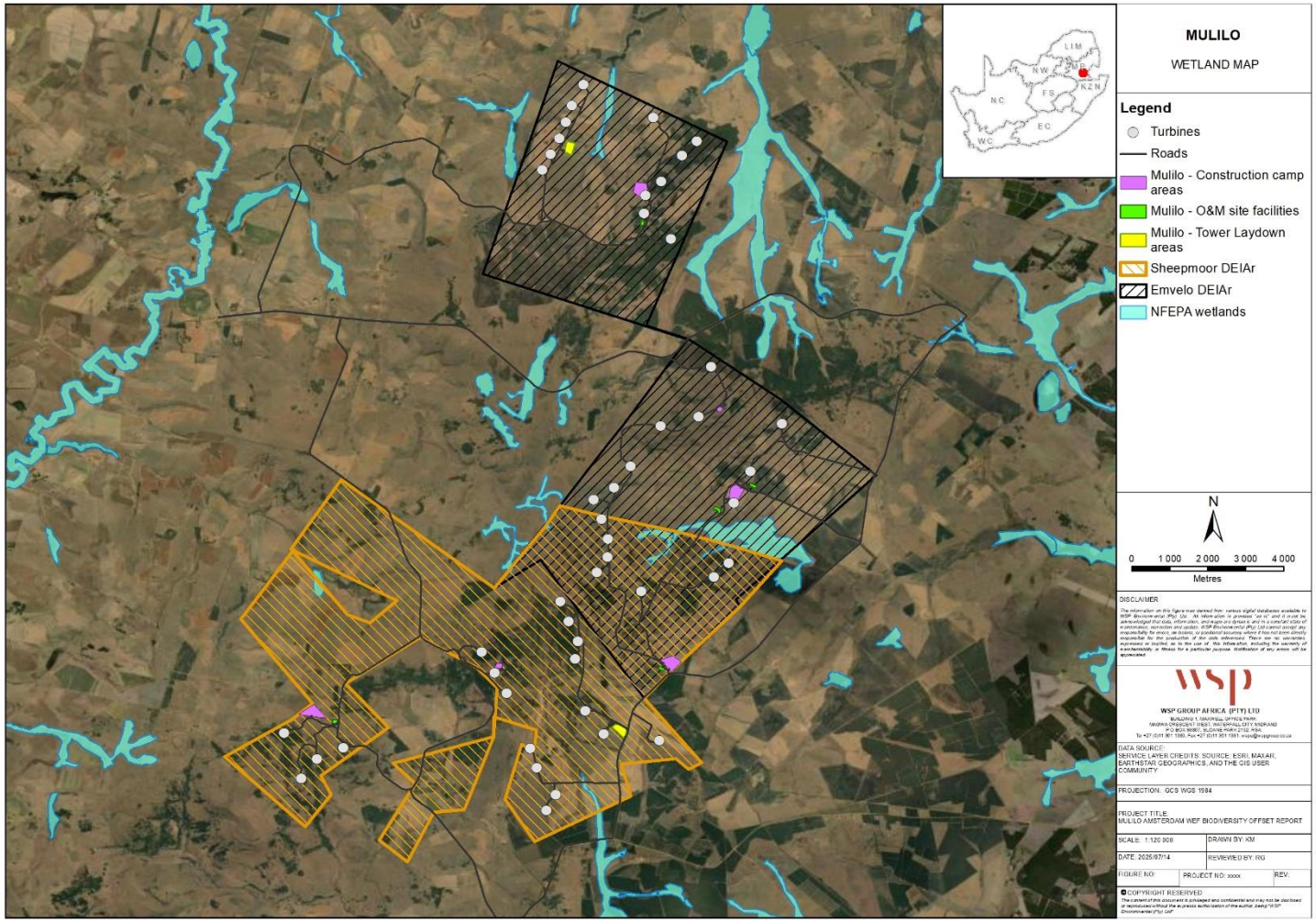


Figure 5-2 – NFEPA Wetlands

6 APPLICATION OF THE MITIGATION HIERARCHY

Biodiversity offsets are the final option in the mitigation hierarchy (Figure 6-1), once all other foregoing steps have been considered to their full extent. Environmental measures that have been incorporated in the Project design so that potential impacts can be avoided, are described in Section 5.1; and additional mitigation measures that have been prescribed in each of the biodiversity specialist reports are summarised in Section 5.2.

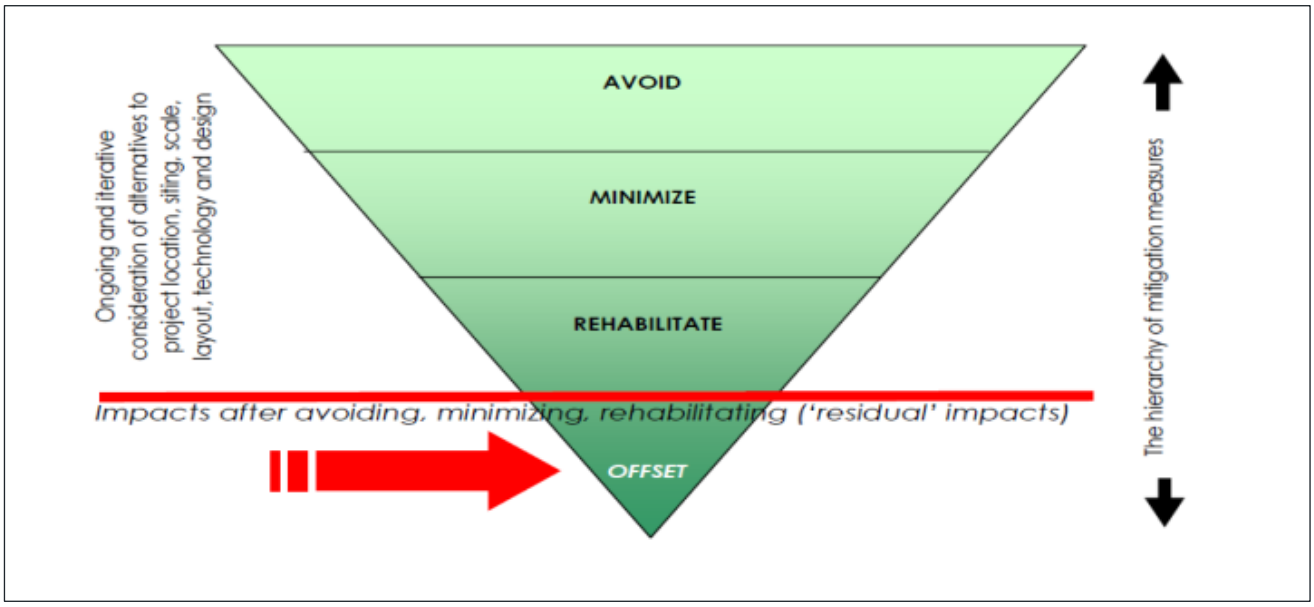


Figure 6-1 - The mitigation hierarchy (DFFE, 2022)

6.1 BIODIVERSITY MITIGATION MEASURES

The mitigation measures to minimise Project impacts on species and ecosystem receptors and rehabilitate impacted areas that have been prescribed in the various biodiversity specialist assessments are summarised as follows.

6.1.1 IMPACTS AND MITIGATION MEASURES

6.1.2 FLORA

Vegetation - Permanent or temporary loss of indigenous vegetation cover because of site clearing. Site clearing before construction will result in the blanket clearing of vegetation within the affected footprint.

- Recommended clearing of alien invaded areas in a ratio of 1:3 for direct loss of natural grassland habitat (as a trade-off or offset), in conjunction with the mitigation measures below as well as post construction rehabilitation of the initial temporary disturbance footprint and implementation of a sound environmental management programme for the duration of the project lifespan can potentially and effectively result in a net positive impact. The loss of vegetation because of the loss of the expected project footprint (~180 Ha) is far outweighed by the potential improvement that can be achieved on the remaining habitat of the site (~7 000 Ha) through the positive management

measures that can be implemented through the EMPr on farmland where there are currently no EMPr in place.

- Site layout to avoid more sensitive vegetation as far as technically viable. Most of the risks associated with this impact have been reduced through identification of risk areas during the initial assessment phases and careful layout design in response to the respective sensitivity.
- Site layout design has effectively reduced this impact to negligible levels with only a very small proportion of the footprint occurring in or near higher sensitivity areas. Very High Sensitivity or No-Go habitat has largely been avoided and reduced to an acceptable level.
- Mitigation measures and management actions are proposed to enhance areas of habitat as a trade-off to offset this nominal loss of elevated sensitivity areas.
- Blanket clearing of vegetation must be limited to the site and footprint. No blanket vegetation clearing outside of footprint to take place.
- Topsoil must be striped and stockpiled separately during site preparation and replaced on completion in areas where revegetation or rehabilitation will take place.
- Any site camps and laydown areas requiring clearing must be located within already disturbed areas and away from watercourses.

Flora Species - Loss of flora species of special concern during pre-construction site clearing activities

- A pre-construction site walkdown to be conducted before commencement to identify SCC's that may require relocation or to microsite turbine positions. A search and rescue must be undertaken before construction commences. Any flora search and rescue will likely include a few individuals of widespread, cosmopolitan or common but protected species.
- Respective permits to be obtained prior to construction commencing.

Faunal Species, Habitat & Processes - Loss of Faunal Species, Habitat & Processes: Activity will result in the loss of faunal species and faunal habitat as well as disruptions to faunal processes.

- High sensitivity areas as identified by the respective faunal specialists to be avoided and specific mitigation measures as per specialists to be implemented.
- Blanket clearing of vegetation must be limited to the footprint.
- The habitats and microhabitats present on the project site are not unique and are widespread in the general area, hence the local impact associated with the footprint would be of low significance if mitigation measures are adhered to.
- Small mammals within the habitat on and around the affected area are generally mobile and likely to be transient to the area. They will most likely vacate the area once construction commences. As with all construction sites there is a latent risk that there will be some accidental mortalities. Specific measures are made to reduce this risk. The risk of species of Conservation Concern is low, and it is unlikely that there will be any impact to populations of such species because of the activity.
- Reptiles such as lizards are less mobile compared to mammals, and some mortalities could arise. It is recommended that a faunal search and rescue be conducted before construction commences, although experience has shown that there could still be some mortalities as these species are mobile and may thus move onto site once construction is underway. A reptile handler should be on call for such circumstances.
- Should any amphibian migrations occur between wetland areas during construction, appropriate measures (including suspending works in the affected area) should be implemented.
- A pre-commencement faunal search and rescue is recommended, but not necessarily required. Respective permits to be obtained beforehand.

- No animals are to be harmed or killed during operations including use of snares.

Alien Invasive Species - Susceptibility of post construction disturbed areas to invasion by exotic and alien invasive species and removal of exotic and alien invasive species during construction. Post construction disturbed areas having no vegetation cover are often susceptible to invasion by weedy and alien species, which can not only become invasive but also prevent natural flora from becoming established.

- Alien species (including alien invasive trees) and weeds must be removed from the site as per CARA/NEMBA requirements.
- A suitable weed management strategy to be implemented during construction and operation phases as outlined in the EMPr section of this report. It is imperative that any actions are implemented timeously as once alien and weed species generate seeds, the problem is exacerbated.
- After clearing and construction is completed, an appropriate cover may be required, should natural re-establishment of grasses not take place in a timely manner along road verges. This will also minimise dust.
- Recommended clearing of alien invaded areas in a ratio of 1:3 for loss of natural grassland habitat, in conjunction with ongoing alien vegetation management of the project footprint will likely result in a net positive impact.

6.1.3 FAUNA

- The various identified faunal impacts are assessed below for the different phases (construction/operational) of the proposed wind farm development. Impacts are based on the information provided to date by ERM, and any changes to these or to the project would require a reassessment.
- The proposed layout proposes several turbines, new access roads, and OHPL alternatives within high sensitive areas. Several of these areas appear to offer ideal habitat for the Oribi, katydid, and the high sensitive escarpment area is likely of general importance for a range of faunal groups, representative of a large contiguous and ecologically intact area of mostly montane grassland.
- Overall, the impact significance during the different phases of the proposed development is considered high negative and moderate negative when mitigation is considered, although it is uncertain if mitigation would fully reduce impacts due to the potentially large total amount of high sensitive habitat loss. Lack of micro-siting of turbines and roads further limits confidence in assessing final impacts. Main impacts will likely come from the building of access roads, especially in high sensitive areas where no formally established roads currently exist. Although turbines have relatively small footprints and impacts during construction can be limited to a certain degree, the main impacts from turbines are likely to come during their operational phase. Access roads could also have continued impacts during the operational phase (Helldin et al., 2012). All OHPL alternatives should have low-medium impacts during construction, if no associated servitude road is built.
- impacts on faunal SCC, although long-term avoidance by mammals of habitat associated with OHPLs has been observed in some cases (Tyler et al., 2014).

Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use.

- If possible, micro-siting of turbine and access roads pre-construction; even small adjustments in placement can help avoid ecologically sensitive areas.
- If high sensitive areas are to be developed, then off-sets will be required.
- Clearing of natural vegetation should be kept to a minimum where possible.
- The smallest possible working corridor, particularly close to sensitive habitats, must be used.
- A ~5 m buffer zone should also be considered for any development close to any high sensitive areas.
- No construction vehicles are allowed within no-go areas.
- Limiting the number and speed of vehicle movements to, from, and within the project area.
- All temporary/permanent security fences will need to be modified (e.g. maintaining a gap, at reasonable intervals, between the base of the fence and the ground of approx. 30 cm) to allow small and medium-sized animals to move freely through and to not act as a barrier to dispersal.
- Any drainage/water run-off trenches required to be built alongside roads should be shallow and broad with low-angle sides (<30 degrees) so as not to trap fossorial invertebrates (e.g. dung beetles) and small vertebrates (e.g. moles, snakes, tortoises).
- Alien invasive vegetation found on the project area should be removed by an alien plant clearing team during the construction phase; invasive alien plants are seen as a significant threat to faunal SCC.
- Restoration and rehabilitation: Natural vegetation or biodiversity features impacted from construction-related activities that could not be completely avoided and/or minimised through re-vegetating of temporary-use and lay-down areas as soon as reasonably practicable after the construction phase.

6.1.4 NO GO ALTERNATIVE

Loss of local populations of faunal SCC through continued loss of remaining patches of grassland habitat from alien plants, over-grazing, and agriculture. Consequences of such impacts can result in the loss of populations of SCC, Further fragmentation of sub-populations of SCC across grassland habitats.

8 RESIDUAL IMPACTS REQUIRING OFFSET

The LSA and Project infrastructure are situated in a high biodiversity value landscape, interacting with extensive areas of natural habitats, areas mapped as terrestrial and aquatic CBAs according to the MBSP, and an IBA, and supports numerous flora and fauna SCC. As a result, a number of residual impacts of moderate-high significance on species and ecosystem receptors have been identified in the various terrestrial and aquatic biodiversity specialist assessment reports. The significant residual impacts are summarised in Table 8-1.

Table 8-1 – Significant residual impact summary for Emvelo and Sheepmoor WEF's

Aspect	Impact Description	Phase	Character	Without Mitigation	With Mitigation
Aquatic Biodiversity	Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones. Loss can also include a functional loss, through change in vegetation type via alien encroachment, reducing aquatic biodiversity. However no aquatic vegetation with conservation concern were observed during this assessment, coupled to the fact that any sensitive areas will be avoided.	C	(-)	Moderate	Low
	Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones and have been included in any Critical Biodiversity Areas. It is assumed that the final layout will orientate the hardstands, crane pads, blade laydowns and construction camps outside of any of the No-Go areas	C	(-)	Moderate	Low
	During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required. This disturbance then allows for the alien species to colonise the soils, if left unmanaged.	C	(-)	Moderate	Low
	During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required, which may	O	(-)	Moderate	Low

Aspect	Impact Description	Phase	Character	Without Mitigation	With Mitigation
	impact the aquatic function or any corridors or connections between aquatic systems. However, all Very High Sensitivity / No-Go areas have been avoided by the proposed layout by also making use of existing road crossings or considering any of the proposed buffers				
	During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required, which may impact the aquatic function or any corridors or connections between aquatic systems. However, these areas must be by the proposed layout by also making use of existing road crossings or by considering any of the proposed buffers	O	(-)	Moderate	Low
	During construction or decommissioning, earthworks will expose and mobilise earth materials, and a number of materials as well as chemicals will be imported and used on site and may end up in the surface water, including soaps, oils, grease and fuels, human wastes, cementitious wastes, paints and solvents, etc. Any spills during transport or while works area conducted in proximity to a watercourse has the potential to affect the surrounding biota. This can result in possible deterioration in aquatic ecosystem integrity and species diversity	D	(-)	Moderate	Low
Bats	Removal of native vegetation, noise and dust generated during construction activities, and the presence of new infrastructure in the landscape, will negatively and indirectly impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement	C	(-)	Low	Low
	Vegetation clearing for grid connection infrastructure (access roads, substation buildings, pylons), as well as noise and dust generated during the construction phase, will impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement ***Sheepmoor WEF Specific***	C	(-)	Low	Low

Aspect	Impact Description	Phase	Character	Without Mitigation	With Mitigation
	Bat mortality (direct impact) through collisions and/or barotrauma with wind turbine blades is the principal impact of wind energy facilities on bats	O	(-)	High	Moderate
	Avoidance of wind turbines by bats, in some cases over several hundred meters distance, has been observed for various species in different habitats, including farmland, resulting in displacement impacts	O	(-)	Moderate	Low
	Construction of grid infrastructure will increase ecological light pollution from artificial lighting associated with the substation and other operational and maintenance buildings. Light pollution can alter ecological dynamics ***Sheepmoor WEF Specific***	O	(-)	Moderate	Low
Animal Species	Faunal species of conservation concern are present within the affected area and are likely to be mobile during operational phase (excluding avifauna), which could result in mortalities.	C	(-)	Low	Low
	Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use	C	(-)	High	Moderate
	Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use	O	(-)	High	Moderate
Avifauna	Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure. Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure	C	(-)	Moderate	Moderate

Aspect	Impact Description	Phase	Character	Without Mitigation	With Mitigation
	Displacement of powerline sensitive species due to disturbance. Displacement of powerline sensitive species due to habitat transformation.	C	(-)	Moderate	Low
	Habitat Transformation	C	(-)	Moderate	Low
	Increased soil erosion and sedimentation	C	(-)	Moderate	Low
	Mortality due to collisions with the wind turbines. Mortality due to electrocutions on the overhead sections of the internal 33 kV cables (if any). Mortality due to collisions with the overhead sections of the internal 33 kV cables (if any).	O	(-)	High	Moderate
	Mortality due to Electrocution (internal 33 kV cables) (if any)	O	(-)	High	Low
	Mortality of priority species due to collisions with the 132 kV OHPL Electrocutions on the 132 kV OHPL and/or in the Substation Yard	D	(-)	High	Moderate
Plant Species	Site clearing before construction will result in the blanket clearing of vegetation within the affected footprint. The proposed footprint comprises an insignificant portion of the vegetation unit regionally and extensive areas of natural vegetation are present surrounding the site. Core habitat areas have been identified for avoidance during the preliminary sensitivity mapping and accommodated in the design	C	(+)	Moderate	Positive
	Species of conservation concern are present within the affected area, which could be destroyed during site clearing. The proposed footprint comprises a negligible portion of the vegetation unit regionally and locally and extensive areas of natural vegetation are present surrounding the site. All species are widespread species, and removal will not result in any significant impact to any flora species or population. While present in the area, species of conservation concern are not prevalent	C	(-)	Low	Low

Aspect	Impact Description	Phase	Character	Without Mitigation	With Mitigation
	within the WEF project site and generally in inaccessible areas or remnant vegetation that are excluded				
	Exotic (weed) and alien invasive species may proliferate during and after construction in disturbed areas. Areas disturbed during construction, having no vegetation cover, including temporary stockpile areas, are often susceptible to invasion by weedy and alien invasive species, which can not only become invasive but also prevent natural flora from becoming established	C	(+)	Low	Low

9 TARGETS FOR OFFSET

Since direct loss of terrestrial habitats cannot be mitigated, these losses must be offset. The results of the guidance provided in the draft Biodiversity Offset Guidelines (DFFE, 2023) are presented in the following sections.

9.1 TERRESTRIAL HABITAT

Residual impacts on terrestrial habitat were defined as the extent of natural habitats supporting plant/fauna SCC that would be lost as a result of the proposed development options.

The basic and adjusted offset ratios for natural terrestrial habitats are set out in Table 9-1, based on the biodiversity offset ratios look-up table provided in the draft Biodiversity Offset Guideline. When the relevant habitats fall within a CBA1, the ratio is automatically set to 30:1, while the basic ratio for areas within CBA2 is adjusted by increasing it by a factor of 1.5. For other mapped categories, excluding 'heavily modified' and 'modified' areas (i.e. Ecological Support Areas - ESAs and Other Natural Areas - ONA) the basic ratio applies.

Table 9-1 – Basic and adjusted biodiversity offset ratios for terrestrial habitats

Criteria	Basic Ratio (DFFE, 2023)	CBA1	CBA2
Endangered ecosystems	10:1	30:1	15:1
Vulnerable ecosystems	5:1	30:1	7.5:1
Eastern Highveld Grassland (EN)	13:1	30:1	19.5:1
Wakkerstroom Montane Grassland (LC)	0	30:1	1.5:1

Mapped vegetation communities within the LSA that will be lost as a result of the proposed infrastructure were ranked according to their occurrence in CBA1, CBA2, ESA and ONA areas mapped by the MBSP. Targets were then set for areas of natural habitat loss (i.e. loss of Montane Grassland, Highveld Grassland, excluding Wetland) only. Loss of areas of Alien Tree Plantations, Cleared Invaded, Plantations and Transformed areas was not included in target setting, even if they occurred within areas mapped as CBA, since their loss is not considered a significant impact.

The calculated targets for each vegetation group within the LSA, for each Project component, are summarised on Table 9-2, with a total of 507.15 ha.

Table 9-2 – Terrestrial habitat offset targets

MBSP category and Vegetation Communities verified infield	Estimated extent of loss based on current design (ha)	Offset Target Total
Sheepmoor and Emvelo	**31.4**	**507.15**
CBA Irreplaceable	**13.7**	**411**
Eastern Highveld Grassland	12.2	366
Wakkerstroom Montane Grassland	1.5	45
CBA Optimal	**9.3**	**82.95**
Eastern Highveld Grassland	6	78
Wakkerstroom Montane Grassland	3.3	4.95
ESA Local and Landscape corridor	**8.4**	**13.2**
Eastern Highveld Grassland	0.4	5.2
Wakkerstroom Montane Grassland	8	8

10 CANDIDATE OFFSET SITES

Wherever possible, a 'like-for-like' biodiversity offset is preferred so that residual negative impacts on affected biodiversity features are appropriately compensated – ensuring no net loss of that feature on a local or regional scale. In addition, the realities of securing offsets in the long-term depends heavily on securing appropriate areas from a land tenure and/or management perspective. For this reason, the selection of candidate offset sites should focus on nearby habitats within the LSA, where the Project Developer has established relationships with landowners and can capitalise on this for offset planning purposes. Sheepmor and Emvelo WEF's have achieved this by pro-actively approaching landowners within the LSA and establishing lease conditions, these lease conditions have been signed by the landowners and are effectively maintenance and repairs considerations which includes natural areas.

The draft National Biodiversity Offset guideline (DFFE, 2022) requires that the below-listed principles – which are widely recognised in standard offset guidance (e.g. BBOP, 2009) – guide the selection of suitable candidate offset sites; these principles were also applied when identifying potentially suitable areas and required actions for offset:

- *Biodiversity offset sites should be selected for ecological equivalence (the "like-for-like" principle) or, where appropriate, there could be "trading-up" to select an area of relatively high or more urgent conservation priority.*
- *Selection should be guided as far as possible by existing biodiversity priority areas in the landscape (for example, the CBA and ESA network, Freshwater Ecosystem Priority Areas, and focus areas for protected area expansion) and/or areas identified as strategic from an ecological infrastructure perspective (such as Strategic Water Source Areas).*
- *Biodiversity offsets should strive to secure the best examples of the features which have been impacted and to improve connectivity in the landscape between protected and priority areas for biodiversity.*
- *The final selection can be influenced by the reasonable consideration of factors other than the biodiversity value of the different candidate sites, such as: ease of the management of the site by a relevant management authority; and threats to conservation due to conflicting land use rights, claims or land use classification*.

For biodiversity offsets in terrestrial ecosystems, rehabilitation and preferably restoration of areas in modified condition (i.e. no longer natural or near-natural) is seen as an integral part of the required management of the offset site. The guidelines state it is optimal for candidate biodiversity offset sites to be in a good ecological condition (natural or near-natural state), to minimise the additional burden of having to rehabilitate or restore an area (DFFE, 2022); however, some level of rehabilitation of natural habitats with a low level of disturbance is normally anticipated.

Wetland offsets, on the other hand, are often focussed in systems that are moderately modified, where the greatest potential for functional gain can be feasibly achieved via implementation of a wetland rehabilitation plan.

Candidate offset sites and required biodiversity outcomes for wetland and terrestrial habitat are therefore proposed to include:

- Unaffected wetland habitat within the study area:

- The presence of extensive areas of modified wetland habitat within the LSA, representing each of the HGM units that will be lost, presents an opportunity for implementation of a wetland rehabilitation programme within the LSA to compensate wetland loss, through securing functional gains via rehabilitation.
- In targeted wetlands, the objective will be to increase the PES score/category through improvement of wetland health as a result of rehabilitation activities, thereby securing functional gains.
- Both the ecosystem conservation target and functional ha-eq target will be easily achievable within the LSA.
- It is envisaged that any necessary wetland offset will be secured via the necessary landowner agreement for the Water Use License that will be required for the implementation of rehabilitation structures/works in wetlands and watercourses. The wetland offset will therefore be done via the WULA process (separate to the EA process).

- Unaffected terrestrial habitat within the study area:
  - Disturbed areas as well as transformed areas, which includes cultivated lands disturbed Montane Grassland, disturbed Highveld Grassland and alien invasive plantations, present the opportunity for additional gains to Montane Grassland and Highveld Grassland through focussed restoration activities. A total of ***4212ha*** of various levels of disturbed habitat is available for restoration efforts as illustrated in Figure 10-1 and Figure 10-2. The focus of the restoration efforts will address the driver of the high biodiversity value of the Escarpment area as well as other High Sensitive natural areas. The aim will therefore be restoring disturbed Montane Grassland and disturbed Highveld Grassland that is currently in a less desirable state and thereby create additional habitat for the SCC that was recorded (*Ourebia ourebi*).
  - Avifauna buffer areas as prescribed in the Avifauna specialist assessment will benefit and be more functional with the additional Montane Grassland and Highveld Grassland, and less cultivated lands and alien invasive plantations.
  - Grassland: areas of natural habitat (i.e. Montane Grassland and Highveld Grassland) within the LSA; particularly those areas situated within CBA1/CBA2 areas, and adjacent to areas of loss; since landowners of areas where construction will take place are already engaged. The final areas and required extent of offset will be confirmed once consultation is finalised, final residual impacts quantified, and agreements with landowners secured.
  - Stewardship agreements with landowners and local communities – support conservation and enhancement of Montane Grassland and Highveld Grassland, and linked fauna species, through management and protection of high ecological importance natural grasslands in the LSA. Conservation servitudes may be utilised to give effect to landowner agreements.
  - Areas where land use consists primarily of livestock grazing of open veld, if incorporated into protection-based offset areas, can potentially provide biodiversity support and demonstrate improved ecological integrity in the long-term, if targeted by suitable management plans e.g. grazing management plans, fire management.



Figure 10-1 - Emvelo Disturbed Habitat



Figure 10-2 - Sheepmoor Disturbed Habitat

10.1 SIGNED LEASE AGREEMENTS

Mulilo has entered into lease agreements with landowners associated with the LSA, the current Signed Option and Lease agreements provides the possibility for far reaching conservation orientated activities to be achieved. The following clauses have been extracted from the lease agreements as examples of conservation orientated activities that are possible.

- Clause 8.3 – Permitted Use:

The Lessee shall utilize the Property for the purpose of constructing, operating, and maintaining the Renewable Energy Facility, and shall not use it for any other purpose without the Lessor's prior written consent, which shall not be unreasonably withheld.

- Clause 6.4 – Special Conditions & Feasibility Studies:

The Lessee is entitled to perform "Feasibility Studies," including environmental assessments.

- Clause 13.2 – Maintenance and Repairs:

Mulilo can motivate to the lessor that the offset plan is part of maintenance and repairs.

The above discussed clauses and the appetite and capability of Mulilo to implement conservation orientated activities will ensure the landscape and species present will benefit from targeted

conservation actions which will benefit the landowners in the long term by creating a stable and resilient ecosystem.

10.2 OFFSITE ACTIONS FOR PRIORITY BIRD SPECIES

Since area-based offsets for residual impacts on affected bird species are not feasible, several offsite actions have been proposed in an effort to achieve no net loss of these species. These include:

- Partnering with the local Rehabilitation Centre to rehabilitate injured birds.
- Donating 5000 Bird diverters to EWT to target high-risk powerlines every 10 years of the project.
- Support of ongoing bird research programmes, particularly for threatened and endemic species, in partnership with universities, and conservation NGOs (e.g. BLSA, EWT).
- Support of improved management of current or potential protected areas that are important sites for the species of concern present within the LSA.
- Support of existing conservation programmes/sites such as Threatened grasslands Species Programme.

It is noted that the finalised agreed offsite actions will be included in the Project BAP subject to determination of the final Project layout.

10.3 CONCEPTUAL MANAGEMENT MEASURES AND PROGRAMME

The conceptual management measures that would need to be employed as part of the biodiversity offset, and programme for implementation, for which the Project developer would be responsible, are summarised in Table 10-1.

Table 10-1 – Conceptual offset management measures and programme for implementation

Management actions	Pre-construction	Construction	Operation
Agree extent and location of offset sites with authorities			
Secure landowner agreements, including legal processes to register conservation servitudes			
Legal mechanism(s), in terms of which the biodiversity offset site would be secured			
Draft Biodiversity Offset Management Plan			
Public Participation			
Final Biodiversity Offset Management Plan			
Offset management activities, including offsite actions for priority bird species			
Biodiversity monitoring (fauna, operation phase avifauna monitoring) in operational area, and of offset sites			

Adaptive management			

11 RECOMMENDED CONDITIONS FOR ENVIRONMENTAL AUTHORISATION

The below-listed conditions are proposed for inclusion in the environmental authorisation, should the Project be authorised, based on the guidance provided in the draft National Biodiversity Offset Guideline:

- The Environmental Authorisation (EA) holder must select a biodiversity offset site(s) from the identified candidate portfolio, of options as per current consultation with landowners, that is sufficient to meet the targets for offset, to be confirmed based on the footprint of the final design (to be determined post EA).
- Only in situations that the proposed offset sites within the LSA are not feasible can the EA holder select a biodiversity offset site that is not identified in the Biodiversity Offset Report and associated consultations, but still meets the requirements for a biodiversity offset under the circumstances – in this situation, the guidance of the relevant conservation planning authority, i.e. MPTA, DFFE will be sought.
- A request for the declaration of the chosen biodiversity offset site as a protected area should be submitted to the Minister or an MEC. Other means of securing the biodiversity offset site (such as the registration of a conservation servitude) may be pursued if the Minister or MEC refuses to declare a protected area under the circumstances.
- A Biodiversity Offset Management Plan must be prepared for the biodiversity offset site and incorporated into the EMPr or a Biodiversity Offset Implementation Agreement.
- A Biodiversity Action Plan (BAP) should be prepared for the Project, subsequent to the finalised layout, in consultation with the relevant authorities and conservation organisations.

12 REFERENCES

BBOP (2009). Biodiversity Offset Design Handbook. Business and Biodiversity Offsets Programme (BBOP), Washington, D.C. Available from: www.forest-trends.org/biodiversityoffsetprogram/guidelines/odh.pdf

DFFE (2022). Draft National Biodiversity Offset Guideline. Department of Forestry, Fisheries and the Environment. Government Gazette No. 46088, 25 March 2022.

ERM (2024). Proposed Sheepmoor Wind Energy Facility and Auxiliary Infrastructure– Draft Environmental Impact Assessment Report.

ERM (2024). Proposed Emvelo Wind Energy Facility and Auxiliary Infrastructure– Draft Environmental Impact Assessment Report.

Appendix A

AFFECTED TERRESTRIAL HABITATS

Project	Category	Subcategory	Area_Ha
Emvelo	Heavily or moderately modified	Heavily modified	0.107961
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.877223
Emvelo	Heavily or moderately modified	Heavily modified	0.985199
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.270908
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.17268
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.097189
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.439848
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.006567
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.467706
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.517481
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.98519

Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.468742
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.516444
Emvelo	Heavily or moderately modified	Heavily modified	0.985188
Emvelo	Critical Biodiversity Area	CBA Optimal	0.026169
Emvelo	Heavily or moderately modified	Heavily modified	0.959018
Emvelo	Heavily or moderately modified	Heavily modified	0.985188
Emvelo	Heavily or moderately modified	Heavily modified	0.985194
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.199567
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.272005
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.513606
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.438674
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.504941
Emvelo	Heavily or moderately modified	Heavily modified	0.041569
Emvelo	Heavily or moderately modified	Heavily modified	0.985188
Emvelo	Other Natural Areas	Other Natural Areas	0.985189
Emvelo	Critical Biodiversity Area	CBA Optimal	0.795376
Emvelo	Critical Biodiversity Area	CBA Optimal	0.189809
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.146444
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.838741
Emvelo	Critical Biodiversity Area	CBA Optimal	0.338153
Emvelo	Heavily or moderately modified	Heavily modified	0.647027
Sheepmoor	Heavily or moderately modified	Heavily modified	0.000345
Sheepmoor	Heavily or moderately modified	Heavily modified	0.984846
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.009859
Sheepmoor	Heavily or moderately modified	Heavily modified	0.001476
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.014746
Sheepmoor	Heavily or moderately modified	Heavily modified	0.959101
Emvelo	Other Natural Areas	Other Natural Areas	0.985185
Emvelo	Other Natural Areas	Other Natural Areas	0.985184
Emvelo	Other Natural Areas	Other Natural Areas	0.985189
Emvelo	Other Natural Areas	Other Natural Areas	0.985193
Emvelo	Other Natural Areas	Other Natural Areas	0.985198
Sheepmoor	Other Natural Areas	Other Natural Areas	0.985187
Sheepmoor	Other Natural Areas	Other Natural Areas	0.985191
Sheepmoor	Other Natural Areas	Other Natural Areas	0.985186
Sheepmoor	Other Natural Areas	Other Natural Areas	0.985191
Sheepmoor	Heavily or moderately modified	Heavily modified	0.286194
Sheepmoor	Other Natural Areas	Other Natural Areas	0.283334
Sheepmoor	Other Natural Areas	Other Natural Areas	0.415658
Sheepmoor	Ecological Support Area	ESA Local corridor	0.623816
Sheepmoor	Other Natural Areas	Other Natural Areas	0.245969
Sheepmoor	Heavily or moderately modified	Heavily modified	0.018485
Sheepmoor	Other Natural Areas	Other Natural Areas	0.096915
Sheepmoor	Other Natural Areas	Other Natural Areas	0.985188

Sheepmoor	Other Natural Areas	Other Natural Areas	0.590959
Sheepmoor	Heavily or moderately modified	Heavily modified	0.231364
Sheepmoor	Other Natural Areas	Other Natural Areas	0.16286
Sheepmoor	Heavily or moderately modified	Heavily modified	0.788169
Sheepmoor	Other Natural Areas	Other Natural Areas	0.197012
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.585723
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.399457
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.43943
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.109417
Sheepmoor	Heavily or moderately modified	Heavily modified	0.436337
Sheepmoor	Other Natural Areas	Other Natural Areas	0.628362
Sheepmoor	Other Natural Areas	Other Natural Areas	0.356823
Sheepmoor	Heavily or moderately modified	Heavily modified	0.985191
Sheepmoor	Heavily or moderately modified	Heavily modified	0.985182
Sheepmoor	Ecological Support Area	ESA Local corridor	0.985193
Sheepmoor	Other Natural Areas	Other Natural Areas	0.092729
Sheepmoor	Heavily or moderately modified	Heavily modified	0.463165
Sheepmoor	Other Natural Areas	Other Natural Areas	0.429292
Sheepmoor	Ecological Support Area	ESA Local corridor	0.981297
Sheepmoor	Other Natural Areas	Other Natural Areas	0.003888
Sheepmoor	Heavily or moderately modified	Heavily modified	0.632403
Sheepmoor	Heavily or moderately modified	Heavily modified	0.352774
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.559896
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.425299
Sheepmoor	Heavily or moderately modified	Heavily modified	0.985198
Sheepmoor	Heavily or moderately modified	Heavily modified	0.985185
Sheepmoor	Ecological Support Area	ESA Landscape corridor	0.985193
Sheepmoor	Ecological Support Area	ESA Landscape corridor	0.436864
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	0.54627
Sheepmoor	Ecological Support Area	ESA Landscape corridor	0.00205
Sheepmoor	Heavily or moderately modified	Heavily modified	2.068876
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.015168
Emvelo	Other Natural Areas	Other Natural Areas	1.494372
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	3.636258
Sheepmoor	Other Natural Areas	Other Natural Areas	3.009691
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	10.02292
Emvelo	Critical Biodiversity Area	CBA Optimal	10.19563
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	3.137904
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	3.100352
Sheepmoor	Other Natural Areas	Other Natural Areas	7.033796
Sheepmoor	Other Natural Areas	Other Natural Areas	0.798259
Sheepmoor	Heavily or moderately modified	Heavily modified	0.597974
Sheepmoor	Other Natural Areas	Other Natural Areas	0.40479
Sheepmoor	Ecological Support Area	ESA Landscape corridor	0.118388

Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	1.183817
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	1.027898
Emvelo	Critical Biodiversity Area	CBA Optimal	0.019376
Emvelo	Heavily or moderately modified	Heavily modified	2.747518
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.119214
Sheepmoor	Other Natural Areas	Other Natural Areas	0.092123
Emvelo	Heavily or moderately modified	Heavily modified	0.014615
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	4.117127
Sheepmoor	Heavily or moderately modified	Heavily modified	1.060366
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	1.444943
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.066948
Emvelo	Heavily or moderately modified	Heavily modified	5.913674
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	0.720758
Emvelo	Critical Biodiversity Area	CBA Optimal	0.445298
Emvelo	Heavily or moderately modified	Heavily modified	0.909514
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.063712
Sheepmoor	Critical Biodiversity Area	CBA Optimal	0.393752
Sheepmoor	Heavily or moderately modified	Heavily modified	2.105846
Sheepmoor	Heavily or moderately modified	Heavily modified	2.241653
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	0.053817
Sheepmoor	Other Natural Areas	Other Natural Areas	1.39514
Sheepmoor	Other Natural Areas	Other Natural Areas	0.684304
Emvelo	Critical Biodiversity Area	CBA Optimal	0.031627
Emvelo	Heavily or moderately modified	Heavily modified	0.003366
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.019348
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	7.697899
Emvelo	Critical Biodiversity Area	CBA Optimal	5.432149
Emvelo	Heavily or moderately modified	Heavily modified	0.662977
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	1.326534
Emvelo	Other Natural Areas	Other Natural Areas	0.08751
Emvelo	Other Natural Areas	Other Natural Areas	0.019663
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	1.798676
Sheepmoor	Critical Biodiversity Area	CBA Optimal	0.366621
Sheepmoor	Ecological Support Area	ESA Local corridor	0.000223
Sheepmoor	Heavily or moderately modified	Heavily modified	1.798398
Sheepmoor	Heavily or moderately modified	Heavily modified	0.04705
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	1.984121
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	0.315818
Sheepmoor	Other Natural Areas	Other Natural Areas	5.84482
Sheepmoor	Other Natural Areas	Other Natural Areas	0.09364
Emvelo	Critical Biodiversity Area	CBA Optimal	2.523065
Emvelo	Heavily or moderately modified	Heavily modified	0.011178
Emvelo	Other Natural Areas	Other Natural Areas	11.09803
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.965288

Sheepmoor	Critical Biodiversity Area	CBA Optimal	0.002858
Sheepmoor	Ecological Support Area	ESA Landscape corridor	2.345695
Sheepmoor	Ecological Support Area	ESA Local corridor	1.607655
Sheepmoor	Heavily or moderately modified	Heavily modified	1.045394
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	2.344012
Sheepmoor	Other Natural Areas	Other Natural Areas	14.08475
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	1.014676
Emvelo	Critical Biodiversity Area	CBA Optimal	0.831463
Emvelo	Critical Biodiversity Area	CBA Optimal	0.060572
Emvelo	Heavily or moderately modified	Heavily modified	2.897463
Emvelo	Heavily or moderately modified	Heavily modified	0.130212
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.539673
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.211818
Sheepmoor	Ecological Support Area	ESA Local corridor	0.007538
Sheepmoor	Heavily or moderately modified	Heavily modified	2.565178
Sheepmoor	Heavily or moderately modified	Heavily modified	2.58458
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	0.206047
Sheepmoor	Other Natural Areas	Other Natural Areas	0.467382
Sheepmoor	Other Natural Areas	Other Natural Areas	1.481326
Emvelo	Critical Biodiversity Area	CBA Optimal	0.110907
Emvelo	Heavily or moderately modified	Heavily modified	0.032496
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	0.04151
Emvelo	Critical Biodiversity Area	CBA Irreplaceable	3.829221
Emvelo	Critical Biodiversity Area	CBA Optimal	1.845749
Emvelo	Critical Biodiversity Area	CBA Optimal	0.005327
Emvelo	Heavily or moderately modified	Heavily modified	4.028086
Emvelo	Heavily or moderately modified	Moderately modified- Old lands	1.772024
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.184945
Sheepmoor	Critical Biodiversity Area	CBA Irreplaceable	0.524367
Sheepmoor	Ecological Support Area	ESA Landscape corridor	0.030224
Sheepmoor	Ecological Support Area	ESA Local corridor	0.020077
Sheepmoor	Heavily or moderately modified	Heavily modified	1.274085
Sheepmoor	Heavily or moderately modified	Heavily modified	0.67773
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	2.454528
Sheepmoor	Heavily or moderately modified	Moderately modified- Old lands	0.270047
Sheepmoor	Other Natural Areas	Other Natural Areas	1.976857
Sheepmoor	Other Natural Areas	Other Natural Areas	0.758624

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

wsp.com

CONFIDENTIAL

Emvelo Wind Energy Facility (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the proposed

Emvelo Wind Energy Facility and Associated Infrastructure

South-east of Ermelo, Mpumalanga



Study done for:

ERM

Prepared by:

EARES
Enviro Acoustic Research

P.O. Box 2047, Garsfontein East, 0060
Tel: 012 – 004 0362, Fax: 086 – 621 0292, E-mail: info@eares.co.za

EXECUTIVE SUMMARY

INTRODUCTION

Enviro-Acoustic Research cc was commissioned by Environmental Resources Management South Africa (Pty) Ltd (the EAP) to identify and assess the potential noise impact from the construction, operation and decommissioning of the proposed Emvelo Wind Energy Facility (WEF) and associated infrastructure south-east of Ermelo, Mpumalanga, on the surrounding soundscape

Due to a number of wind turbines proposed in an area with a number of potentially noise-sensitive receptors, a full environmental noise impact study will be conducted.

PROJECT DESCRIPTION

The project applicant is proposing the development of a cluster of commercial WEFs (and associated infrastructure south-east of Ermelo, with the projects known as Emvelo WEF and Emvelo WEF, with this report specifically focusing on the Emvelo WEF. The proposed Emvelo WEF will comprise up to 40 turbines with a maximum output capacity of up to 260 MW.

The project site is proposed to accommodate the following infrastructure:

- Up to 25 wind turbines generators (WTG) with a maximum hub height of up to 150m, rotor diameter of up to 220, blade length of up to 110 and have a rotor tip height of up to 260m;
- Internal roads between different WTG and infrastructure;
- Site office, an operations and maintenance (O&M) facility and car parking facilities for employee and service vehicles;
- Medium voltage cabling connecting the WTGs to the 33/132kV on-site Independent Power Producer (IPP) sub-station; and
- Permanent and temporary laydown and storage areas.

DESCRIPTION OF THE SURROUNDING LAND USE

The proposed WEF will be located in the Msukaligwa Local Municipality (Gert Sibande District – Mpumalanga Province). Most residential dwellings featuring in the vicinity of the project focus area are scattered in a heterogeneous fashion, typical of a rural farming area. Croplands, animal husbandry and limited residential activities (farmers and workers with their families) are predominant in the study area.

DESCRIPTION OF THE CLOSEST POTENTIAL NOISE SENSITIVE RECEPTORS

Residential areas and potential noise-sensitive developments/receptors/communities (NSR) were identified using aerial images as well as physical site visits, with the site visits verifying a number of structures used for residential activities. The potential noise impacts are assessed on these NSR in this noise study.

BASELINE SOUND LEVELS

Ambient sound levels were measured over a 2-night period from 7 to 9 June 2023 at six locations in the vicinity of the WEF, resulting in more than 900 daytime and 500 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, statistical sound levels as well as spectral information. Confidence levels in the resulting data are high and it is expected that the ambient sound level data would be applicable of other locations in the area.

Bird communication noises were significant and generally dominant, with some sounds from domestic animals (dogs, cows, sheep and chickens) audible at times.

Considering the average fast-weighted sound level data collected in the area:

- daytime fast-weighted sound levels ranged from 24 to more than 70 dBA, with average daytime sound levels being 43.3 dBA. This is typical of a rural noise district and considering the developmental character, a rating level of 45 dBA (typical of a rural noise district) will be assumed for the daytime period; and
- night-time fast-weighted sound levels ranged from 21 to more than 58 dBA, with average night-time sound levels being 37.3 dBA. This is typical of a rural to suburban noise district, with a typical rating level of 35 dBA.

ACCEPTABLE NOISE RATING LEVELS AND LIMITS

The development of the WEF will result in changes in the ambient sound levels during the construction and operational phases. Two scenarios must be considered for a WEF, as while construction activities may take place during periods with no-, low- and high-winds, while the WTG will only operate during periods when wind speeds are elevated. As such, two sets of desired rating levels should be considered.

For the construction period, the likely rating levels would be:

- 45 dBA for the daytime period (typical of a rural noise district, setting a daytime noise limit of 52 dBA); and

- 35 dBA for the night-time period (typical of a rural noise district, setting a night noise limit of 42 dBA).

Because the WTG will only operate during periods with increased winds, this report will consider the requirements of the noise control regulations and bylaws as well as the noise limits recommended by the World Bank Group (WBG), with desired noise limits for the Emvelo WEF being:

- 52 dBA for the daytime period (based on the noise control bylaws, even though the WBG accepts an upper limit of 55 dBA); and
- 45 dBA for the night-time period.

FINDINGS

This study considers the potential noise impact on the surrounding environment due to the construction, operational and future decommissioning activities associated with the Emvelo WEF. It makes use of conceptual scenarios to develop noise propagation models to estimate potential noise levels. It was determined that the potential noise impacts, without mitigation, would be:

- of a **medium significance** for the daytime construction of the access roads. Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **medium significance** for the daytime construction traffic passing NSR (one NSR). Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **low significance** for the daytime construction activities (hard standing areas, excavation and concreting of foundations and the erecting of the WTG and other infrastructure);
- of a **medium significance** for the night-time construction activities (such as the pouring of concrete, erecting the WTG, etc.). While night-time construction is not likely, it may be required that such activities take place at night, and mitigation measures were included that would reduce the significance of the noise impact to **low**;
- of a **low significance** for the daytime operational activities;
- of a **high significance** for night-time operational activities (noises from wind turbines) at the Emvelo WEF when considering the worst-case PWL. Mitigation is available to reduce the significance of the noise impact to **low**; and
- of a **low significance** for the potential decommissioning activities.

There is a potential for a cumulative noise impact at two receptors (NSR E082 and E066).

MANAGEMENT & MITIGATION OF NOISE IMPACT

Construction Phase Mitigation

The significance of the noise impact associated with access road construction activities, road traffic noises and night-time construction activities could be of a **medium** significance. The **medium** significance noise impact may relate to the worst-case scenario being investigated as well as the use of strict EIA criteria.

Potential mitigation measures that could reduce the significance of construction noise impacts could include:

1. The applicant should discuss the potential noise levels associated with road construction activities with NSR staying within 60m from access roads;
2. The applicant can locate access roads further than 60 m from NSR;
3. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people;
4. Where possible, night-time construction activities closer than 1,000m from NSR should not be permitted without prior warning the NSR about the proposed activities as well as the duration;
5. Plan construction schedule that such simultaneous activities are only required at one WTG location (WTG located within 1,000m from an NSR). Other simultaneous construction activities can continue, but should take place further than 1,000m from NSR;
6. Minimise active construction equipment at night, planning the completion of noisiest activities (such a pile driving, rock breaking and excavation) during the daytime period; and
7. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people.

The following measures are also recommended for the applicant to discuss with the project contractor to implement in their environmental management programme:

- If practical, road construction or upgrading activities (when working closer than 120 m from NSR) should ideally be planned for when NSR are not at home (children at school, adults at work or busy). Ideally work near NSR should be planned to take place between 08:00 and 14:00;
- Construction vehicles should reduce speeds to the minimum when passing NSR staying closer than 60 m from the road;

- NSR should be provided with the contact details of the environmental representative (Environmental Control Officer "ECO") to register potential complaints about noise;
- Access roads passing within 120 m from NSR should ideally not be used at night by construction vehicles (trucks and heavy construction equipment).

Operational Phase Mitigation

Worst-case noise levels could exceed 45 dBA (the night-time upper recommended noise limit) at a number of NSR considering the layout and a WTG with a maximum PWL of 111.2 dBA (re 1 pW). For this layout, mitigation will be required for any WTG with a PWL exceeding 107 dBA (re 1 pW).

The significance of the daytime noise impact during the operation phase is projected to be **low**, with the night-time operational noise impact projected to be **high**. Additional mitigation measures are required and recommended for the operational phase (focusing on the night-time period). Potential measures that will ensure acceptable night-time noise levels are discussed in the following subsections.

Planning Phase

Potential future construction and operational noise impacts must be addressed during the planning stage, as the costs implications will make the implementation of viable mitigation measures prohibitive. Measures that should be addressed during the planning stage include:

1. Considering potential future night-time operational noise levels, the applicant can relocate certain NSR (such as NSR E048, E050, E051, E038, E056, E039, E041 and/or E040) where operational noise levels will be high (for the evaluated cumulative scenario, this could be E050, E047, E051, E038, E043, E056, E039, E042, E057, E041, E040, E049, E046, E052, E044, E053 and/or E058);
2. The applicant can reduce the number of WTG closer than 800m from certain NSR;
3. The applicant can relocate WTG further from identified NSR where operational noise levels will be high (reducing the locations where construction activities may take place);
4. Discussions with NSR at locations where night-time projected noise levels will slightly exceed the recommended night-time noise limit (45 – 48 dBA). NSR should be informed about the potential issues associated with long-term exposure to high noise level. If acceptable to the NSR, the applicant could consider the acoustic treatment of the dwellings to ensure compliance with Table 1 of SANS 10103. Each dwelling must be treated on a case-to-case base, as this option is mainly available to housing structures of proper construction (concrete or brick, with a roof with a ceiling space);

5. Together with a combination of the mitigation measures raised in points 1, 2, 3 and 4; the applicant can add noise reducing additions (such as serrated trailing edges) to the blades of certain WTG. This could reduce noise levels between 1 and 2 dBA at NSR;
6. Together with a combination of the mitigation measures raised in points 1, 2, 3, 4 and 5; the applicant can design and implement a noise abatement plan that would reduce the noise emissions from the WTG during certain times or conditions. This can reduce noise emission levels significantly at NSR.
7. The potential mitigation measures should be modelled to ensure that the potential future operational noise levels will comply with the recommended and agreed noise limits. Noise modelling must consider the cumulative scenario; and
8. Once the mitigation measures above are selected and modelled, the applicant must design a noise monitoring program at representative NSR locations where the modelled worst-case noise rating levels exceed 42 dBA. This should include the measurement of ambient sound levels prior to the development of the WEF, followed by noise measurements once the WEF is operational to confirm that noise levels are less than 45 dBA.

Operational Phase

It is the intention to manage noise levels during the Planning Phase, however, it may still be necessary to implement a noise abatement plan. If noise monitoring indicates that the measures designed during the planning stage do not adequately mitigate noise levels to be within acceptable levels, the applicant should design and implement a noise abatement programme that will further reduce the noise emission levels during certain wind speeds, wind directions, time periods or meteorological conditions.

The potential significance of the decommissioning noise impact would be similar as the daytime construction phase (**low** significance) and no further mitigation is recommended or required for the decommissioning phase.

RECOMMENDATIONS

The proposed layout (turbine placement) is considered acceptable, as reasonable mitigation measures exists to manage the medium and high significance rating (pre-mitigation). Mitigation measures could include a combination of:

- Relocating a number of NSR where noise levels could exceed the recommended noise limits (such as NSR E048, E050, E051, E038, E056, E039, E041 and/or E040; where simple mitigation measures such as serrated trailing edges may not be sufficient); and

- Reducing the noise emission levels (selecting a WTG with a lower sound PWL, using blade additions to reduce noise emission levels and potentially implementing a noise abatement plan during certain periods of time, wind speeds or meteorological conditions. Acoustic treatment of residential dwellings should only be considered after other mitigation measures were considered.

The applicant could also change the layout (locating WTG further from NSR, or reducing the number of WTG within 1,000m from NSR) to mitigate the noise impact, though the applicant should re-evaluate the noise impact should:

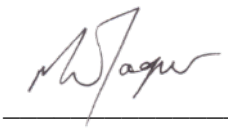
- the layout be revised (as part of amendment process post EA) where any WTG, located within 2,500 m from a confirmed NSR, are moved closer to the NSR;
- the layout be revised (as part of amendment process post EA) where any new WTG are introduced within 2,500m from an NSR;
- the layout be revised (as part of amendment process post EA) where the number of WTG within 2,500m from an NSR are increased; and
- the applicant selects to use a WTG with a SPL higher than 111.2 dBA (re 1 pW).

The applicant should also develop and implement an environmental noise monitoring programme at selected NSR living within the 42 dBA noise contour.

It is proposed that the applicant recommend to landowners that:

- no new residential dwellings 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 permanent residential purposed.

Therefore, considering the potential noise levels and viability of available mitigation measures, it is recommended that the Emvelo WEF be authorized (in terms of noise).



Signature
Morné de Jager
2025 – 05 – 20

Report should be sited as:

De Jager, M. 2025. "*Environmental Noise Impact Assessment for the Proposed Emvelo Wind Energy Facility and Associated Infrastructure South-east of Ermelo, Mpumalanga*", Enviro-Acoustic Research cc, Pretoria

Client:

Environmental Resources Management South Africa (Pty) Ltd
for Emvelo Wind Energy Facility (Pty) Ltd

The Great Westerford
240 Main Road
Rondebosch
Cape Town

Report no:

ERM-EWEF/ENIA/202505-Rev 1

Author:

M. de Jager *(B. Ing (Chem); PriSci Nat, 117253; SAIOSH, 72765282)*

Review:

Johan Maré *(MSc. Microbiology: PriSci Nat, 400092/91)*

Date:

May 2025

COPYRIGHT WARNING

This information is privileged and confidential in nature and unauthorized dissemination or copying is prohibited. This information will be updated as required. Environ-Acoustic Research CC claims protection of this information in terms of the Promotion of Access to Information Act, (No 2 of 2002) and without limiting this claim, especially the protection afforded by Chapter 4.

The document is the property of Enviro Acoustic Research CC. The content, including format, manner of presentation, ideas, technical procedure, technique and any attached appendices are subject to copyright in terms of the Copyright Act 98 of 1978 (as amended by the respective Copyright Amendment Acts No. 56 of 1980, No. 66 of 1983, No. 52 of 1984, No. 39 of 1986, No. 13 of 1988, No. 61 of 1989, No. 125 of 1992, Intellectual Property Laws Amendment Act, No. 38 of 1997 and, No. 9 of 2002) in terms of section 6 of the aforesaid Act, and may only be reproduced as part of the Environmental Impact Assessment process by ERM SA (Pty) Ltd and Mulilo Renewable Project Developments (Pty) Ltd.

TABLE OF CONTENTS

page

EXECUTIVE SUMMARY ii

TABLE OF CONTENTS x

LIST OF TABLES xiv

LIST OF FIGURES xv

APPENDICES xvii

1 CHECKLIST: GG43110 MINIMUM REQUIREMENTS 1

2 INTRODUCTION 3

2.1 Introduction and Purpose 3
2.2 Brief Project Description 3
2.3 Proposed Wind Turbine 4
2.4 Study area 5
2.4.1 Topography 6
2.4.2 Surrounding Land Use 6
2.4.3 Transportation Networks 6
2.4.4 Other commercial, industrial or mining activities 6
2.4.5 Ground conditions and vegetation 6
2.4.6 Sensitive Receptors 7
2.4.7 Existing Ambient Sound Levels 7
2.4.8 Desired Rating Levels 8
2.5 Environmental Sensitivity – Noise Theme 9
2.6 Comments received during the EIA 9
2.7 Terms of Reference 9
2.7.1 Requirements as per Government Gazette 43110 of March 2020 10
2.7.2 Requirements as per South African National Standards (SANS) 11

3 LEGAL CONTEXT, POLICIES AND GUIDELINES 17

3.1 The Republic of South Africa Constitution Act ("the Constitution") ... 17
3.1.1 Gert Sibande District Municipal: Noise Control By-Laws (LAN. 85, 2014) 17
3.2 The National Environmental Management Act, 1998 (Act 107 of 1998) 18
3.3 The Environment Conservation Act (Act 73 of 1989) 19
3.3.1 National Noise Control Regulations (GN R154 of 1992) 19

3.4 Noise Standards....19
3.4.1 SANS 10103:2008....20
3.4.2 SANS 10328:2008....22
3.5 International Guidelines....23
3.5.1 Guidelines for Community Noise (WHO, 1999) [144]....23
3.5.2 Night Noise Guidelines for Europe (WHO, 2009) [145]....24
3.5.3 The Assessment and Rating of Noise from Wind Farms (Energy Technology Support Unit, 1997)....24
3.5.4 Noise Guidelines for Wind Farms (MoE, 2008) [88]....26
3.5.5 Equator Principles....26
3.5.6 IFC: General EHS Guidelines – Environmental Noise Management [65]....27
3.5.7 European Parliament Directive 2000/14/EC [38]....29
3.5.8 Environmental, Health, and Safety Guidelines for Wind Energy [66]....29
3.5.9 Environmental Noise Guidelines for the European Region (2018) [146]....30
3.5.10 Concluding remarks on the use of International Guidelines in this Assessment....31
4 CURRENT ENVIRONMENTAL SOUND CHARACTER....33
4.1 Influence of Season on Ambient Sound Levels....33
4.1.1 Effect of Temperature inversions....34
4.1.2 Effect of Wind....35
4.1.3 Effect of Humidity and Temperature....36
4.2 Temperature and Humidity Measurements....37
4.3 Sound Level Measurements - Procedure....38
4.3.1 Long-term Measurement Location EMAWCLTSL01....40
4.3.2 Long-term Measurement Location - EMAWCLTSL02....43
4.3.3 Long-term Measurement Location - EMAWCLTSL03....46
4.3.4 Long-term Measurement Location - EMAWCLTSL04....49
4.3.5 Long-term Measurement Location - EMAWCLTSL05....52
4.3.6 Long-term Measurement Location - EMAWCLTSL06....55
4.4 Summary of Sound Level data measured....58
5 INVESTIGATION OF EXISTING AND FUTURE NOISE LEVELS 63
5.1 Potential Noise Sources: Construction Phase....63
5.1.1 Construction equipment....63
5.1.2 Material supply: Concrete batching plants....65
5.1.3 Blasting....65
5.1.4 Construction Traffic....66

5.2 Potential Noise Sources: Operation Phase....69
5.2.1 Wind Turbine Noise: Aerodynamic sources [7, 18, 31, 41, 108] 69
5.2.2 Wind Turbine: Mechanical sources [45, 63, 108, 111]....71
5.2.3 Low Frequency Noise 72
5.2.4 Amplitude modulation....73
5.2.5 Transformer noises (Substations)....76
5.2.6 Transmission Line Noise (Corona noise) 76

6 METHODS: NOISE IMPACT ASSESSMENT 78

6.1 Noise Impact on Animals 78
6.1.1 Domesticated Animals 79
6.1.2 Wildlife 79
6.1.3 Avifauna 80
6.1.4 Concluding Remarks - Noise Impacts on Animals 80
6.2 Why noise concerns communities [3, 15, 20, 25, 31, 52, 76, 92, 108, 122] 82
6.2.1 Noise Annoyance....83
6.3 Impact Assessment Criteria 85
6.3.1 Overview: The Common Characteristics 85
6.3.2 Noise criteria of concern 86
6.4 Setting appropriate Noise Limits 87
6.5 Determining the Significance of the Noise Impact 89
6.5.1 Identifying the Potential Impacts without Mitigation Measures (WOM)....92
6.5.2 Identifying the Potential Impacts with Mitigation Measures (WM) 92

7 METHODS: CALCULATION OF NOISE LEVELS 94

7.1 Point and Area Noises – Construction and Operational activities 94
7.2 Road Traffic Noise Levels....95

8 ASSUMPTIONS AND LIMITATIONS 96

8.1 Limitations - Acoustical Measurements....96
8.2 Calculating noise emissions – Adequacy of predictive methods 97
8.3 Adequacy of Underlying Assumptions 98
8.4 Uncertainties associated with mitigation measures....98
8.5 Uncertainties of Information Provided 99
8.6 Conditions to which this study is subject 100

9 PROJECTED NOISE RATING LEVELS....101

9.1 Conceptual Scenarios – Noise due to Future construction Activities 101

9.2 Conceptual Scenarios – Noise due to Future Operational Activities. 106
9.3 Potential Cumulative Noise Impacts..... 106
9.4 Potential Decommissioning, Closure and Post-closure Noise Levels 107

10 SIGNIFICANCE OF THE NOISE IMPACT..... 113

10.1 Noises Impact relating to the Planning and Design Phase..... 113
10.2 Noise Impact due to Future Construction Activities 113
10.2.1 Construction activities relating to the Access Roads..... 113
10.2.2 Noises relating to Construction Traffic passing NSR 113
10.2.3 Construction activities at the WEF 113
10.3 Noise Impact due to Future Operational Activities..... 113
10.4 Cumulative noise impact 114
10.5 Noise Impact due to Future Decommissioning Activities..... 114
10.6 Evaluation of Alternatives 114
10.6.1 Alternative 1: No-go option 114
10.6.2 Alternative 2: Proposed Renewable Power Generation activities 114
10.7 Impact Assessment Tables..... 115

11 MITIGATION OPTIONS 121

11.1 Mitigation options available to reduce Noise Impact during the Construction Phase..... 122
11.2 Mitigation options available to reduce Noise Impact during operation 123
11.2.1 Planning Phase 124
11.2.2 Operational Phase..... 125
11.3 Mitigation options available to reduce Noise Impact during decommissioning 125
11.4 Mitigation and Management conditions to be included in the EMPr and Environmental Authorization 125

12 ENVIRONMENTAL MONITORING PLAN 127

12.1 Measurement Localities and Frequency 127
12.2 Measurement Procedures 127
12.3 Measurement Procedures 128

13 ENVIRONMENTAL MANAGEMENT 129

14 CONCLUSIONS AND RECOMMENDATIONS 132

15 REFERENCES..... 134

LIST OF TABLES

page

Table 3-1: Recommended ambient noise for different areas of occupancy indoors (Table 2 - SANS 10103:2008).....20
Table 3-2: Acceptable Zone Sound Levels for noise in districts (Table 2 - SANS 10103:2008) 21
Table 3-3: Summary of Sound Level Limits for Wind Farms (MoE) 26
Table 3-4: IFC Table 7.1-Noise Level Guidelines 28
Table 4-1: Temperature and Humidity measured onsite (7 – 9 June '23) 37
Table 4-2: Equipment used to gather data at EMAWCLTSL01 40
Table 4-3: Noises/sounds heard during site visits at EMAWCLTSL01.....40
Table 4-4: Sound levels considering various sound level descriptors at EMAWCLTSL01..41
Table 4-5: Equipment used to gather data at EMAWCLTSL02 43
Table 4-6: Noises/sounds heard during site visits at EMAWCLTSL02.....43
Table 4-7: Sound levels considering various sound level descriptors at EMAWCLTSL02..44
Table 4-8: Equipment used to gather data at EMAWCLTSL03 46
Table 4-9: Noises/sounds heard during site visits at EMAWCLTSL03.....46
Table 4-10: Sound levels considering various sound level descriptors at EMAWCLTSL03 47
Table 4-11: Equipment used to gather data at EMAWCLTSL04 49
Table 4-12: Noises/sounds heard during site visits at EMAWCLTSL04.....49
Table 4-13: Sound levels considering various sound level descriptors at EMAWCLTSL04 50
Table 4-14: Equipment used to gather data at EMAWCLTSL05 52
Table 4-15: Noises/sounds heard during site visits at EMAWCLTSL05.....52
Table 4-16: Sound levels considering various sound level descriptors at EMAWCLTSL05 53
Table 4-17: Equipment used to gather data at EMAWCLTSL06 55
Table 4-18: Noises/sounds heard during site visits at EMAWCLTSL06.....55
Table 4-19: Sound levels considering various sound level descriptors at EMAWCLTSL06 56
Table 5-1: Equipment list and Sound power emission levels used for modelling.....65
Table 5-2: Potential maximum noise levels generated by construction equipment.....67
Table 5-3: Potential equivalent noise levels generated by various equipment 68
Table 6-1: Threshold levels reported by the WHO (2009) 85
Table 6-2: Proposed ambient sound levels and acceptable rating levels 89
Table 6-3: Impact Assessment Criteria – Consequence.....91
Table 6-4: Impact Assessment Criteria - Duration.....91
Table 6-5: Impact Assessment Criteria – Spatial extent.....91

Table 6-6: Impact Assessment Criteria – Probability 92
Table 6-7: Impact Assessment Criteria – Significance without Mitigation 92
Table 6-8: Impact Assessment Criteria – Significance with Mitigation 93
Table 10-1: Impact Assessment: Daytime activities relating to the construction of access roads 115
Table 10-2: Impact Assessment: Daytime construction traffic passing NSR.....115
Table 10-3: Impact Assessment: Daytime construction activities.....116
Table 10-4: Impact Assessment: Night-time construction activities.....117
Table 10-5: Impact Assessment: Daytime operation of numerous WTG 117
Table 10-6: Impact Assessment: Night-time operation of numerous WTG.....118
Table 10-7: Impact Assessment: Potential Cumulative Noise Impacts 119
Table 10-8: Impact Assessment: Decommissioning activities 119
Table 13-1: Environmental Management for planning phase 129
Table 13-2: Environmental Management for night-time construction activities.....130
Table 13-3: Environmental Management for night-time operational period.....131

LIST OF FIGURES

page
Figure 2-1: Regional Location of the proposed Emvelo WEF 13
Figure 2-2: Project infrastructure of the proposed Emvelo WEF 14
Figure 2-3: Study area and potential noise-sensitive receptors close to Emvelo WEF 15
Figure 2-4: Study area and potential noise-sensitive areas identified by the online screening tool 16
Figure 3-1: Criteria to assess the significance of impacts stemming from noise 22
Figure 4-1: Influence of temperature inversions on the propagation of sound 34
Figure 4-2: Influence of temperature inversions on the propagation of sound 34
Figure 4-3: Influence of wind on sound propagation 35
Figure 4-4: Effect of Temperature and Humidity on propagation of Sound 37
Figure 4-5: Temperature and Humidity readings measured onsite 38
Figure 4-6: Localities where ambient sound levels were measured 39
Figure 4-7: Residual noise Levels at EMAWCLTSL01 42
Figure 4-8: Maximum, minimum and Statistical sound levels at EMAWCLTSL01 42
Figure 4-9: Classification of night-time measurements in typical noise districts at EMAWCLTSL01 42
Figure 4-10: Classification of daytime measurements in typical noise districts at EMAWCLTSL01 42
Figure 4-11: Residual noise Levels at EMAWCLTSL02 45

Figure 4-12: Maximum, minimum and Statistical sound levels at EMAWCLTSL02 45
Figure 4-13: Classification of night-time measurements in typical noise districts at EMAWCLTSL02 45
Figure 4-14: Classification of daytime measurements in typical noise districts at EMAWCLTSL02 45
Figure 4-15: Residual noise Levels at EMAWCLTSL03 48
Figure 4-16: Maximum, minimum and Statistical sound levels at EMAWCLTSL03 48
Figure 4-17: Classification of night-time measurements in typical noise districts at EMAWCLTSL03 48
Figure 4-18: Classification of daytime measurements in typical noise districts at EMAWCLTSL03 48
Figure 4-19: Ambient Sound Levels at EMAWCLTSL04 51
Figure 4-20: Maximum, minimum and Statistical sound levels at EMAWCLTSL04 51
Figure 4-21: Classification of night-time measurements in typical noise districts at EMAWCLTSL04 51
Figure 4-22: Classification of daytime measurements in typical noise districts at EMAWCLTSL04 51
Figure 4-23: Ambient Sound Levels at EMAWCLTSL05 54
Figure 4-24: Maximum, minimum and Statistical sound levels at EMAWCLTSL05 54
Figure 4-25: Classification of night-time measurements in typical noise districts at EMAWCLTSL05 54
Figure 4-26: Classification of daytime measurements in typical noise districts at EMAWCLTSL05 54
Figure 4-27: Ambient Sound Levels at EMAWCLTSL06 57
Figure 4-28: Maximum, minimum and Statistical sound levels at EMAWCLTSL06 57
Figure 4-29: Classification of night-time measurements in typical noise districts at EMAWCLTSL06 57
Figure 4-30: Classification of daytime measurements in typical noise districts at EMAWCLTSL06 57
Figure 4-31: Daytime ambient sound levels measured in vicinity of Emvelo WEF project59
Figure 4-32: Night-time ambient sound levels measured in vicinity of Emvelo WEF project 60
Figure 4-33: Daytime ambient sound levels measured north-west of Emvelo WEF project 61
Figure 4-34: Night-time ambient sound levels measured north-west of Emvelo WEF project 62
Figure 5-1: Noise Emissions Curve of a number of different wind turbines (figure for illustration purposes only) 70
Figure 5-2: Octave sound power emissions of various wind turbines 71

Figure 5-3: Third octave band sound power levels at various wind speeds at a location where wind induced noises dominate 73
Figure 5-4: Example time-sound series graph illustrating AM as measured by Stigwood (2013) [125] 74
Figure 6-1: Logarithmic Chart of the Hearing Ranges of Some Animals 79
Figure 6-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling 83
Figure 9-1: Project layout, proposed roads and other infrastructure locations for Emvelo WEF 102
Figure 9-2: Projected conceptual construction noise levels – Road upgrading or construction activities 103
Figure 9-3: Projected conceptual construction noise levels – Decay over distance from linear activities (roads) 104
Figure 9-4: Projected conceptual construction noise levels – Emvelo WEF 105
Figure 9-5: Projected noise levels at different wind speeds (worst-case PWL) 107
Figure 9-6: Projected future operational worst-case noise rating level contours (WTG with a PWL of 111.2 dBA re 1 pW) 109
Figure 9-7: Projected future operational worst-case noise rating level contours (WTG with a PWL of 111.2 dBA re 1 pW) 110
Figure 9-8: Effect of distance between wind turbines – potential cumulative noise 111
Figure 9-9: Projected future cumulative noise rating level contours – Operation of the Emvelo and Sheepmoor WEFs 112

APPENDICES

Appendix A Curriculum Vitae
Appendix B Glossary of Terms
Appendix C Site Sensitivity Verification
Appendix D Photos of Measurement Locations
Appendix E Calculated conceptual noise levels

GLOSSARY OF ABBREVIATIONS

ADT	Articulated Dump Trucks
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DEM	Digital Elevation Model
DFFE	Department of Forestry, Fisheries and the Environment

EA	Environmental Authorization
EAP	Environmental Assessment Practitioner
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EHS	Environmental Health and Safety
EMPr	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
ENM	Environmental Noise Monitoring
ENPAT	Environmental Potential Atlas for South Africa
ETSU	Energy Technology Support Unit
EPs	Equator Principles
EPFIs	Equator Principles Financial Institutions
FEL	Front-end Loader
GN	Government Notice
GNR	Government Notice Regulation
HNI	House Not Inhabited
I&APs	Interested and Affected Parties
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
LAN	Local Authority Notice
METI	Ministry of Economy, Trade, and Industry
NASA	National Aeronautical and Space Administration
NAP	Noise Abatement Program
NEMA	National Environmental Management Act
NCR	Noise Control Regulations
NSR	Noise-sensitive Receptor
PPP	Public Participation Process
PWL	Sound Power Level
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Pressure Level (or sound level)
SR	Significance Rating
TLB	Tractor-Loader-Backhoe (also referred to as a backhoe)
UTM	Universal Transverse Mercator
WHO	World Health Organization
WEF	Wind Energy Facility

WF	Wind Farm
WIN	Wind Induced Noises
WTG	Wind Turbine Generator
WTN	Wind Turbine Noise

GLOSSARY OF UNITS

^{o}C	Degrees Celsius (measurement of temperature)
dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)
km	Kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)
pW	pico Watt (10^{-12}) (measurement of power – sound power in air)
µPa	Micro pascal (measurement of pressure – in air in this document)

1 CHECKLIST: GG43110 MINIMUM REQUIREMENTS

The National Web based Environmental Screening Tool[1] was used to screen the proposed site for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site location illustrated in **Figure 2-1**.

The site report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization (EA) documentation.

The screening report was developed for *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the noise sensitive areas illustrated on **Figure 2-4**. The areas defined to have a potential "very high" sensitivity to noise were downloaded as a layer from the online screening tool.

In terms of GNR320 (20 March 2020), a Noise Study must contain, as a minimum, the following information:

Clause	Requirement	Comment / Reference
2.3.1	Current ambient sound levels recorded at relevant locations over a minimum of two nights and that provide a representative measurement of the ambient noise climate, with each sample being a minimum of ten minutes and taken at two different times of the night on each night, in order to record typical ambient sound levels at these different times of night	Sections 4.1 and 4.3 as well as Figure 4-31
2.3.2	Records of the approximate wind speed at the time of the measurement	Section 4.3 and Figure 4-31
2.3.3	Mapped distance of the receiver from the proposed development that is the noise source	Section 2.4.6 and 9
2.3.4	Discussion on temporal aspects of baseline ambient conditions	Section 4.1
2.4.1	Characterization and determination of noise emissions from the noise source, where characterization could include types of noise, frequency, content, vibration and temporal aspects	Table 5-2, Table 5-3 and Table 5-1
2.4.2	Projected total noise levels and changes in noise levels as a result of the construction, commissioning and operation of the proposed	Section 9

[1] https://screening.environment.gov.za/screeningtool/#/pages/welcome

	development for the nearest receptors using industry accepted models and forecasts	
2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Appendix A
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Appendix C
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	See section 4
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	See section 4.1
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	See Figure 2-1
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimize disturbance to receptors	Site development limited to wind resource
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	See section 0
2.5.8	any conditions to which this statement is subjected	See section 8.6
2.5.9	the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered	Site development limited to the location of the wind resource
2.5.10	A motivation must be provided if there were development footprints identified as per paragraph 2.5.9 above that were identified as having a "low" noise sensitivity and that were not considered appropriate	Site development limited to the location of the wind resource
2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	See section 11 and 12
2.5.12	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	See section 8

2 INTRODUCTION

2.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was commissioned by Environmental Resources Management South Africa (Pty) Ltd (the EAP) to identify and assess the potential noise impact from the construction, operation and decommissioning of the proposed Emvelo Wind Energy Facility (WEF) and associated infrastructure south-east of Ermelo, Mpumalanga, on the surrounding soundscape. The regional location is presented in **Figure 2-1**.

This report describes ambient sound levels in the area, potential worst-case noise rating levels and the potential noise impact that the Project may have on the surrounding environment, highlighting the methods used, potential issues identified, findings and recommendations.

This study considered local regulations and both local and international guidelines, using the terms of reference (ToR) as proposed by SANS 10328:2008 for a comprehensive Environmental Noise Impact Assessment (ENIA) and as proposed by the requirements specified in the Assessment Protocol for Noise that were published on 20 March 2020, in Government Gazette 43110, GN 320. The study also considers the noise limits as proposed by the International Finance Corporation (IFC) which is based on studies completed by the World Health Organization (WHO).

Due to a number of wind turbines proposed within an area with a potential high sensitivity to noise, a full environmental noise impact study will be conducted.

2.2 BRIEF PROJECT DESCRIPTION

The project applicant is proposing the development of a cluster of commercial WEFs (and associated infrastructure south-east of Ermelo, with the projects known as Emvelo WEF and Sheepmoor WEF, with this report specifically focusing on the Emvelo WEF. The proposed Emvelo WEF will comprise up to 22 turbines with a maximum output capacity of up to 260 MW.

The project site is proposed to accommodate the following infrastructure:

- Up to 22 wind turbines generators (WTG) with a maximum hub height of up to 150m, rotor diameter of up to 220m, blade length of up to 110m and have a rotor tip height of up to 260m, with the evaluated layout illustrated in **Figure 2-2**;
- Internal roads between different WTG and infrastructure;

- Site office, an operations and maintenance (O&M) facility and car parking facilities for employee and service vehicles;
- Medium voltage cabling connecting the WTGs to the 33/132kV on-site Independent Power Producer (IPP) substation; and
- Permanent and temporary laydown and storage areas.

2.3 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 may not want to reveal the actual WTG that they may consider, whether for commercial/economic reasons, possible Non-Disclosure Agreements etc. The applicant requested that a WTG with a sound power emission level (PWL) of 114 dBA (re 1 pW) be evaluated.

As such this assessment uses the sound emission characteristics of the Envision EN182-8.0 MW WTG (Envision, 2024 **[42]**). This WTG have a maximum PWL of 111.2 dBA (re 1 pW), with the manufacturer offering various options to manage noise emission levels, something all manufacturers of WTG offer. Typical noise reduction measures include, amongst others:

- The WTG blades can be fitted with serrated trailing edges, which will reduce the PWL with an additional 1.5 – 2.0 dBA;
- Reducing the rotational speeds during certain periods; etc
- Changing the operational parameters, such as the pitch of the blades, to reduce noise at certain wind speeds.

It is important to note that the exact details of the actual WTG are **not** 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);
- The PWL of the WTG (or noise source) selected/that the developer is considering; and
- Noise abatement technologies implemented by the manufacturer.

Minor factors in the noise levels are:

- The spectral characteristics of the WTG;
- Temperature and Humidity;
- The hub height of the WTG;
- Topography and wind shear effects;
- Ground surface characteristics.

Factors that do not influence PWL are:

- The rotor diameter of the WTG (the declared PWL level already include this factor);
- The manufacture of the WTG, the model name or number (the declared PWL level already include this factor).

The sound power emission levels are provided by the manufacturer either as the apparent sound power emission levels (PWL), maximum warranted PWL, a calculated PWL (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 PWL, with larger WTG with a lower PWL. 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.

2.4 STUDY AREA

The proposed WEF will be located in the Msukaligwa Local Municipality (Gert Sibande District – Mpumalanga Province). The project focus area (PFA) is an area selected to enclose all potential project infrastructure, up to 2,000 m from the proposed project boundaries (which would include activities or equipment that may generate significant noise). The PFA is described in terms of environmental components that may contribute to or change the sound character in the area.

2.4.1 Topography

The Environmental Potential Atlas of South Africa (ENPAT) [**139**] describes the topography as *"moderately undulating plains"*. The project is situated at approximately 1,530 – 1,775 meters above sea level (mamsl). Due to the height of the WTG, as well as the position where they may be developed, it is unlikely that topographical features will limit the propagation of sound from the WTG.

2.4.2 Surrounding Land Use

Most dwellings featuring in the vicinity of the project focus area are scattered in a heterogeneous fashion, typical of a rural farming area. Land use within the PFA is residential, wilderness (including ecotourism), some dryland crops (including forestry activities) and animal husbandry.

Minor noise sources are associated with typical household activities and associated agricultural activities. Noise from these sources will not be investigated or considered in this environmental noise impact assessment (ENIA).

2.4.3 Transportation Networks

The R65 transects the PFA, though traffic on this road is generally very low. This road is also relatively far from the locations where WTG may be developed. Noise from vehicular traffic will not be considered in this ENIA report. There are a number of small access roads leading from the R65, mainly to serve the farmers in the area. Traffic volumes on these small access roads are low and will be of no acoustical significance. Noise from vehicular traffic will therefore not be considered in this Environmental Noise Impact Assessment (ENIA) report

2.4.4 Other commercial, industrial or mining activities

No commercial, industrial or mining activities were identified during the site visit.

2.4.5 Ground conditions and vegetation

Most of the area falls within the Grassland biome with the natural vegetation being a mix of north-easterly sandy highveld, Piet Retief sourveld and bankenveld to sour sandveld transition [**139**]. The natural veldt has been impacted due to anthropogenic activities, though most of the surface area is well vegetated with (seasonal) crops, grasses, shrubs, sedges and trees.

Taking into consideration available information it is the opinion of the author that the ground conditions (when considering acoustic propagation on a ground surface) can be classified as medium. A worst-case scenario will be investigated, considering a ground surface factor of

both 50 and 75% hard ground (with the 75% hard ground surface implying that the ground surface is not very acoustically absorbent) for operational modelling and 50% for construction modelling.

It should be noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

2.4.6 Sensitive Receptors

Potential noise-sensitive developments, receptors and communities (NSRs) were identified using tools such as Google Earth® up to a distance of 2,000 m from the project boundary. These receptors are highlighted in **Figure 2-3**, with the use of the NSR defined in **Appendix E, Table 1**.

Generally, noises from wind turbines:

- could be significant within 500 – 800 m (depending on the WTG layout and the PWL of the WTG), with receptors[2] staying within 500 m from operational WTG subject to noises at a potentially sufficient level to be considered disturbing. There no NSR staying within 500m from any WTG (see also **Figure 2-3** depicting the 500m no-go buffer around all NSR);
- are normally limited to a distance of approximately 500 – 1 500m from operational WTG (although this is subject to WTG layout[3] as well as the PWL of the WTG). Night-time ambient sound levels could be elevated and the potential noise impact measurable to significant. There are at least 20 NSR living between 500 and 1 000m from potential WTG locations; and
- likely to be audible up to a distance of 2,500m at night. Noises from the WTG are of a low concern at distances greater than 2,500m, although the sound of the WTGs may be audible at greater distances during certain metrological phenomena. There are at least 11 NSR staying between 1 000 to 2 500 m from a WTG.

2.4.7 Existing Ambient Sound Levels

Ambient sound levels were measured over a 2-night period from 7 to 9 June 2023 at six locations in the vicinity of the WEF, resulting in more than 900 daytime and 500 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, statistical sound levels as well as spectral information. Confidence levels in the

[2] Depending on the layout as well as the specific sound power emission levels of the selected wind turbine.
[3] WTG cumulatively contribute to noise levels within 2,500m from WTG

resulting data are high and it is expected that the ambient sound level data would be applicable of other locations in the area.

Bird communication noises were significant and generally dominant, with some sounds from domestic animals (dogs, cows, sheep and chickens) audible at times.

Considering the average fast-weighted sound level data collected in the area:

- daytime fast-weighted sound levels ranged from 24 to more than 70 dBA, with average daytime sound levels being 43.3 dBA. This is typical of a rural noise district and considering the developmental character, a rating level of 45 dBA (typical of a rural noise district) will be assumed for the daytime period; and
- night-time fast-weighted sound levels ranged from 21 to more than 58 dBA, with average night-time sound levels being 37.3 dBA. This is typical of a rural to suburban noise district, with a typical rating level of 35 dBA.

Significant ambient sound level data are available for the area, with this data also consulted to augment the data measured for this project. The results and findings of the ambient sound level measurements are summarised in **Section 4.3**.

2.4.8 Desired Rating Levels

The development of the WEF will result in changes in the ambient sound levels during the construction and operational phases. Two scenarios must be considered for a WEF, as while construction activities may take place during periods with no-, low- and high-winds, while the WTG will only operate during periods when wind speeds are elevated. As such, two sets of desired rating levels should be considered.

For the construction period, the likely rating levels would be:

- 45 dBA for the daytime period (typical of a rural noise district); and
- 35 dBA for the night-time period (typical of a rural noise district).

Because the WTG will only operate during periods with increased winds, this report will consider the requirements of the noise control regulations and bylaws (see **section 3.1.1**) as well as the noise limits recommended by the World Bank Group (WBG) and the International Finance Corporation (IFC – see **section 3.5.6**), with desired noise limits for the Emvelo WEF being:

- 52 dBA for the daytime period (based on the noise control bylaws, even though the WBG accepts an upper limit of 55 dBA); and
- 45 dBA for the night-time period.

It will also be required to consider the relevant Noise Control Regulations, discussed in detail in **section 3.3** (specific legislation) as well as **section 6.4** (setting appropriate noise limits).

2.5 ENVIRONMENTAL SENSITIVITY – NOISE THEME

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool[4].

Potential noise-sensitive areas with a "very high" sensitivity were obtained from the online screening tool using the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the potential noise-sensitive areas illustrated on **Figure 2-4**.

The screening report generated for the category *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* does stipulate:

- that a Noise Specialist Study should be appended to the Environmental Impact Assessment (EIA), and
- that the GNR320 Assessment Protocol be followed when doing the noise impact assessment.

2.6 COMMENTS RECEIVED DURING THE EIA

The author is not aware of any comments raised by the authorities or interested and affected parties at the date this report was compiled. It should however be noted that the Noise Assessment is part of a suite of studies commissioned by the Environmental Assessment Practitioner (EAP), who is undertaking the Public Participation Process (PPP) as part of the EIA. Comments regarding noise may only be available during the EIA and PPP process.

2.7 TERMS OF REFERENCE

A noise impact assessment must be completed for the following reasons:

- It was identified as an environmental theme needing further investigation in terms of (i.t.o.) the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- If an industry is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);

[4] https://screening.environment.gov.za/screeningtool/#/pages/welcome

- If a wind farm (wind turbines - SANS 10328:2008 [5.4 (i)]) or a source of low-frequency noise (such as cooling or ventilation fans - SANS 10328:2008 [5.4 (l)]) is to be established within 2,000 m from a potential noise sensitive development *or vice versa*;
- It is a controlled activity in terms of the NEMA regulations and an ENIA is required, because it may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice 579 of 2010;
- It is generally required by the local or district authority as part of the EA or planning approval in terms of Regulation 2(d) or GN R154 of 1992;

2.7.1 Requirements as per Government Gazette 43110 of March 2020

The Department of Forestry, Fisheries and Environment (DFFE) also promulgated Regulation 320, dated 20 March 2020 as published in Government Gazette No. 43110. The Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for EA would be applicable to this project.

This regulation defines the requirements for undertaking a site sensitivity verification, specialist assessment and the minimum report content requirements for environmental impact where a specialist assessment is required but no protocol has been prescribed. It requires that the current land use be considered using the national web based environmental screening tool to confirm the site sensitivity available at: https://screening.environment.gov.za.

If an applicant intending to undertake an activity identified in the scope of this protocol for which a specialist assessment has been identified on the screening tool on a site identified as being of:

- "very high" sensitivity for noise, must submit a Noise Specialist Assessment; or
- "low" sensitivity for noise, must submit a Noise Compliance Statement.

On a site where the information gathered from the site sensitivity verification differs from the designation of "very high" sensitivity on the screening tool and it is found to be of a "low" sensitivity, a Noise Compliance Statement must be submitted.

On a site where the information gathered from the initial site sensitivity verification differs from the designation of "low" sensitivity on the screening tool and it is found to be of a "very high" sensitivity, a Noise Specialist Assessment must be submitted.

If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint excluding linear activities for which noise impacts are associated with construction activities only and the noise levels return to the current levels after the completion of construction activities, in which case a compliance statement applies. In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

The minimum requirements for a Noise Specialist Study (i.t.o. GNR 320 of 2020) are also covered in **Section 1** in the form of a checklist.

This assessment will be comprehensive and a Noise Specialist Assessment will be submitted because there are a number of potential noise-sensitive receptors living within 2,000 m from the proposed Project.

2.7.2 Requirements as per South African National Standards (SANS)

In South Africa the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It has been thoroughly revised in 2008 and brought in line with the guidelines of the World Health Organisation (WHO). It provides the maximum average ambient noise levels during the day and night to which different types of developments indoors may be exposed.

In addition, SANS 10328:2008 (Edition 3) [**115**] specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for EIA purposes. These minimum requirements are:

a) the purpose of the investigation (see **section 2.1**);
b) a brief description of the planned development or the changes that are being considered (see **section 2.2**);
c) a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements (see **section 2.4 and 4**);
d) the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics (see **section 5 and 7**);
e) the identified noise sources that were not taken into account and the reasons as to why they were not investigated (see **section 5, 7 and 8**);

f) the identified noise-sensitive developments and the noise impact on them (see **section 2.4.6, 9 and 10**);
g) where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics (see **section 8**);
h) an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations (see **section 7 and 8**);
i) an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question (see **section 4, 7 and 9**);
j) the location of measuring or calculating points in a sketch or on a map (see **Figure 9-6**);
k) quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made (see **section 9**);
l) alternatives that were considered and the results of those that were investigated (see **section 10.6**);
m) a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation (see **section 2.6**);
n) a detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them (see **section 2.6**);
o) conclusions that were reached (see **section 14**);
p) proposed recommendations (see **section 14**);
q) if remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority (see **section 11 and 14**); and
r) any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future (see **section 14**).

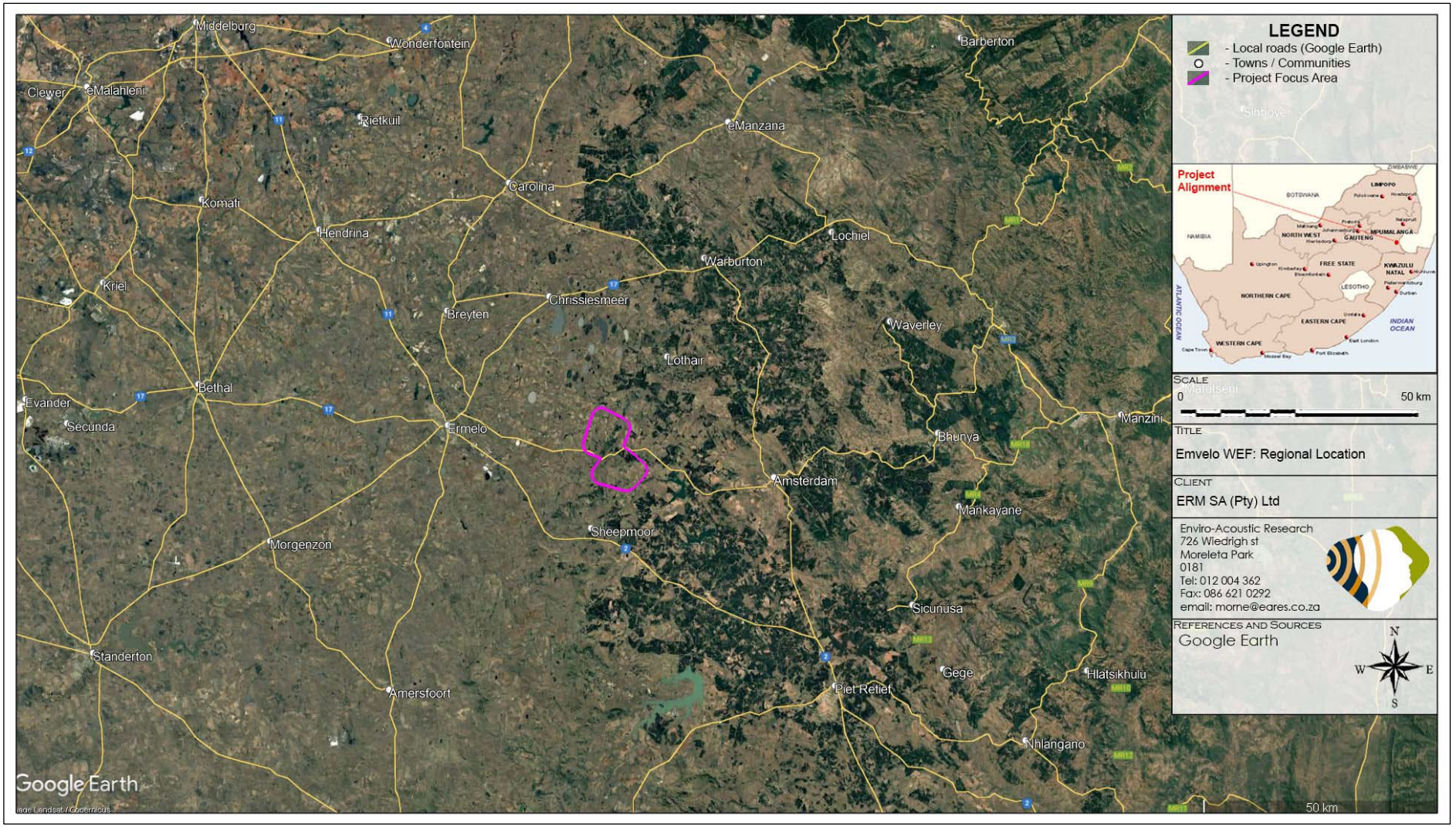


Figure 2-1: Regional Location of the proposed Emvelo WEF



Figure 2-2: Project infrastructure of the proposed Emvelo WEF

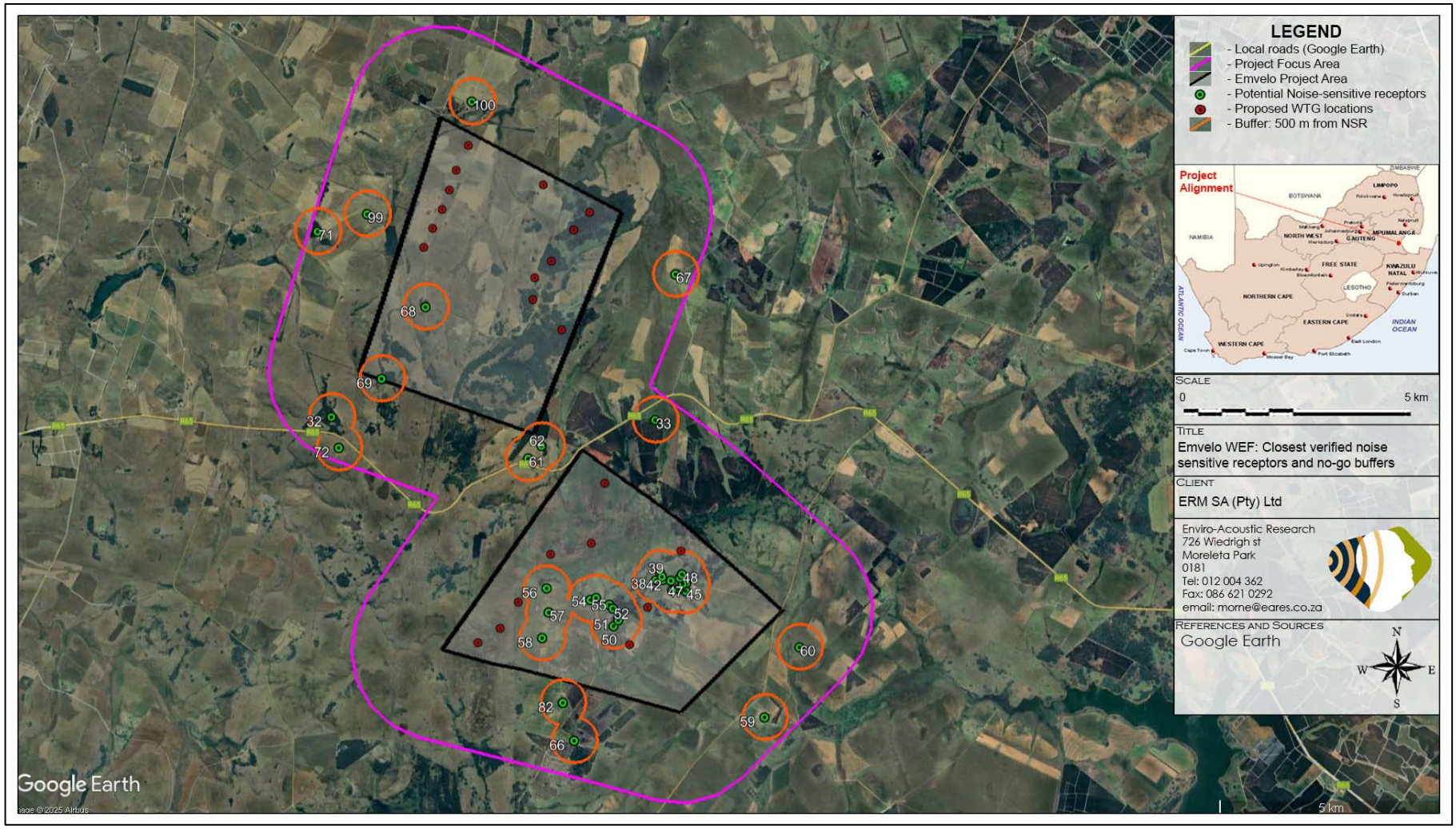


Figure 2-3: Study area and potential noise-sensitive receptors close to Emvelo WEF

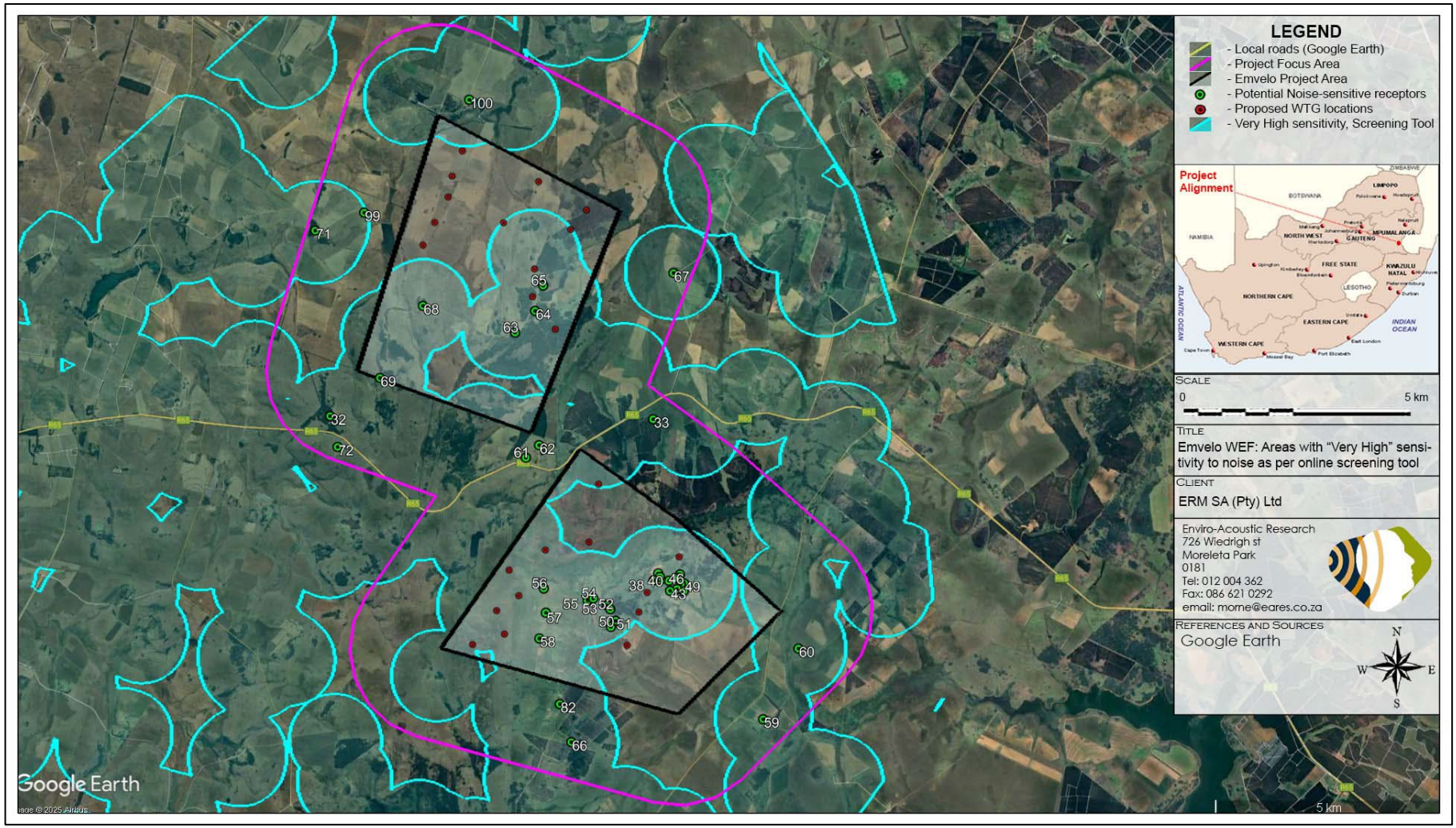


Figure 2-4: Study area and potential noise-sensitive areas identified by the online screening tool

3 LEGAL CONTEXT, POLICIES AND GUIDELINES

3.1 THE REPUBLIC OF SOUTH AFRICA CONSTITUTION ACT ("THE CONSTITUTION")

The environmental rights contained in section 24 of the Constitution provide that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to well-being. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate in the particular circumstances. The subjectivity of this approach can be problematic, which has led to the development of noise standards (see **Section 3.4**).

"Noise pollution" is specifically included in Part B of Schedule 5 of the Constitution, which means that noise pollution control is a local authority competence, provided that the local authority concerned has the capacity to carry out this function.

3.1.1 Gert Sibande District Municipal: Noise Control By-Laws (LAN. 85, 2014)

The Gert Sibande District Municipality promulgated Local Authority Notice (LAN) 85 in 2014 in terms of section 152(2) of the Constitution (to be read with section 11(3)(m) of the Municipal Systems Act, 2000). This bylaw is roughly based on the Noise Control Regulations (GN R154 of 1992).

This by-law defines (amongst others):

"**ambient sound level"** to mean:
The reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

"**Disturbing Noise"** to mean:
A noise level that exceeds the ambient sound level measured continuously by 7 dBA or more or that exceeds the typical rating levels for ambient noise in districts, indicated in table 2 of SANS 10103 excluding residential source of disturbing noise.

"**zone sound level**" means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a municipality for an area.

Clause 7 of this by-law prohibits the generation of a disturbing noise, with clause 9 defining various activities that require approval by the local authority.

3.2 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT 107 OF 1998)

The National Environmental Management Act, 1998 (Act 107 of 1998), as amended ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures, which may be regarded as reasonable. They include the following measures to:

1. investigate, assess and evaluate the impact on the environment;
2. inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed to avoid causing significant pollution or degradation of the environment;
3. cease, modify or control any act, activity or process causing the pollution or degradation;
4. contain or prevent the movement of the pollution or degradation;
5. eliminate any source of the pollution or degradation; and
6. remedy the effects of the pollution or degradation.

Regulations have been promulgated in GN R982, R983, R984 and R985 in GG 38282, dated 4 December 2014, which came into effect on 8 December 2014. These were amended in April 2017, specifically promulgated in GN R326, R327, R325 and R324 in GG 40772, dated 7 April 2017.

Furthermore, Protocols were published in Government Gazette 43110 / GNR 320 on 20 March 2020 for specific environmental themes, including noise. "Requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation".

These Protocols prescribe the general requirements for undertaking site sensitivity verification and the level of specialist assessment required as well as the assessment reporting requirements per environmental theme. The requirements of the Noise Protocol for the undertaking of a Noise Specialist Assessment have been adhered to. The national web-based Environmental Screening Tool identified the site to be of high noise sensitivity and therefore full Noise Specialist Assessment has been undertaken.

When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by the requirements of GNR 320 of 2020.

3.3 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act (ECA) allows the Minister of Environment, Forestry and Fisheries to make regulations regarding noise, among other concerns. While most sections of this Act have been repealed with the promulgation of the NEMA, Section 25 of this Act is still in effect.

3.3.1 National Noise Control Regulations (GN R154 of 1992)

The Noise Control Regulations (NCR) were promulgated in terms of section 25 of the ECA. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996 legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial noise control regulations exist in the Free State, Gauteng and Western Cape provinces. The Gert Sibande District Municipality promulgated LAN 85 in 2014, which will be relevant for the Leghoya 1 WF.

3.4 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from developments, industry and roads. They are:

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication' [**113**].
- SANS 10210:2004. 'Calculating and predicting road traffic noise' [**114**].
- SANS 10328:2008. 'Methods for environmental noise impact assessments' [**115**].
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary' [**116**].

The relevant standards use the equivalent continuous rating level (calculated from the sound pressure levels over the reference time, see **Appendix A**) as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise

by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful *per se*. In terms of environmental noise, the two most important standards are SANS 10103 and 10328 discussed below:

3.4.1 SANS 10103:2008

SANS 10103 provide standard procedures to measure and define rating levels with respect to annoyance and speech communication, mainly focusing on subsections:

- clause 4.1 - Ambient indoor noise;
- clause 4.2 – Typical noise in various districts; and
- clause 4.5 – Assessment of annoyance.

3.4.1.1 Clause 4.1 – Ambient indoor noise

This is a critical section, frequently ignored by authorities and even acoustic specialists. This clause provide recommended rating levels ($L_{Req,T}$) for ambient noise for different areas of occupancy during the time periods when the areas are used for their intended purposes and with the building services (e.g. ventilation systems, air-conditioning systems, lifts, plumbing and lighting) under normal operating conditions. The rating levels given in column 2 of the table are design values, while those given in column 3 are the maximum levels beyond which the ambient noise can be considered to be annoying or otherwise intrusive. Note 2 highlights that, where these levels are used as guidance for the design of buildings in non-residential areas where the ambient noise exceeds the typical level for the type of development, the building design should provide sufficient acoustic isolation to result in the occupancy level specified in Table 1 of SANS 10103 (see example for residential use in **Table 3-1**).

Table 3-1: Recommended ambient noise for different areas of occupancy indoors (Table 2 - SANS 10103:2008)

1	2	3
Types of occupancy or activity	**Design equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**	**Maximum equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**
9. Residential buildings		
Living rooms	35	45
Kitchens and service areas	45	55
Bathrooms and toilets	40	55
Bedrooms	30	40

3.4.1.2 Clause 4.2 – Typical noise in various districts

This section covers typical rating levels ($L_{Req,T}$) for ambient noise in different districts in Table 2 (duplicated in **Table 3-2**). This standard recommends that these values not be exceeded, and outdoor ambient noise exceeding these levels will be considered to be annoying to the community.

Table 3-2: Acceptable Zone Sound Levels for noise in districts (Table 2 - SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise dBA**					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**	**Day/night $L_{R,dn}$**	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

The levels may be used as a guide for zoning purposes and assumes that a building with natural ventilation and open windows will provide sound insulation of about 10 dBA, with the rating levels considering Table 1 rating levels (duplicated in **Table 3-1**). This standard highlight in note 1 that, where occupancies have to be allowed within areas where the acceptable outdoor values are exceeded for the particular type of occupancy, the sound insulation of the building housing the occupancy should be proven to comply to the indoor levels defined in Table 1 (see example for residential use in **Table 3-1**) of this standard.

3.4.1.3 Clause 4.5 – Assessment of annoyance

This section recommends investigation only when the rating level ($L_{Req,T}$) of the ambient noise exceeds the rating level ($L_{Req,T}$) of the residual noise (ambient sound levels) at the same location during the relevant time period. The ambient indoor or outdoor sound level should be compared with the appropriate level given in Table 1 (see **section 3.4.1.1**) or Table 2 (see **section 3.4.1.2**). This standard state that it is probable that the noise is

annoying or otherwise intrusive to the community or to a group of persons if the rating level of the ambient noise under investigation exceeds the applicable of the following:

a) the rating level of the residual noise (determined in the absence of the specific noise under investigation);
b) the maximum rating level for the ambient indoor noise given in table 1 (see example for residential use in **Table 3-1**); or
c) the typical rating level for the ambient noise for the applicable environment given in table 2 (duplicated in **Table 3-2**). The probable community or group response to the excess ($\Delta L_{Req,T}$) is given in **Figure 3-1**.

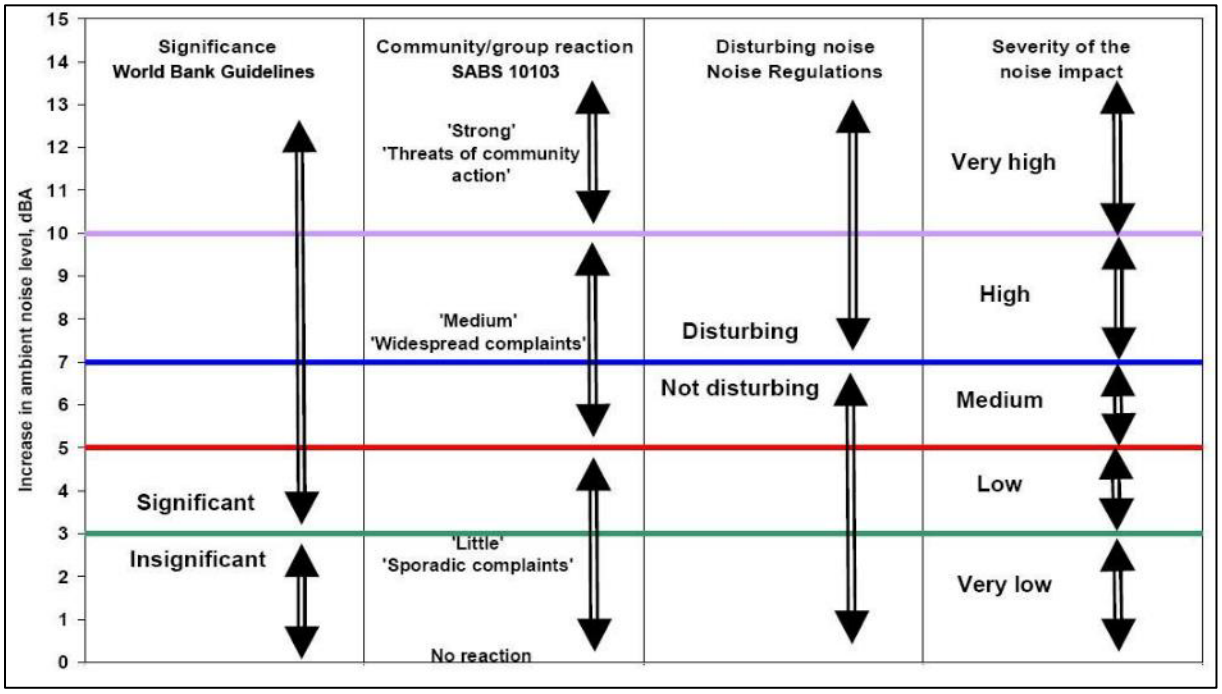


Figure 3-1: Criteria to assess the significance of impacts stemming from noise

3.4.2 SANS 10328:2008

SANS 10328 provide methods for environmental noise impact assessment, with relevant regulations (see **section 3.1.1**) and GNR320 (see **section 2.7.1** and checklist in **section 1**) stipulating that this standard be followed when doing a noise specialist study.

SANS 10328 recommends that the procedures given in clause 6 to clause 8 (inclusive) be followed if:

a) an application, in respect of any activities identified in terms of the current relevant legislation are proposed, if noise sources listed in clauses 3.17 and 3.18 (of SANS 10328) are to be developed, or the issues listed in clause 5 (of SANS 10328) may take place, is made to the relevant authority;

b) an application for a noise-sensitive development (see 3.16 of SANS 10328) is made to the relevant authority;
c) an application for a change in land use is made to the relevant authority; or
d) an environmental noise impact investigation is requested by an applicant or any interested or affected party.

The minimum contents of the noise specialist study are also included in **section 2.7.2** of this report.

3.5 INTERNATIONAL GUIDELINES

While a number of international guidelines and standards exists, those selected below are used by numerous countries for environmental noise management.

3.5.1 Guidelines for Community Noise (WHO, 1999) [144]

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO expert task force meeting held in London, United Kingdom, in April 1999 [**144**]. It is based on the document entitled "Community Noise" that was prepared for the WHO and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments. It discusses the specific effects of noise on communities including:

- Interference with communication, noise-induced hearing impairment, sleep disturbance effects, cardiovascular and psychophysiological effects, mental health effects, effects on performance, annoyance responses and effects on social behavior.

It further discusses how noise can affect (and propose guideline noise levels) specific environments such as residential dwellings, schools, preschools, hospitals, ceremonies, festivals and entertainment events, sounds through headphones, impulsive sounds from toys, fireworks and firearms, and parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during

the day, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. At night, equivalent sound levels at the outside façades of the living spaces should not exceed 45 dBA and 60 dBA L_{Amax} so that people may sleep with bedroom windows open. It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

3.5.2 Night Noise Guidelines for Europe (WHO, 2009) [145]

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the WHO has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe [**145**]. Rather than a maximum of 30 dB inside at night (which equals 45-50 dB max outside), the WHO now recommends a maximum year-round outside night-time noise average of 40 db to avoid sleep disturbance and its related health effects. The report notes that only below 30 dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40 dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

The 184-page report offers a comprehensive overview of research into the various effects of noise on sleep quality and health (including the health effects of non-waking sleep arousal), and is recommended reading for anyone working with noise issues. The use of an outdoor noise standard is in part designed to acknowledge that people do prefer to leave windows open when sleeping, though the year-long average may be difficult to obtain (it would require longer-term sound monitoring than is usually budgeted for by either industry or neighbourhood groups).

While recommending the use of the average level, the report notes that some instantaneous effects occur in relation to specific maximum noise levels, but that the health effects of these "cannot be easily established."

3.5.3 The Assessment and Rating of Noise from Wind Farms (Energy Technology Support Unit, 1997)

This report describes the findings of a Working Group on Wind Turbine Noise, facilitated by the United Kingdom Department of Trade and Industry [**45**]. It was developed as an Energy

Technology Support Unit[5] (ETSU) project. The aim of the project was to provide information and advice to developers and planners on noise from wind turbines. The report represents the consensus view of a number of experts (experienced in assessing and controlling the environmental impact of noise from wind farms). Their findings can be summarised as follows:

1. Absolute noise limits applied at all wind speeds are not suited to wind farms; limits set relative to the background noise (including wind as seen in **Figure 4-31**) are more appropriate;
2. $L_{A90,10mins}$ is a much more accurate descriptor when monitoring ambient and turbine noise levels;
3. The effects of other wind turbines in a given area[6] should be added to the effect of any proposed Wind Farm (WF), to calculate the cumulative effect;
4. Noise from a WEF should be restricted to no more than 5 dBA above the current ambient noise level at a receptor. Ambient noise levels are measured onsite in terms of the $L_{A90,10min}$ descriptor for a period sufficiently long enough for a set period;
5. Wind farms should be limited within the range of 35 dBA to 40 dBA (day-time) in a low noise environment. A fixed limit of 43 dBA should be implemented during all night time noise environments. This should increase to 45 dBA (day and night) if the NSD has financial investments in the WF; and
6. A penalty system should be implemented for wind turbine/s that operates with a tonal characteristic.

While this guideline may be 25 years old, planning policy in England, Scotland, Wales and Northern Ireland still refer to the ETSU-R97 for guidance on the assessment of wind turbine noise [**23**, **44**, **67**, **129**, **132**]. In Australia and New Zealand, ETSU-R-97 has been adopted as the base assessment method of assessment [**23**, **43**]. The ETSU-R97 is referenced in NARUC (2011) [**90**] as well as the recommended method in IFC (2015) [**66**]. Because of its international importance, the methodologies used in the ETSU R97 document will be considered in this report for implementation should projected noise levels (from the proposed WEF at NSR) exceed the zone sound levels as recommended by SANS 10103:2008.

[5] ETSU was set up in 1974 as an agency by the United Kingdom Atomic Energy Authority to manage research programmes on renewable energy and energy conservation. The majority of projects managed by ETSU were carried out by external organizations in academia and industry. In 1996, ETSU became part of AEA Technology plc which was separated from the UKAEA by privatisation.

[6] Though the area has not been defined, it is the opinion of the author that this would be withing the potential area of effect, defined as 2,000m in SANS 10328:2008. Considering that WTG from two adjacent WEFs may have a slight influence at 2,000m, this area typically would be a maximum of 4,000m from two or more WEFs

3.5.4 Noise Guidelines for Wind Farms (MoE, 2008) [88]

This document establishes the sound level limits for land-based wind power generating facilities and describes the information required for noise assessments and submissions under the ECA and the Environmental Protection Act, Canada.

The document defines:

- Sound Level Limits for different areas (similar to rural and urban areas), defining limits for different wind speeds at 10 m height, refer also **Table 3-3**[7]
- The Noise Assessment Report, including:
    - Information that must be part of the report;
    - Full description of noise sources;
    - Adjustments, due to the wind speed profile (wind shear);
    - The identification and defining of potential sensitive receptors;
    - Prediction methods to be used (ISO 9613-2);
    - Cumulative impact assessment requirements;
    - It also defines specific model input parameters;
    - Methods on how the results must be presented; and
    - Assessment of Compliance (defining magnitude of noise levels).

Table 3-3: Summary of Sound Level Limits for Wind Farms (MoE)

Wind speed (m/s) at 10 m height	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits, Class 3 Area, dBA	40	40	40	43	45	49	51
Wind Turbine Sound Level Limits, Class 1 & 2 Areas, dBA	45	45	45	45	45	49	51

The document used the $L_{Aeq,1h}$ noise descriptor to define noise levels.

It should be noted that these Sound Level Limits are included for the reader to illustrate the criteria used internationally. Due to the lack of local regulations specifically relevant to WFs this criterion will also be considered during the determination of the significance of the noise impact.

3.5.5 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial

[7]The measurement of wind induced background sound level is not required to establish the applicable limit. The wind induced background sound level reference curve was determined by correlating the A-weighted ninetieth percentile sound level (L90) with the average wind speed measured at a particularly quiet site. The applicable Leq sound level limits at higher wind speeds are given by adding 7 dB to the wind induced background L90 sound level reference values

Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. Revision III of the EPs has been in place since June 2013. As of March 2021, 116 financial institutions in 37 countries have officially adopted the Equator Principles, covering the majority of international project finance debt in emerging and developed markets.

The participating banks chose to model the Equator Principles on the environmental standards of the World Bank (1999) and the social policies of the International Finance Corporation (IFC). As of beginning 2022:

- More than 90 banks and financial institutions have voluntarily adopted the Equator Principles, which are based on IFC's Performance Standards[8].
- 32 export credit agencies of the Organization of Economic Co-operation and Development countries benchmark private sector projects against IFC's Performance Standards.
- The Multilateral Investment Guarantee Agency applies IFC's Performance Standards in its operations.
- The World Bank applies IFC's Performance Standards (known as World Bank Performance Standards) to projects supported by IBRD/IDA (International Bank for Reconstruction and Development/International Development Association) that are owned, constructed and/or operated by the private sector.

3.5.6 IFC: General EHS Guidelines – Environmental Noise Management [65]

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principles. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the IFC Environmental, Health and Safety (EHS) Guidelines.

Document 1.7[9] of the IFC: General EHS Guidelines states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from project facilities/operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to

8 https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/performance-standards

9 https://www.ifc.org/wps/wcm/connect/4a4db1c5-ee97-43ba-99dd-8b120b22ea32/1-7%2BNoise.pdf?MOD=AJPERES&CVID=nPtgwZY

implement noise control measures at source. It goes as far as to proposed methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment casing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas;
- Re-locating noise sources to less-sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 3-4**) and highlights certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. This criterion will effectively sterilize large areas of any development. Therefore, it is the author's considered opinion that this criterion was introduced to address cases where the existing ambient noise level is already at, or in excess of the recommended limits.

Table 3-4: IFC Table 7.1-Noise Level Guidelines

Receptor type	One-hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The document uses the $L_{Aeq,1hr}$ noise descriptors to define noise levels. It does not determine the detection period, but refers to the IEC standards, which requires the fast detector setting on the Sound Level Meter during measurements in Europe.

3.5.7 European Parliament Directive 2000/14/EC [38]

Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors was adopted by the European Parliament and the Council and first published in May 2000 and applied from 3 January 2002. The directive placed sound power limits on equipment to be used outdoors in a suburban or urban setting. Failure to comply with these regulations may result in products being prohibited from being placed on the EU market. Equipment list is vast and includes machinery such as compaction machineries, dozers, dumpers, excavators, etc. Manufacturers as a result started to consider noise emission levels from their products to ensure that their equipment will continue to have a market in most countries.

3.5.8 Environmental, Health, and Safety Guidelines for Wind Energy [66]

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 from the time of the environmental impact assessment, and continue to be applied throughout the construction and operational phases.

It provides a brief overview of construction and operational noises, potential operational mitigation measures and a number of principles on the assessment of noise impacts, including:

- Receptors should be chosen according to their environmental sensitivity (human, livestock, or wildlife);
- Preliminary modeling should be carried out to determine whether more detailed investigation is warranted. The preliminary modeling can be as simple as assuming hemispherical propagation (i.e., the radiation of sound, in all directions, from a source point). Preliminary modeling should focus on sensitive receptors within 2,000 meters (m) of any of the turbines in a wind energy facility;
- If the preliminary model suggests that turbine noise at all sensitive receptors is likely to be below an L_{A90} of 35 dBA at a wind speed of 10 meters/second (m/s) at 10 m height during day and night times, then this preliminary modeling is likely to be sufficient to assess noise impact; otherwise it is recommended that more detailed modeling be carried out, which may include background ambient noise measurements;
- All modeling should take account of the cumulative noise from all wind energy facilities in the vicinity having the potential to increase noise levels;
- If noise criteria based on ambient noise are to be used, it is necessary to measure the background noise in the absence of any wind turbines. This should be done at

one or more noise-sensitive receptors. Often the critical receptors will be those closest to the wind energy facility, but if the nearest receptor is also close to other significant noise sources, an alternative receptor may need to be chosen; and

- The background noise should be measured over a series of 10-minute intervals, using appropriate wind screens. At least five of these 10-minute measurements should be taken for each integer wind speed from cut-in speed to 12 m/s.

3.5.9 Environmental Noise Guidelines for the European Region (2018) [146]

This document identifies levels at which noise has "adverse health effects" and recommends actions to reduce exposure. Compared to previous WHO guidelines on noise, this version contains five significant developments:

- Stronger evidence of the cardiovascular and metabolic effects of environmental noise;
- Inclusion of new noise sources, namely wind turbine noise and leisure noise, in addition to noise from transportation (aircraft, rail, and road traffic);
- Use of a standardized approach to assess the evidence;
- A systematic review of evidence, defining the relationship between noise exposure and risk of adverse health outcomes;
- Use of long-term average noise exposure indicators to better predict adverse health outcomes.

The WHO (2018) **[146]** considers adverse health effects in section 2.4.3.2 of that report, dividing these effects into the following health outcomes:

- Cardiovascular disease – Ischaemic heart disease and hypertension;
- Cognitive impairment – Reading and oral comprehension;
- Permanent hearing impairment; and
- Self-reported sleep disturbance and annoyance.

While the WHO (2018) **[146]** highlights that there is insufficient evidence of adverse health effects at noise levels below 40 dBA L_{night}, adverse health effects were reported at levels starting from 40 dB L_{night}. At 40 dB, about 3–4% of the population still reported being highly sleep-disturbed due to noise, which was considered relevant to health. It recommends that the guideline level should minimise adverse health effects to less than:

- 3% of the population experiencing sleep disturbances; and
- 10% of the population being highly annoyed.

This report recommends, that, for average noise exposure, the WHO Guideline Development Group conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den}[10], as wind turbine noise above this level is associated with adverse health effects.

3.5.10 Concluding remarks on the use of International Guidelines in this Assessment

As highlighted in **section 6.4**, South African guidelines (such as SANS 10103) or regulations (such as GNR.154 of 1992), does not cater for instances when background noise levels change due to the impact of external forces (such as the influence of increased winds). As such this report considers both local legislation, regulations and guidelines as well as international guidelines. Of the more than 340,000 WTG[11] operation in the rest of the world (more than 15,000 wind farms[12]), less than 500 WTG are currently operational in South Africa (34 - 37 wind farms, depending on source). The rest of the world therefore have had experience with the effects and impacts of wind farms since 1980; South Africa only since 2002.

As such, almost all the scientific articles, papers, publications and presentations available are based on the research and experiences gained from these international wind farms. Therefore, discarding the knowledge and experiences gained by the rest of the world would be irresponsible and unwise. In summary:

- The WHO Guidelines for Community Noise recommends that night-time equivalent sound levels (at the outside façades of the living spaces) not exceed 45 dBA with L_{Amax} less than 60 dBA so that people may sleep with bedroom windows open **(Section 3.5.1)**;
- The Night Noise Guidelines for Europe revised noise levels, recommending a maximum year-round outside night-time noise average of 40 dB to avoid sleep disturbance and its related health effects **(Section 3.5.2)**;
- The ETSU-R97 guideline recommends an upper noise limit of 45 dBA for project participants, and a noise limit of 40 dBA for external parties **(Section 3.5.3)**;
- The MoE guideline propose a changing noise limit at different wind speeds for wind farm developments, varying from 40 dBA (at a wind speed of 4 m/s) to a maximum of 51 dBA (at a wind speed of 10 m's or more) **(Section 3.5.4)**;

---

[10] Day–evening–night noise level is a European standard to express noise level over an entire day. It imposes a penalty on sound levels during evening and night and it is primarily used for noise assessments of airports, busy main roads, main railway lines and in cities over 100,000 residents. This equates to a night-time equivalent noise level of approximately 38.7 dBA.

[11] https://gwec.net/there-are-over-341000-wind-turbines-on-the-planet-heres-how-much-of-a-difference-theyre-actually-making/#:~:text=According%20to%20the%20Global%20Wind,were%20spinning%20and%20generating%20energy.

[12] https://globalenergymonitor.org/projects/global-wind-power-tracker/

- The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007, with the guidelines recommending a night-time noise limit of 45 dBA **(Section 3.5.6)**;
- The European Directives does not set noise limits, but there are a number that obligate equipment manufacturers to define and indicate the sound power emission levels of their equipment. When presented with a number of equipment options, applicants can use this data to select the quietest piece of equipment, in such to minimize noise levels **(Section 3.5.7)**;
- While the IFC EHS Guidelines for Wind Energy does not stipulate specific noise limits, it does recommend the measurement of ambient sound levels at different speeds (referring to the ETSU-R97 guidelines discussed in **Section 3.5.3** should noise criteria based on ambient sound levels be used **(Section 3.5.8)**; and
- The Environmental Noise Guidelines for the European Region report recommends that, for average noise exposure, noise levels produced by wind turbines should remain below 45 dBA L_{den} (an L_{Aeq} of ± 38.7 dBA) **(Section 3.5.9)**.

As WTGs only operate during a period with wind speeds are elevated, a period that generally coincide with increased noise levels (due to wind-induced noises) this report recommends an upper noise limit of 45 dBA, at the same time considering the international recommended levels (as further motivated in **sections 6.4.1.1** and **6.4.1.3**) and summarized in **Table 6-2**.

4 CURRENT ENVIRONMENTAL SOUND CHARACTER

4.1 INFLUENCE OF SEASON ON AMBIENT SOUND LEVELS

Natural sounds are a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises such as wind flowing through vegetation increasing as wind speed increase. Work by Fégeant (2002) [**48**] stressed the importance of wind speed and turbulence causing variations in the level of vegetation-generated noise. In addition, factors such as the season (e.g., dry or no leaves versus green leaves), the type of vegetation (e.g., grass, conifers, deciduous), the vegetation density and the total vegetation surface all determine both the sound level as well as spectral characteristics.

Ambient sound levels are significantly affected by the area where the sound measurement location (or a listener) is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and even increased wind speeds have an insignificant to massive impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings), however, are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication is more significant during the warmer spring and summer months as various species communicate in an effort to find mates. Faunal communication is normally less during the colder months.
- Seasonal changes in weather patterns, mainly due to increased wind speeds (also see **Sub Section 4.1.1** below) and potential gustiness of the wind.

For environmental noise, weather plays an important role, the greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible. Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the sub-sections below.

Ambient sound levels are generally less during the colder months (due to less faunal communication) and higher during the warmer months.

4.1.1 Effect of Temperature inversions

On a typical sunny afternoon, the air is the hottest near the ground surface and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. The potential effect of refraction is illustrated in **Figure 4-1**.

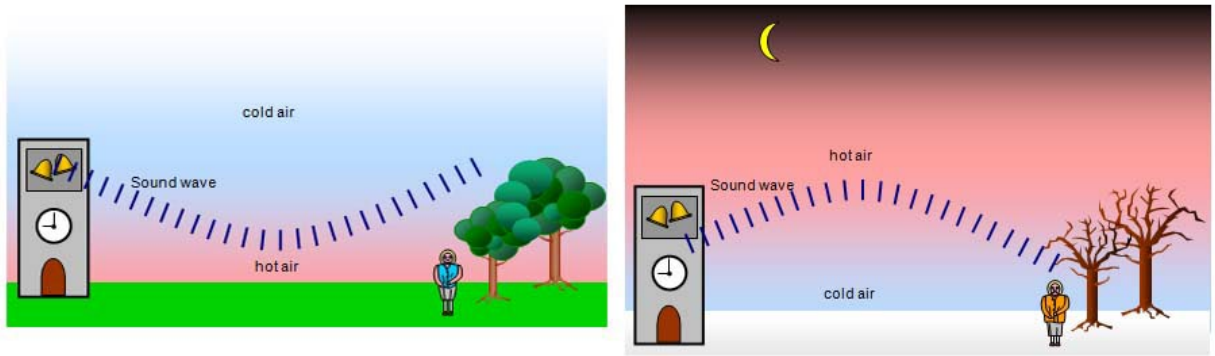


Figure 4-1: Influence of temperature inversions on the propagation of sound

In the evening, this temperature gradient will reverse, but, during certain meteorological conditions, the normal vertical temperature gradient could be inverted so that the air is colder near the surface, with a warmer layer blanketing the lower layer. This inversion layer may result in the reflection of some of the sound waves as illustrated in **Figure 4-2** below.

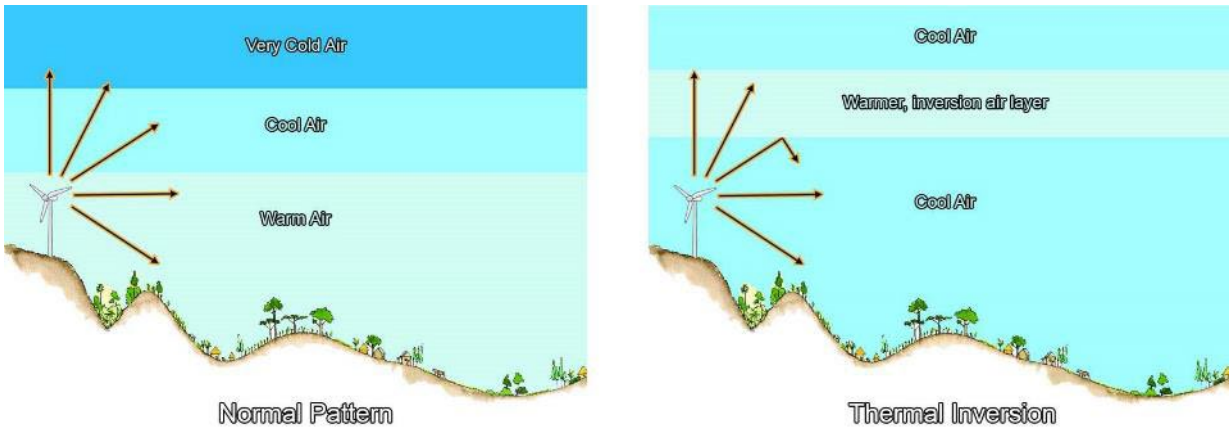


Figure 4-2: Influence of temperature inversions on the propagation of sound

When such an inversion layer is present, some of the sound waves will be refracted[13] by the temperature gradient, with the refracted sound waves returned to the ground. This effect

[13] Redirecting the wave propagation direction due to a change in the density of the air which influence the speed of sound.

has been noticed near airports and roads, where noises can be heard over greater distances at night than other times of day (Parnell, 2015, **[99]**; Saurenman, 2005, **[117]**), and reported by Van der Berg (2003) **[134]** for WEF noises.

Like wind gradients, temperature gradients can influence sound propagation over long distances, complicate sound level measurements as well as propagation modelling.

4.1.2 Effect of Wind

Wind alters sound propagation by the mechanism of refraction, that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source as illustrated in **Figure 4-3**. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high. Over short distances wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e., less than 5 m/s.

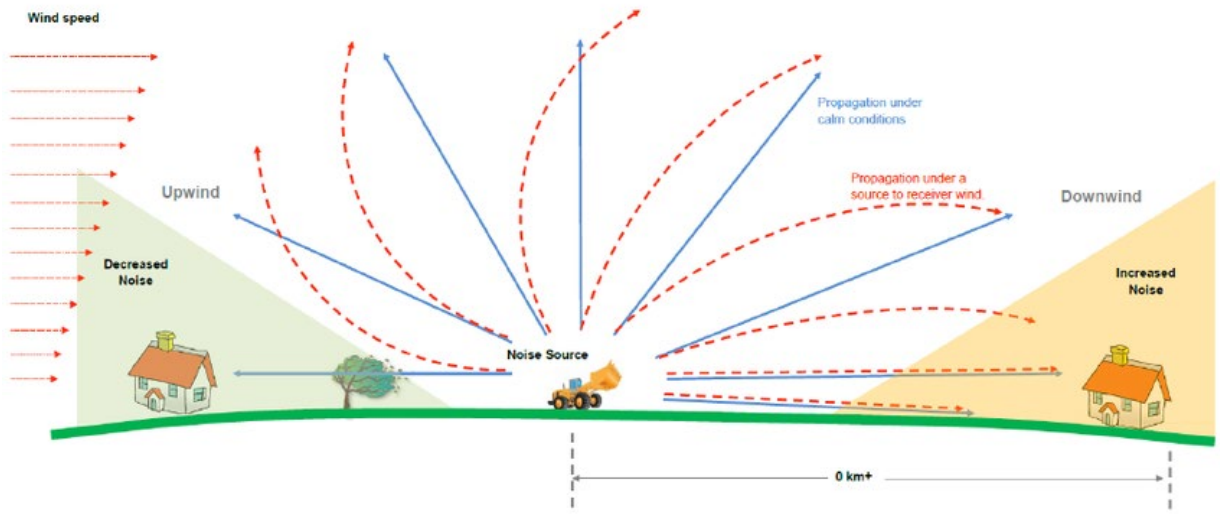


Figure 4-3: Influence of wind on sound propagation

Wind speed frequently plays a role in increasing sound levels in natural locations. With no wind, there is little vegetation movement that could generate noises and faunal noises (normally birds and insects) dominate, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on

the type of vegetation in a certain area. The impact of increased wind speed on sound levels depends on the vegetation type (deciduous versus conifers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes unanticipated consequences, as suitable vegetation may create suitable habitats and food sources attracting birds and insects (and the subsequent increase in faunal communication).

4.1.3 Effect of Humidity and Temperature

On a typical sunny afternoon, the air is the hottest near the ground surface and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, resulting in cooler temperatures near the ground. This condition, often referred to is a temperature inversion will cause sound to bend downward towards the ground and results in louder noise levels at the listener position. Like wind gradients, temperature gradients can influence sound propagation over long distances, complicate sound level measurements as well as propagation modelling.

Generally, sound propagate better at lower temperatures (down to 10^{o}C), and with everything being equal, a decrease in temperature from 32^{o}C to 10^{o}C could increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

The effect of humidity on sound propagation is quite complex, but effectively relates to how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at a higher high humidity. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz at 20^{o}C).

Together, the impact of temperature and humidity (together with air pressure - to a minor extent) are complex and highly dependent on the frequency composition of the noise. This is illustrated in **Figure 4-4**.

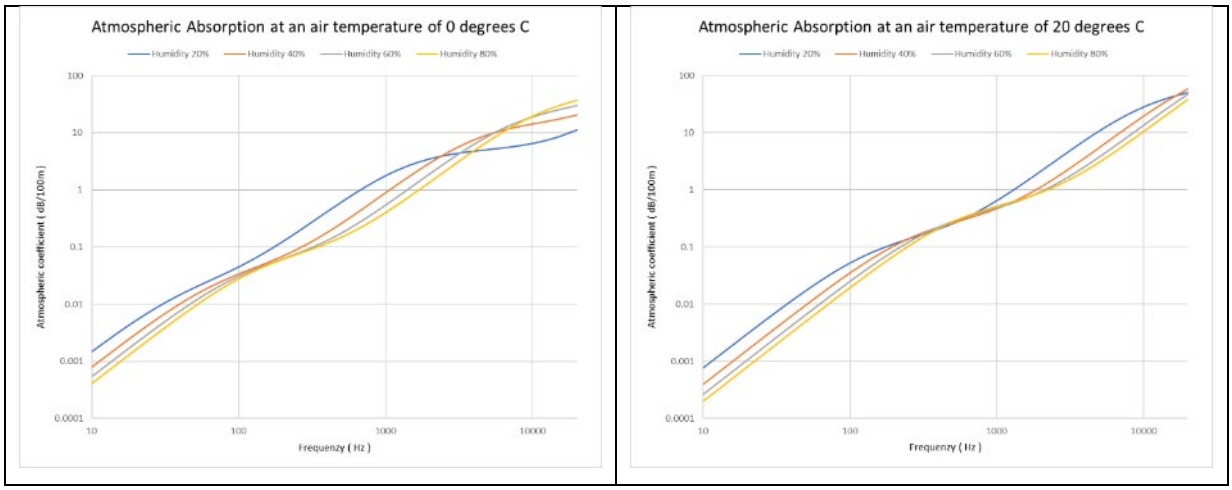


Figure 4-4: Effect of Temperature and Humidity on propagation of Sound

4.2 TEMPERATURE AND HUMIDITY MEASUREMENTS

Temperature and humidity were measured during site visit, with the average, maximum and minimum readings defined in **Table 4-1**, with the data illustrated on **Figure 4-5**. For the purpose of modelling, average humidity of 70 % and temperatures of 10 °C at an air pressure of 85 kPA will be used.

Table 4-1: Temperature and Humidity measured onsite (7 – 9 June '23)

	Humidity	Temperature
Day average	43.6	16.3
Night average	72.0	11.3
Day minimum	16.8	7.5
Day maximum	80.1	21.9
Night minimum	48.6	6.6
Night maximum	82.1	13.2

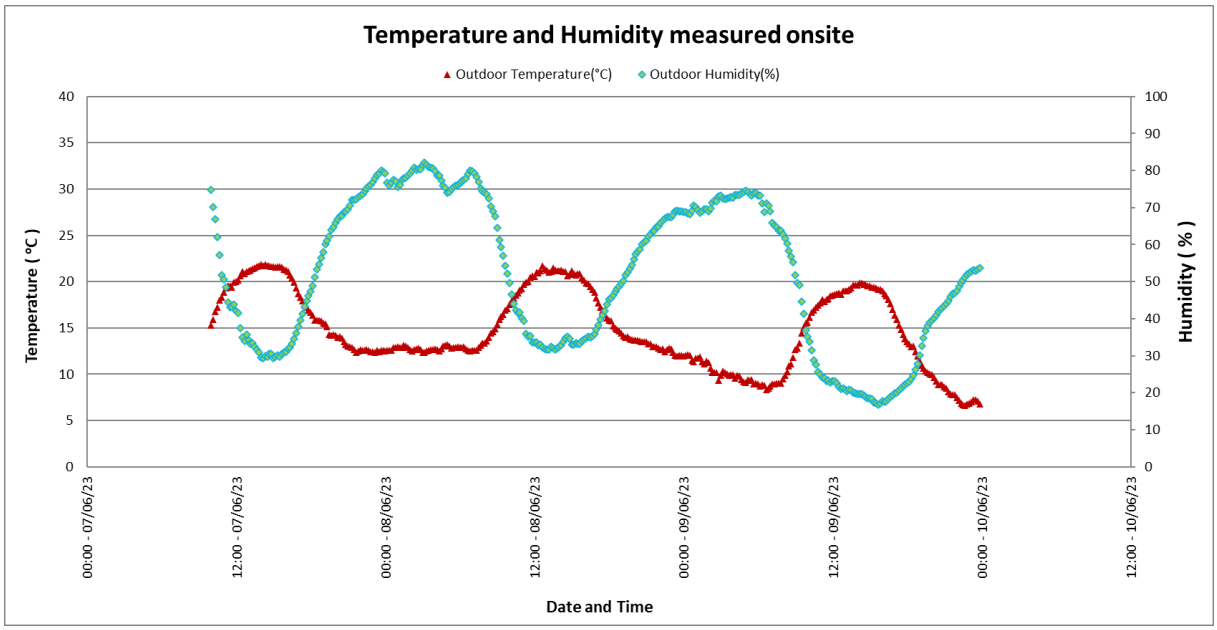


Figure 4-5: Temperature and Humidity readings measured onsite

4.3 SOUND LEVEL MEASUREMENTS - PROCEDURE

Ambient (background) sound levels were measured at six locations from 7 to 9 June 2023, which would represent typical ambient sound levels during the quieter winter months. Ambient sound level data was also available for a number of other projects in the area.

All measurements were done in accordance with the South African National Standard SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***" considering the protocols defined in GG 43110.

The protocol defined the SANS guidelines to be used and time periods (in which measurements must be collected), with the guidelines specifying the acceptable techniques for sound measurements including, the type of equipment (Class 1), minimum duration of measurement, microphone positions and height above ground level, calibration procedures and instrument checks and supplementary weather measurements and observations.

The sound levels were measured using class-1 Sound Level Meters (SLMs) with the measurement localities presented in **Figure 4-6**. The SLMs would measure "average" sound levels over 10-minute periods, save the data and start with a new 10-minute measurement until the instruments were stopped.

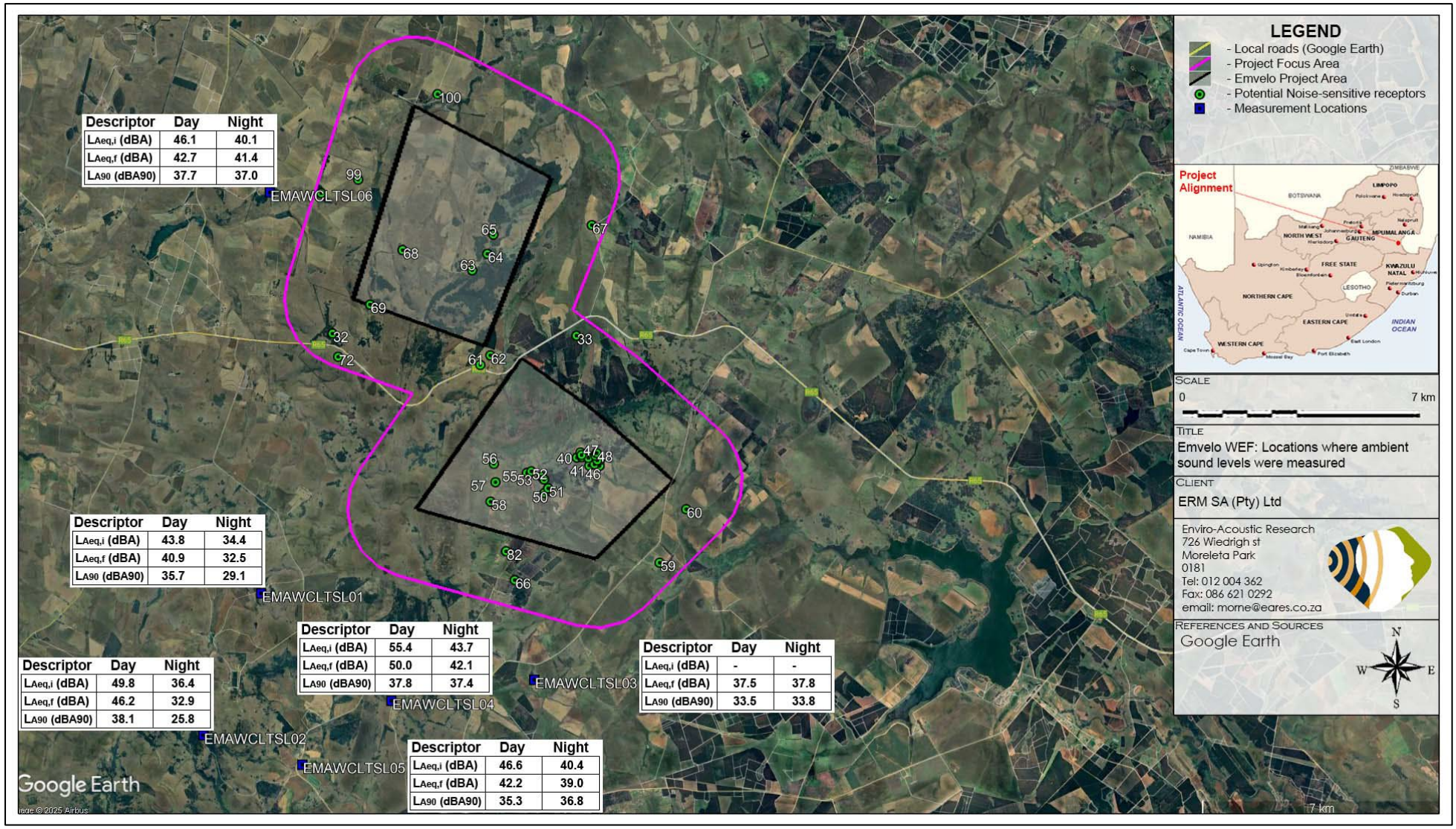


Figure 4-6: Localities where ambient sound levels were measured

4.3.1 Long-term Measurement Location EMAWCLTSL01

The measurement location was selected to be indicative of potential residual noise levels at a typical farm dwelling in the area. The microphone was deployed in the garden in front of the house, with a significant number of large trees and palms within 100m. Large trees will influence ambient sound levels during periods with higher wind speeds.

The equipment defined in **Table 4-2** was used for gathering data, with photos of this measurement location presented in **Appendix D**. Refer to **Table 4-3** highlighting sounds heard during equipment deployment and collection.

Table 4-2: Equipment used to gather data at EMAWCLTSL01

Equipment	Model	Serial no	Calibration
Sound Level Meter	Svan 977	34849	January 2023
Pre-amplifier	SV 12L	32395	January 2023
Microphone	ACO 7052E	33077	January 2023
Calibrator	Quest CA-22	J 2080094	July 2022

Table 4-3: Noises/sounds heard during site visits at EMAWCLTSL01

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Wind-induced noises dominant.
	Sounds associated with the household	Sheep bleating.
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Wind-induced noises dominant. Birds clearly audible to audible.
	Sounds associated with the household	Sheep audible. Voices from workers.
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-7** and summarized in **Table 4-4** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-8**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the background noise levels (residual noise levels).

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} level was higher than expected for a rural noise district, likely relating to faunal (birds and insects) noises as well as wind-induced noises.

Maximum noise levels did not exceed 65 dBA at any of the measurement nights. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[14].

Table 4-4: Sound levels considering various sound level descriptors at EMAWCLTSL01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	43.8	40.9	35.7	-
Night arithmetic average	-	34.4	32.5	29.1	-
Day equivalent	-	43.8	41.0	-	-
Night equivalent	-	30.5	29.0	-	-
Day minimum	-	26.4	24.8	-	20.3
Day maximum	76.8	56.6	52.5	-	-
Night minimum	-	27.2	25.1	-	18.1
Night maximum	59.5	40.7	38.8	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-9** (night) and **Figure 4-10** (day).

(14) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

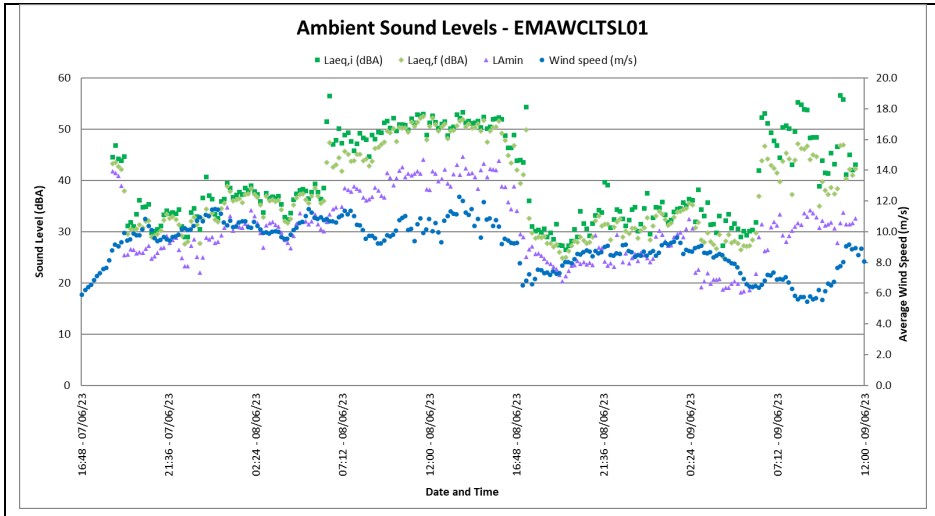


Figure 4-7: Residual noise Levels at EMAWCLTSL01

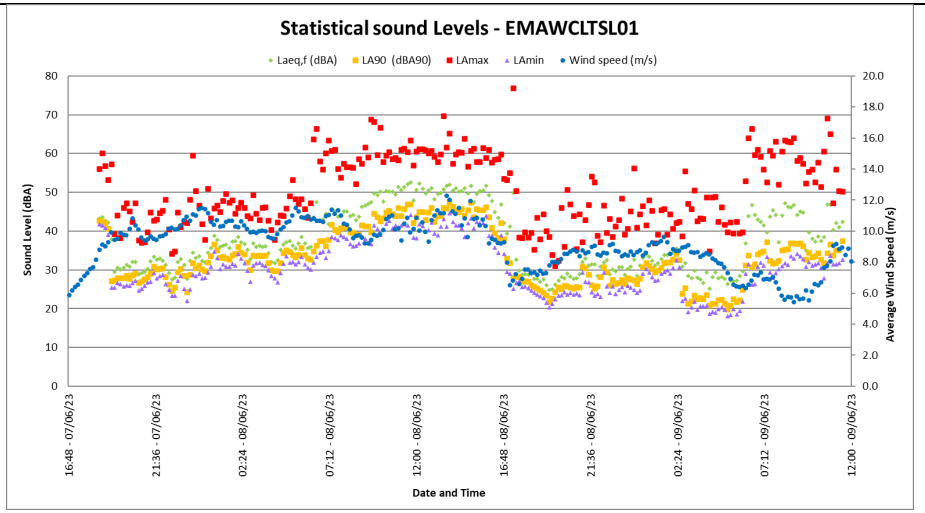


Figure 4-8: Maximum, minimum and Statistical sound levels at EMAWCLTSL01

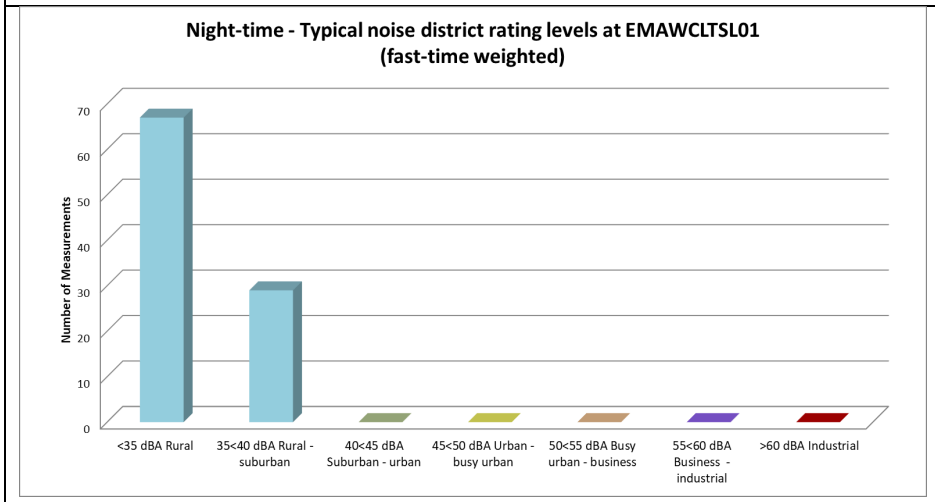


Figure 4-9: Classification of night-time measurements in typical noise districts at EMAWCLTSL01

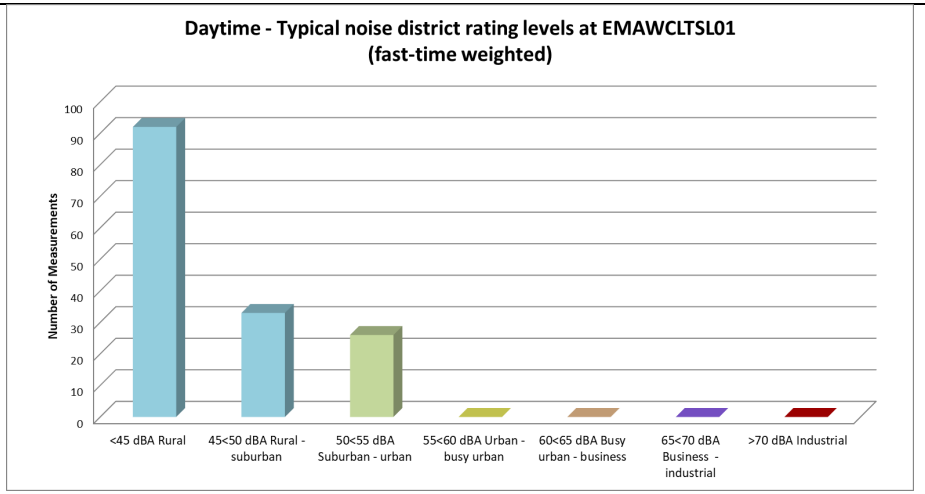


Figure 4-10: Classification of daytime measurements in typical noise districts at EMAWCLTSL01

4.3.2 Long-term Measurement Location - EMAWCLTSL02

The measurement location was located near the residential dwelling, on the edge of the cultivated lawn. There were a number of trees within 100m from the microphone. Natural noises generally dominated the soundscape.

The equipment defined in **Table 4-5** was used for gathering data with **Table 4-6** highlighting sounds heard during equipment deployment and collection, with photos of this measurement location presented in **Appendix D**.

Table 4-5: Equipment used to gather data at EMAWCLTSL02

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	Rion NL-62	00511783	September 2022
Pre-amplifier	NH-26	11981	September 2022
Microphone	UC-59L	02249	September 2022
Calibrator	Quest CA-22	J 2080094	July 2022

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

Table 4-6: Noises/sounds heard during site visits at EMAWCLTSL02

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Bird sounds dominant. Some wind-induced noises in area.
	Residential	-
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Bird sounds dominant. Some wind-induced noises in area.
	Residential	-
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-11** and summarized in **Table 4-7** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-12**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the background noise levels (residual noise levels).

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} levels were significantly higher than the levels expected for a rural noise district, likely relating to faunal (both domesticated and wildlife) noises.

Maximum noise level exceeded 65 dBA three times night two, with the source of the noises not defined. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[15].

Table 4-7: Sound levels considering various sound level descriptors at EMAWCLTSL02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	49.8	46.2	38.1	-
Night arithmetic average	-	36.4	32.9	25.8	-
Day equivalent	-	52.2	48.1	-	-
Night equivalent	-	32.6	28.9	-	-
Day minimum	-	30.1	26.4	-	20.9
Day maximum	93.4	76.0	65.9	-	-
Night minimum	-	28.5	25.8	-	20.0
Night maximum	72.3	45.8	41.0	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-13** (night) and **Figure 4-14** (day).

(15) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

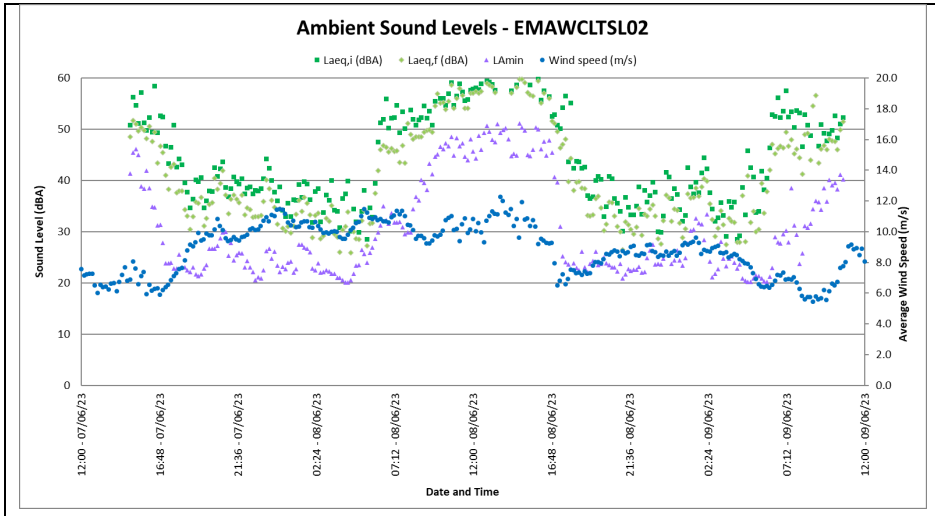


Figure 4-11: Residual noise Levels at EMAWCLTSL02

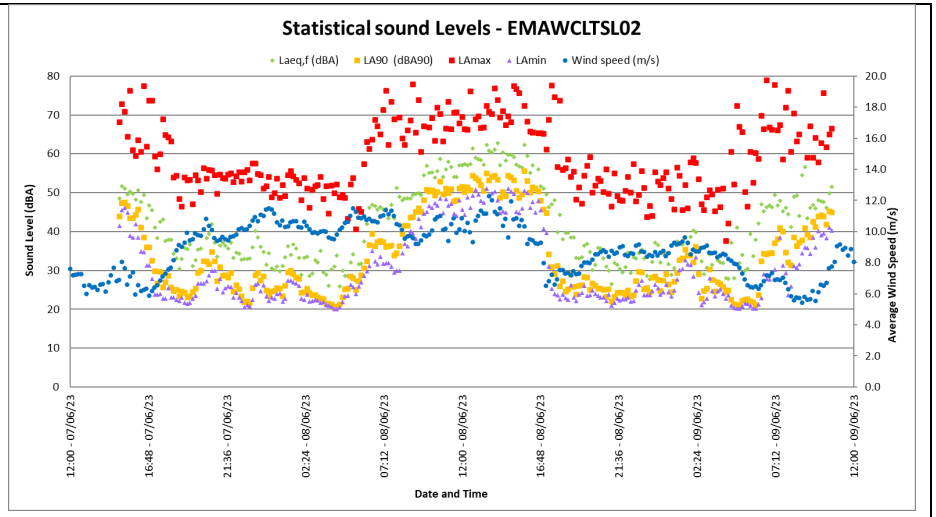


Figure 4-12: Maximum, minimum and Statistical sound levels at EMAWCLTSL02

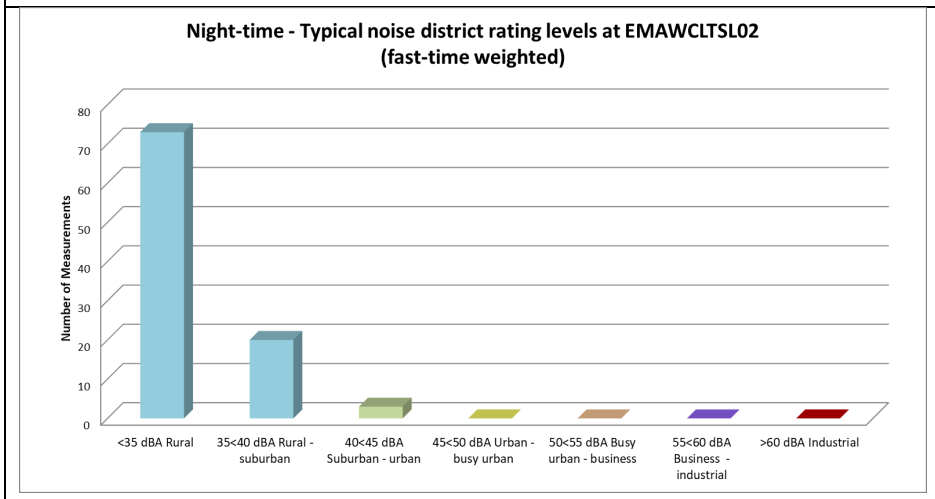


Figure 4-13: Classification of night-time measurements in typical noise districts at EMAWCLTSL02

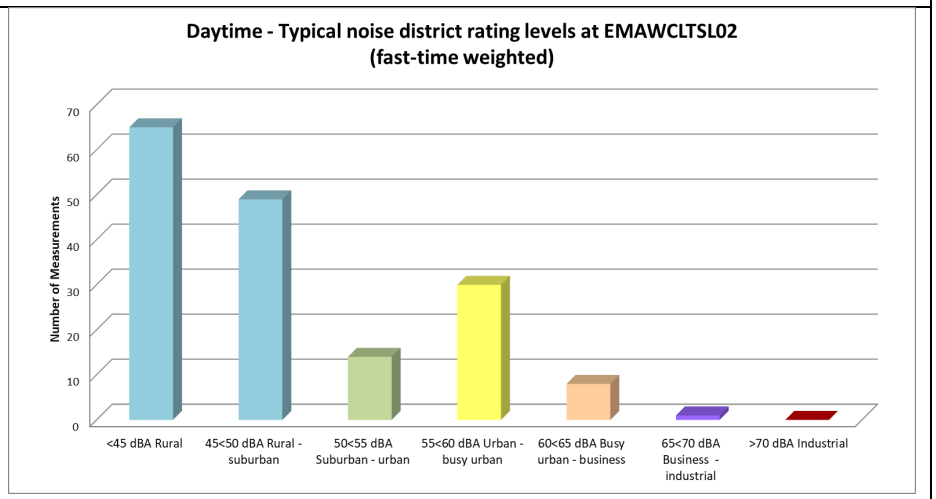


Figure 4-14: Classification of daytime measurements in typical noise districts at EMAWCLTSL02

4.3.3 Long-term Measurement Location - EMAWCLTSL03

The instrument was deployed in an area considered to be very quiet, with the microphone located between the house and the fence area. The equipment defined in **Table 4-8** was used for gathering data with **Table 4-9** highlighting sounds heard during equipment deployment and collection, with photos of this measurement location presented in **Appendix D**.

Table 4-8: Equipment used to gather data at EMAWCLTSL03

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	Larson Davis 824	824A0896	February 2023
Pre-amplifier	PRM902	1345	February 2023
Microphone	2541	6427	February 2023
Calibrator	Quest CA-22	J 2080094	July 2022

Table 4-9: Noises/sounds heard during site visits at EMAWCLTSL03

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Bird sounds dominant. Some wind-induced noises in area. Insects audible.
	Residential	-
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Bird sounds dominant. Some wind-induced noises in area.
	Residential	-
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-15** and summarized in **Table 4-10** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-16**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the background noise levels (residual noise levels).

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} levels were significantly elevated

both day and night, more typical of an urban or even industrial district, indicating a constant and relative significant noise in the background.

Maximum noise levels exceeded 65 dBA four times each night one and two. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[16].

Table 4-10: Sound levels considering various sound level descriptors at EMAWCLTSL03

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	-	37.5	33.5	-
Night arithmetic average	-	-	37.8	33.8	-
Day equivalent	-	-	35.9	-	-
Night equivalent	-	-	33.8	-	-
Day minimum	-	-	27.0	-	19.9
Day maximum	79.8	-	50.6	-	-
Night minimum	-	-	26.6	-	19.3
Night maximum	74.3	-	48.8	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-17** (night) and **Figure 4-18** (day).

(16) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

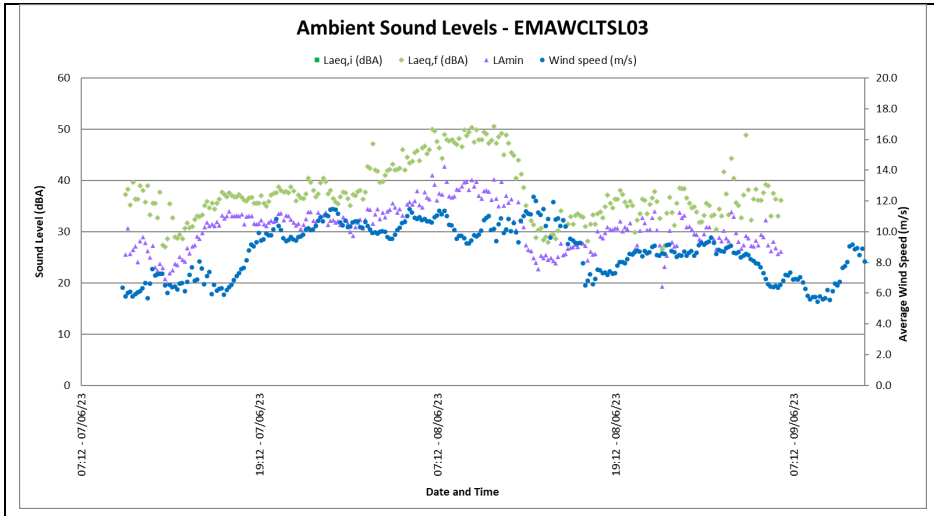


Figure 4-15: Residual noise Levels at EMAWCLTSL03

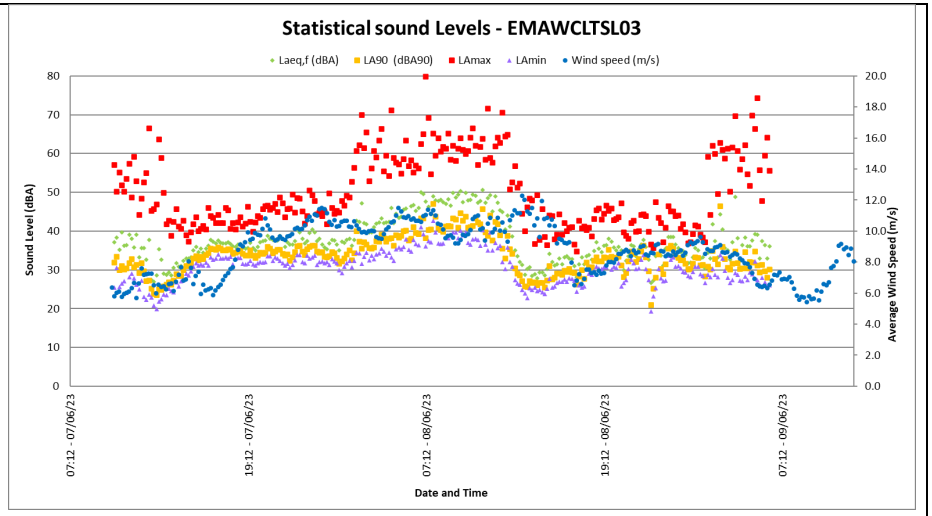


Figure 4-16: Maximum, minimum and Statistical sound levels at EMAWCLTSL03

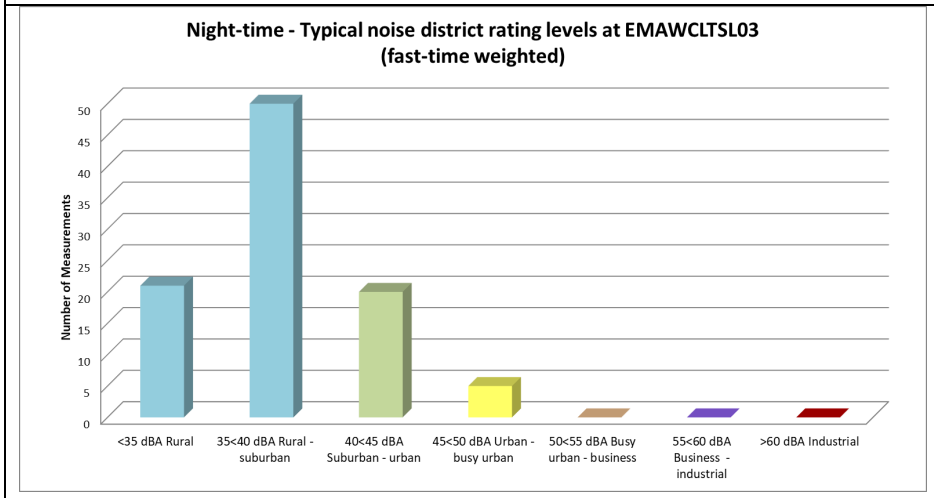


Figure 4-17: Classification of night-time measurements in typical noise districts at EMAWCLTSL03

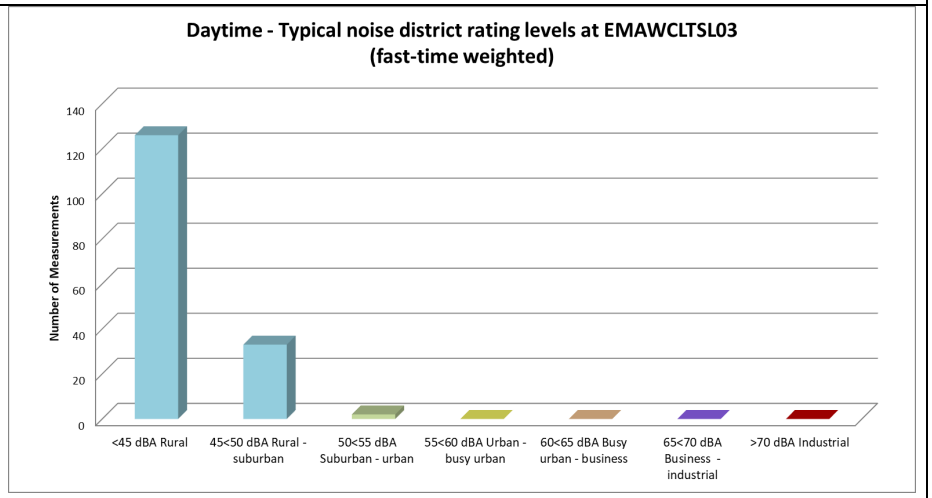


Figure 4-18: Classification of daytime measurements in typical noise districts at EMAWCLTSL03

4.3.4 Long-term Measurement Location - EMAWCLTSL04

The instrument was deployed in the garden behind a residential house. There was significant vegetation near the area, including a number of strelitzia plants. The ambient sound level measurements are representative of the area surrounding the small residence. The equipment defined in **Table 4-5** was used for gathering data with **Table 4-6** highlighting sounds heard during equipment deployment and collection. Photos of this measurement location is presented in **Appendix D**.

Table 4-11: Equipment used to gather data at EMAWCLTSL04

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	BSWA 308	589036	May 2022
Pre-amplifier	MA 231T	580052	May 2022
Microphone	231	570172	May 2022
Calibrator	Quest CA-22	J 2080094	July 2022

Table 4-12: Noises/sounds heard during site visits at EMAWCLTSL04

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Birds dominant.
	Residential	Chickens and cattle audible at times, with noises significant at times.
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Bird sounds dominant. Some wind-induced noises in area.
	Residential	Cattle audible.
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-11** and summarized in **Table 4-7** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-12**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level. The L_{A90} levels were slightly higher than expected for a rural noise district, likely relating to faunal (birds and insects) noises as well as wind-induced noises.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} levels were significantly elevated both day and night, more typical of an urban or even industrial district, indicating a constant and relative significant noise in the background.

Maximum noise levels did exceed 65 dBA at least 5 times night one, with the source not defined. If maximum noise levels exceed 65 dBA more than 10 times at night, it may increase the probability where a receptor may be awakened at night, ultimately impacting on the quality of sleep[17].

Table 4-13: Sound levels considering various sound level descriptors at EMAWCLTSL04

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	55.4	50.0	37.8	-
Night arithmetic average	-	43.7	42.1	37.4	-
Day equivalent	-	63.4	53.6	-	-
Night equivalent	-	48.5	40.7	-	-
Day minimum	-	32.2	30.5	-	20.4
Day maximum	94.2	81.7	72.6	-	-
Night minimum	-	23.5	21.6	-	17.7
Night maximum	85.1	69.2	58.6	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-13** (night) and **Figure 4-14** (day).

(17) World Health Organization, 2009, '*Night Noise Guidelines for Europe.*

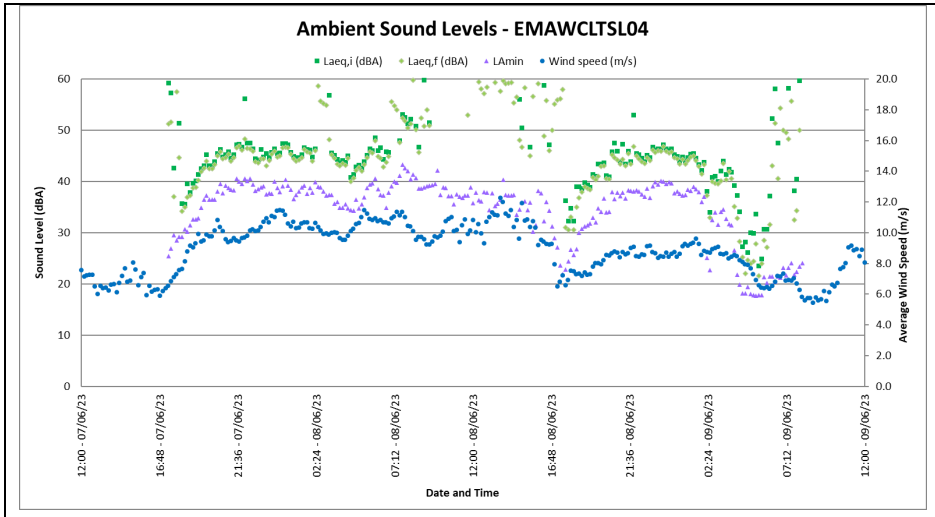


Figure 4-19: Ambient Sound Levels at EMAWCLTSL04

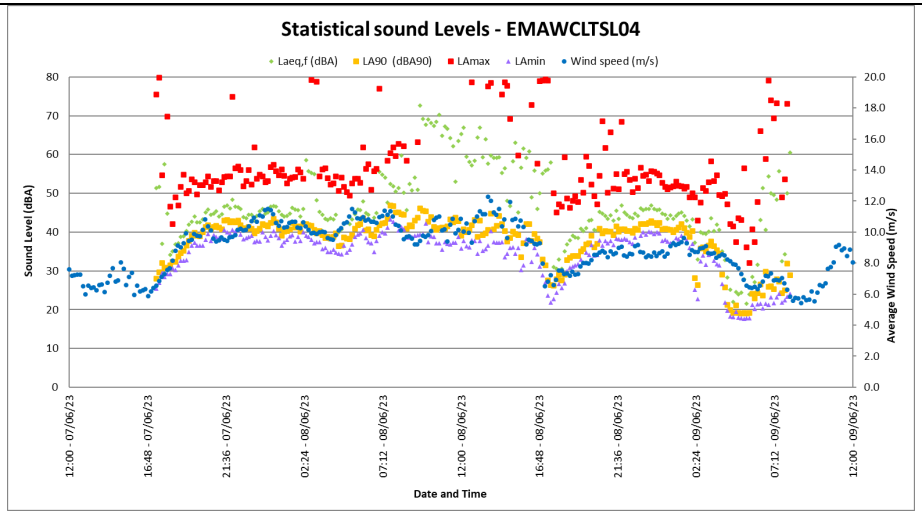


Figure 4-20: Maximum, minimum and Statistical sound levels at EMAWCLTSL04

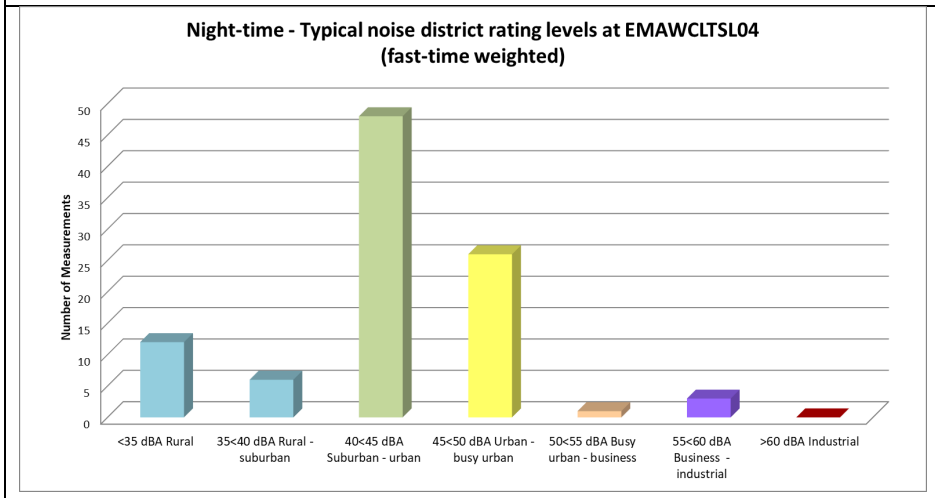


Figure 4-21: Classification of night-time measurements in typical noise districts at EMAWCLTSL04

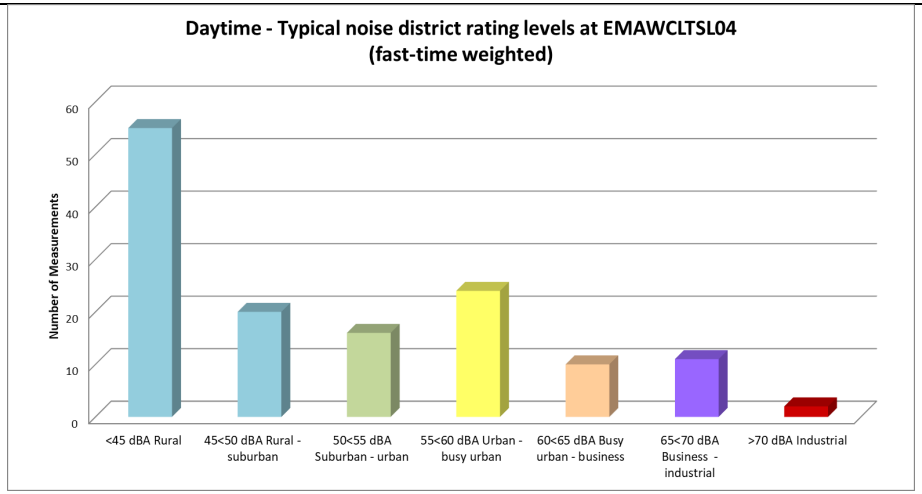


Figure 4-22: Classification of daytime measurements in typical noise districts at EMAWCLTSL04

4.3.5 Long-term Measurement Location - EMAWCLTSL05

The instrument was deployed in the garden of a residential dwelling. There was significant trees and vegetation in the area, with an electrical substation located approximately 320m from the instrument. There was a constant hum audible from this substation during quiet periods. The equipment defined in **Table 4-14** was used for gathering data with **Table 4-15** highlighting sounds heard during equipment deployment and collection. Photos of this measurement location is presented in **Appendix D**.

Table 4-14: Equipment used to gather data at EMAWCLTSL05

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	SVAN 977	36176	February 2022
Pre-amplifier	SV 12L	25685	February 2022
Microphone	ACO 7052E	49596	February 2022
Calibrator	Quest CA-22	J 2080094	July 2022

Table 4-15: Noises/sounds heard during site visits at EMAWCLTSL05

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Birds generally dominant. Wind induced noises audible.
	Residential	Dogs barking at times, dominant during event.
	Industrial & transportation	Substation audible.
	During equipment collection	
	Faunal and Natural	Birds generally dominant.
	Residential	Dogs barking at times, dominant during event.
	Industrial & transportation	Substation audible.

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-23** and summarized in **Table 4-16** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-24**.

The impulse time-weighted sound descriptor is mainly used in South Africa to define sound and noise levels. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} levels were significantly elevated

both day and night, more typical of an urban or even industrial district, indicating a constant and relative significant noise in the background.

Maximum noise levels did not exceed 65 dBA at night.

Table 4-16: Sound levels considering various sound level descriptors at EMAWCLTSL05

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	46.6	42.2	35.3	-
Night arithmetic average	-	40.4	39.0	36.8	-
Day equivalent	-	46.9	40.8	-	-
Night equivalent	-	41.5	40.2	-	-
Day minimum	-	31.5	29.9	-	20.7
Day maximum	85.5	65.1	55.3	-	-
Night minimum	-	22.9	21.8	-	20.4
Night maximum	64.5	51.1	49.9	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-25** (night) and **Figure 4-26** (day).

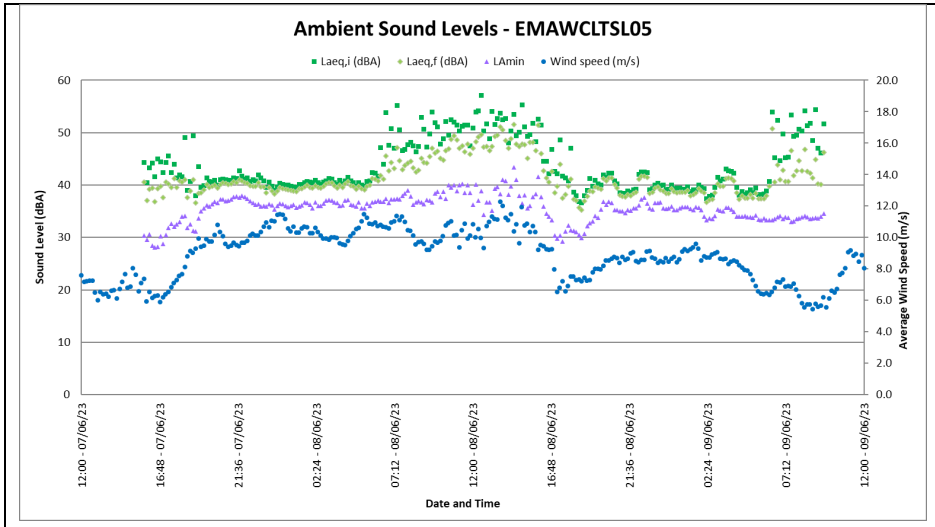


Figure 4-23: Ambient Sound Levels at EMAWCLTSL05

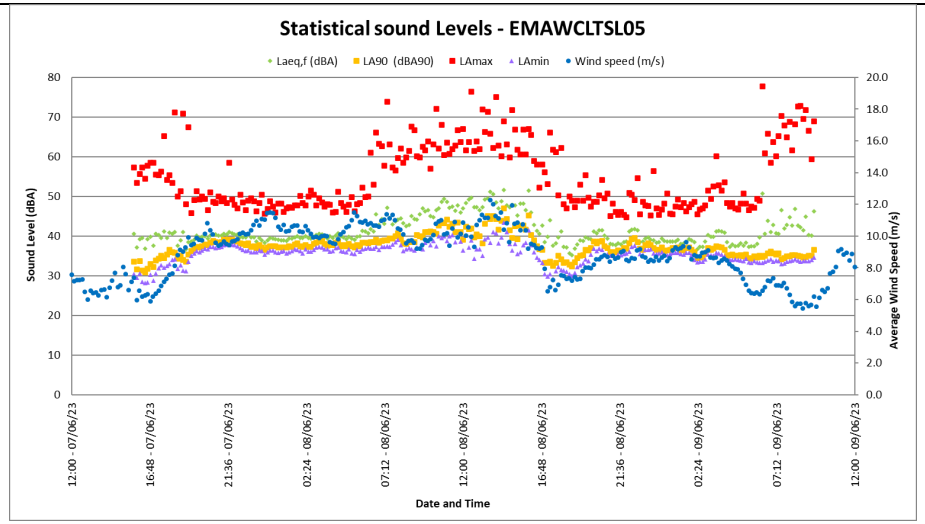


Figure 4-24: Maximum, minimum and Statistical sound levels at EMAWCLTSL05

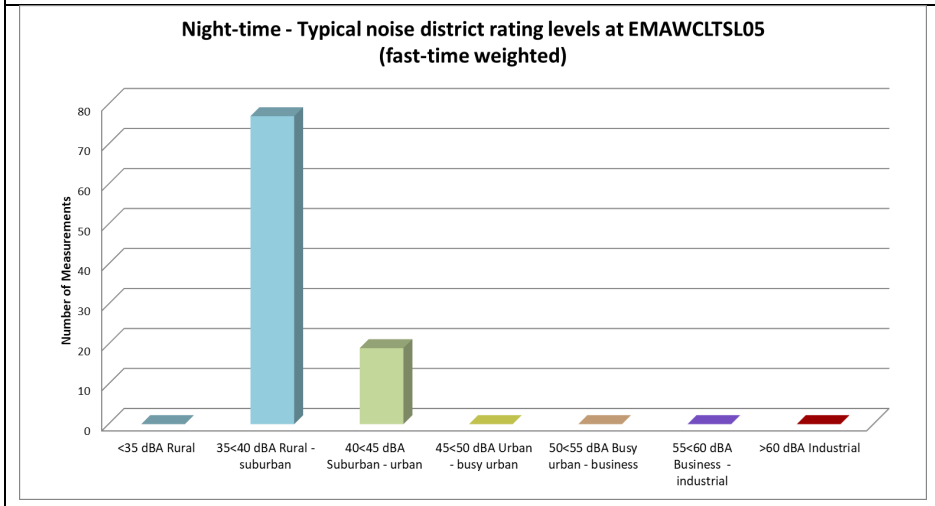


Figure 4-25: Classification of night-time measurements in typical noise districts at EMAWCLTSL05

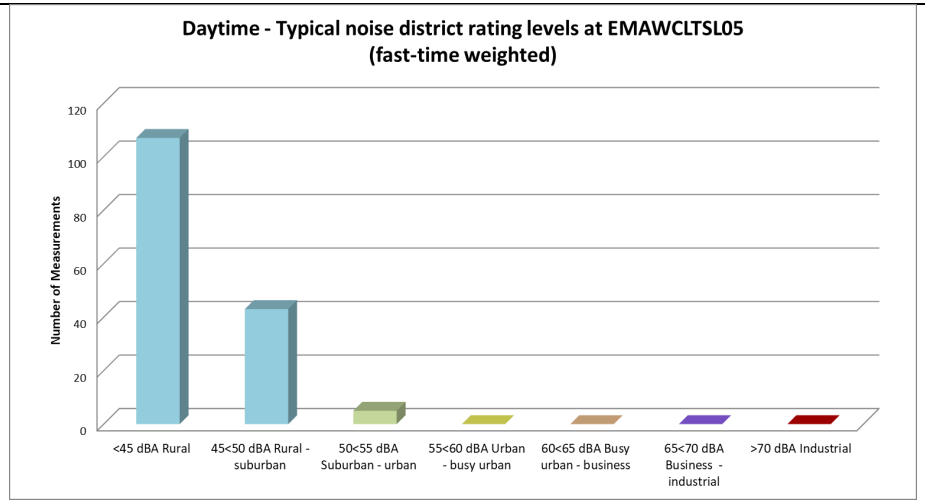


Figure 4-26: Classification of daytime measurements in typical noise districts at EMAWCLTSL05

4.3.6 Long-term Measurement Location - EMAWCLTSL06

The instrument was deployed in the garden of a residential house, with a significant number of trees in the vicinity of the microphone. The equipment defined in **Table 4-17** was used for gathering data with **Table 4-18** highlighting sounds heard during equipment deployment and collection. Photos of this measurement location is presented in **Appendix D**.

Table 4-17: Equipment used to gather data at EMAWCLTSL06

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	Rion NL-62	00511791	August 2022
Pre-amplifier	NH-26	11989	August 2022
Microphone	UC-59L	02257	August 2022
Calibrator	Quest CA-22	J 2080094	July 2022

Table 4-18: Noises/sounds heard during site visits at EMAWCLTSL06

Noises/sounds heard during onsite investigations		
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating**	**During equipment deployment**	
	Faunal and Natural	Birds generally dominant. Wind induced noises audible. Insects clearly audible.
	Residential	-
	Industrial & transportation	-
	During equipment collection	
	Faunal and Natural	Birds dominant.
	Residential	-
	Industrial & transportation	-

Impulse time-weighted equivalent sound levels $L_{AIeq,10min}$ and fast time-weighted equivalent sound levels $L_{AFeq,10min}$ are presented in **Figure 4-27** and summarized in **Table 4-19** below. The maximum (L_{Amax}), minimum (L_{Amin}) and 90th percentile (L_{A90}) statistical values are illustrated in **Figure 4-28**.

Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

The L_{A90} level is presented in this report to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on average sound level. The L_{A90} levels were significantly elevated both day and night, more typical of an urban or even industrial district, indicating a constant and relative significant noise in the background.

Maximum noise levels did not exceed 65 dBA at night.

Table 4-19: Sound levels considering various sound level descriptors at EMAWCLTSL06

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)
Day arithmetic average	-	46.1	42.7	37.7	-
Night arithmetic average	-	40.1	39.3	37.0	-
Day equivalent	-	45.9	41.4	-	-
Night equivalent	-	37.3	36.4	-	-
Day minimum	-	36.6	35.2	-	28.1
Day maximum	77.7	57.1	51.6	-	-
Night minimum	-	37.4	36.7	-	33.3
Night maximum	60.2	43.0	41.8	-	-

The numerous 10-minute measurements are further classified for the day- and night-time periods in terms of the SANS 10103:2008 typical noise district areas in **Figure 4-29** (night) and **Figure 4-30** (day).

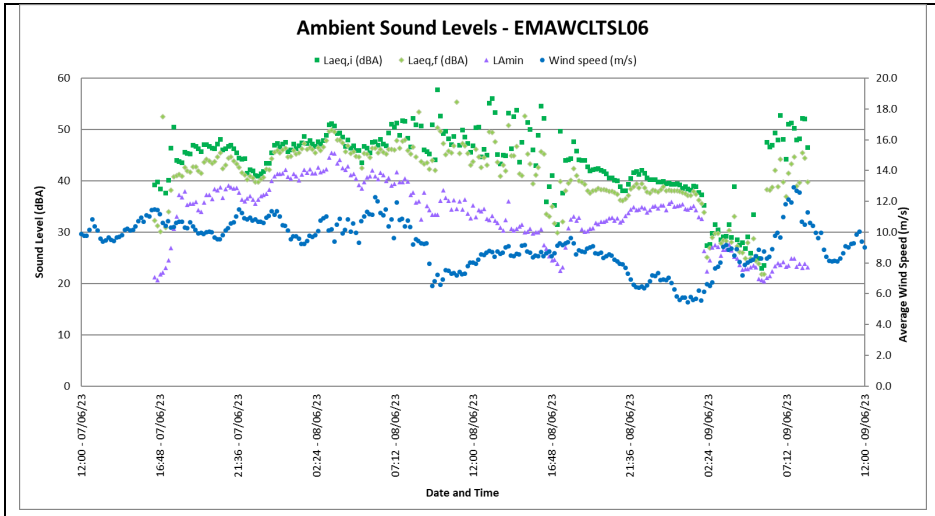


Figure 4-27: Ambient Sound Levels at EMAWCLTSL06

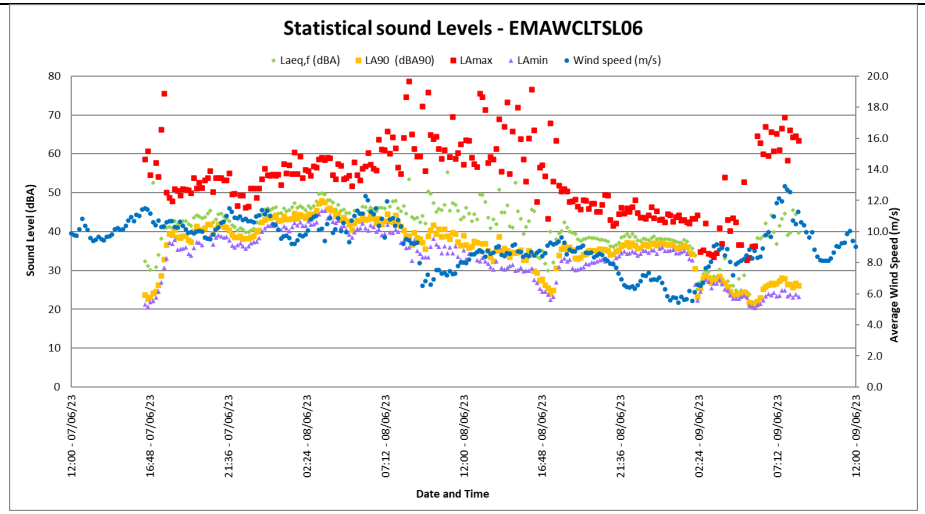


Figure 4-28: Maximum, minimum and Statistical sound levels at EMAWCLTSL06

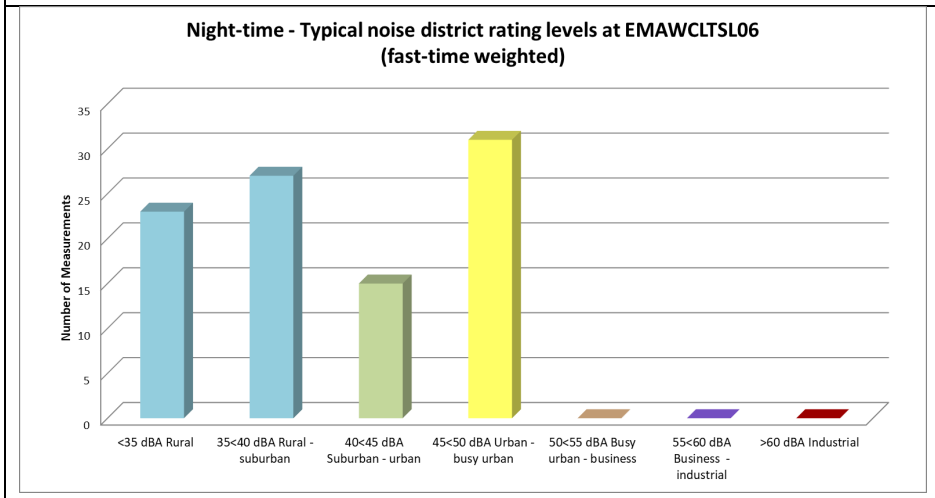


Figure 4-29: Classification of night-time measurements in typical noise districts at EMAWCLTSL06

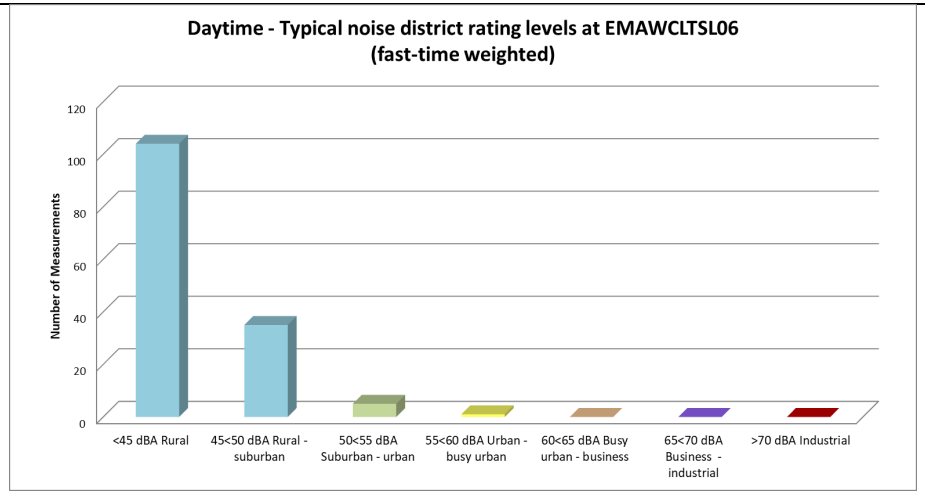


Figure 4-30: Classification of daytime measurements in typical noise districts at EMAWCLTSL06

4.4 SUMMARY OF SOUND LEVEL DATA MEASURED

The measurements collected for the Emvelo WEF project resulted in around 1,000 daytime and 570 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, statistical sound levels as well as spectral information.

Also available are measurements collected in September 2023 just north-west of the Emvelo WEF project, which resulted in more than 4,900 day-, and 2,400 night-time measurements.

Confidence levels in the resulting ambient sound level data are high and it is expected that the ambient sound level data would be applicable of other locations in the area.

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels ranged from 24.8 to more than 72.0 dBA, with average sound levels being 43.3 dBA. The average equivalent level over the full daytime periods is 50.2 dBA for the 6 measurement locations. Only considering the average fast-weighted values, sound levels are typical of a rural noise district, setting a zone sound level of 45 dBA for the daytime period; and
- night-time fast-weighted sound levels ranged from 21.6 to more than 58 dBA, with average sound levels being 37.3 dBA. The average equivalent level over the full night-time periods is 39.4 dBA for the 6 measurement locations. Only considering the average fast-weighted values as well as the developmental character of the area, a zone sound level of 35 dBA would be used (typical of a rural noise district).

In addition, considering international guidelines, the IFC (projects financed by the World Bank Group - see **section 3.5.6**) the following noise levels should not be exceeded:

- 55 dBA (as recommended by the IFC) for daytime residential use; and
- 45 dBA (as recommended by the IFC) for night-time residential use.

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 in **Figure 4-31** and **Figure 4-32** (data collected for the Emvelo WEF project 7 – 9 June 2023), with **Figure 4-33** and **Figure 4-34** reflecting similar data, collected during September 2023 just north-west of the Emvelo WEF project.

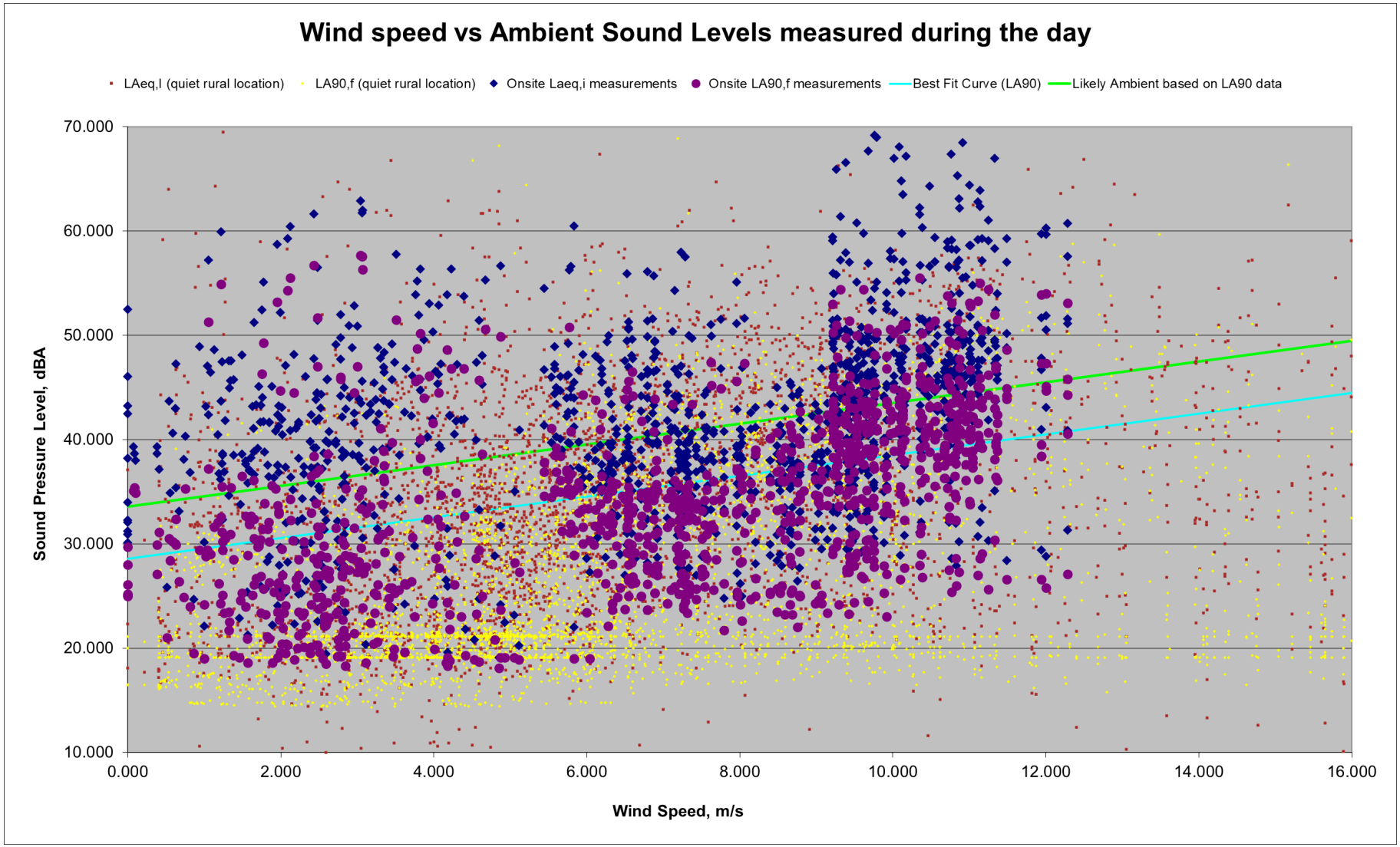


Figure 4-31: Daytime ambient sound levels measured in vicinity of Emvelo WEF project

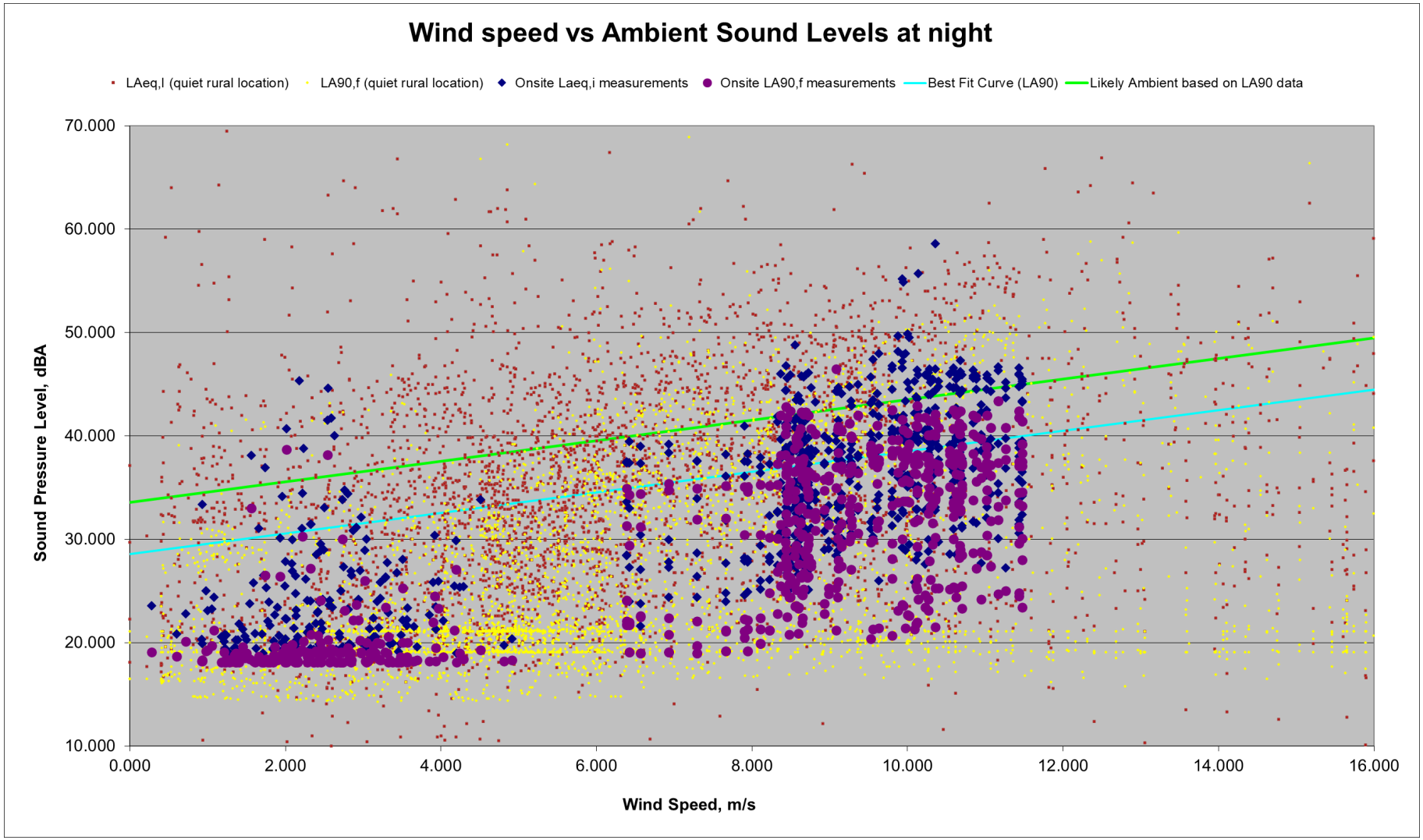


Figure 4-32: Night-time ambient sound levels measured in vicinity of Emvelo WEF project

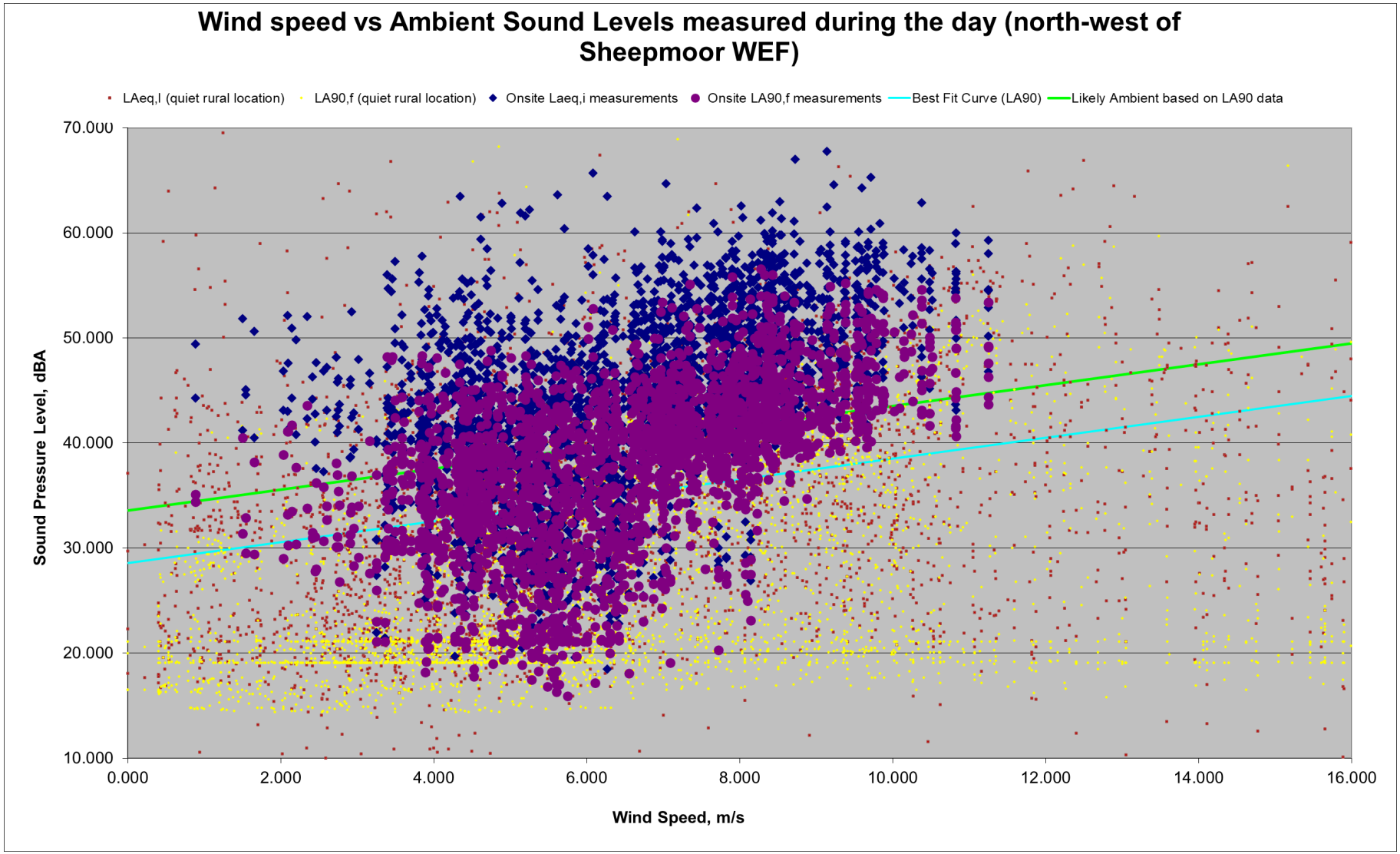


Figure 4-33: Daytime ambient sound levels measured north-west of Emvelo WEF project

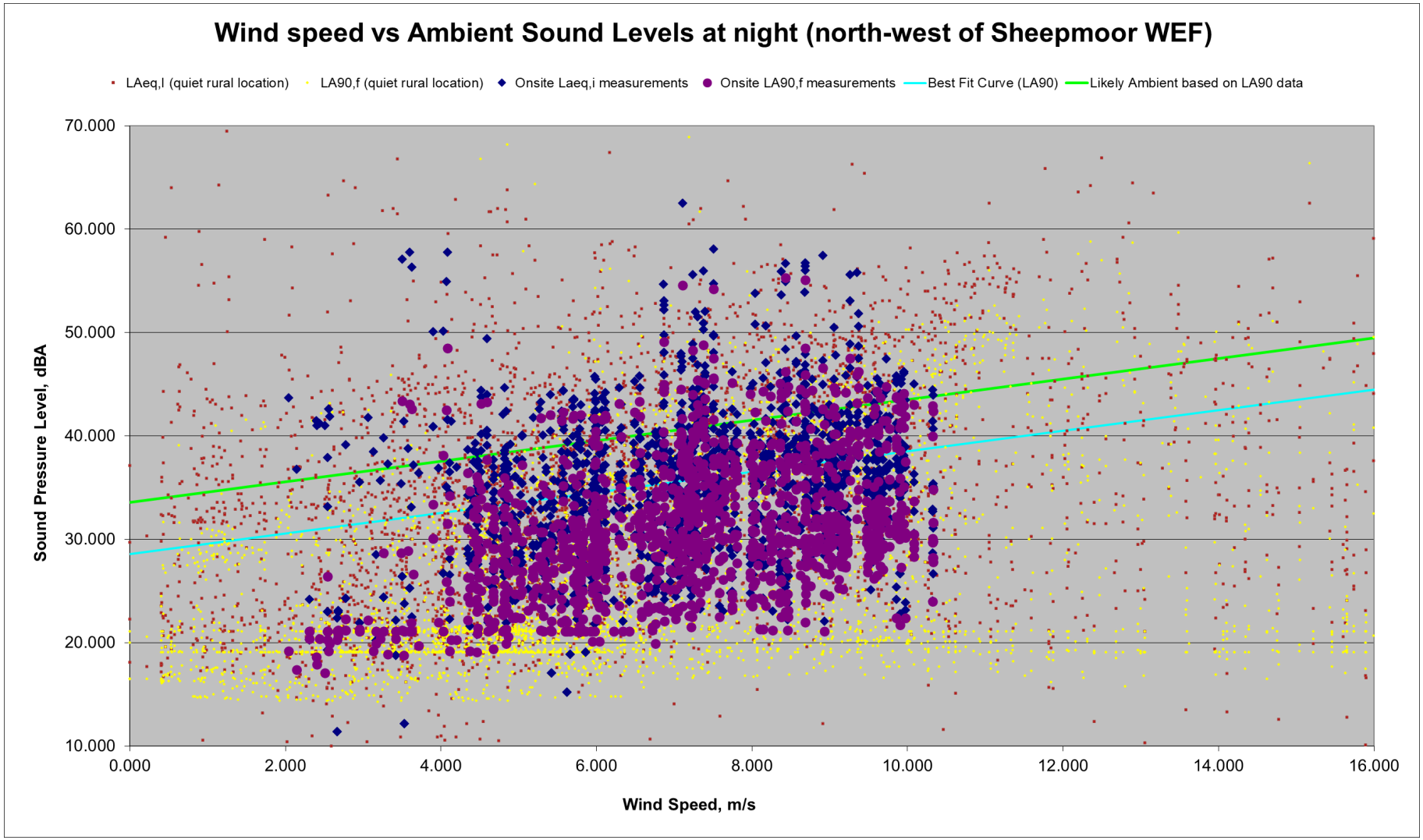


Figure 4-34: Night-time ambient sound levels measured north-west of Emvelo WEF project

5 INVESTIGATION OF EXISTING AND FUTURE NOISE LEVELS

Increased noise levels are directly linked with the various activities associated with the construction of the proposed Emvelo WEF project and related infrastructure, as well as the operation phase of the activity. The potential noise impacts from the activities associated with these phases are discussed in the following sections.

5.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

5.1.1 Construction equipment

It is estimated that construction will take approximately 18 - 24 months subject to the final design of the Project, weather and ground conditions, including time for testing and commissioning. The construction process will consist of the following principal activities:

- Site survey and preparation;
- Establishment of site entrance, internal access roads, contractors' compound and passing places;
- Civil works to sections of the public roads to facilitate with WTG component delivery;
- Site preparation activities will include clearance of vegetation at the footprint of each turbine as well as crane hard-standing areas. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construct foundations – due to the volume of concrete that will be required, an on-site batching plant will be required to ensure a continuous concreting operation. The source of aggregate is yet undefined but is expected to be derived from an offsite source or brought in as ready-mix.
- Transport of components & equipment to site – all components will be brought to site in sections by means of flatbed trucks. Additionally, components of various specialized construction and lifting equipment are required on site to erect the wind turbines and will need to be transported to site. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g., excavators, trucks, graders, compaction equipment, cement trucks, etc.). The transportation of ready-mix concrete to site or the materials for onsite concrete batching will result in a temporary increase in heavy traffic (one turbine foundation may require up to 100 concrete trucks, and is undertaken as a continuous pour);
- Establishment of laydown & hard standing areas - laydown areas will need to be established at each turbine position for the placement of wind turbine components. Laydown and storage areas will also be required to be established for the civil

engineering construction equipment which will be required on site. Hard standing areas will need to be established for operation of the cranes. Cranes of the size required to erect turbines are sensitive to differential movement during lifting operations and require a hard-standing area;

- Erect turbines - a crane will be used to lift the tower sections into place and then the nacelle will be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor on the ground; it will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while the large crane will be needed to put it in place;
- Construct substation - the underground cables carrying the generated power from the individual turbines will connect at the substation. The construction of the substation would require a site survey; site clearing and levelling (including the removal / cutting of rock outcrops) and construction of access road/s (where required); construction of a substation terrace and foundation; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas;
- Establishment of ancillary infrastructure - A workshop as well as a contractor's equipment camp may be required. The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required; and
- Site rehabilitation - once construction is completed and all construction equipment are removed; the site will be rehabilitated where practical and reasonable.

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dB, the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in **Table 5-2**.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 5-3**.

The equipment likely to be required to complete the above tasks will typically include:

- excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, TLB, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.

The noise levels and the octave sound power emission levels used for modelling for the construction (and operational) phase are highlighted in **Table 5-1**.

Table 5-1: Equipment list and Sound power emission levels used for modelling

Equipment	Sound power level, dB re1 pW, in octave band, Hz							Max PWL
Centre frequency	63	125	250	500	1000	2000	4000	(dBA)
Construction and WTG equipment and activities								
Envision EN182-8.0 MW	115.0	114.7	112.6	109.4	108.8	108.1	101.0	111.2
General noise (Construction)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	113.6

5.1.2 Material supply: Concrete batching plants

There exist mainly two options for the supply of the concrete to the development site. These options are:

1. The transport of "ready-mix" concrete from the closest centre to the development.
2. The transport of aggregate and cement from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities. This would most likely be a movable plant.

This noise study will consider the use of a concrete batching plant.

5.1.3 Blasting

Though unlikely, blasting may be required as part of the civil works to clear obstacles or to prepare foundations (of either the WEF, power pylons or other infrastructure).

However, blasting will not be considered for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner. The breaking of rocks and obstacles with explosives is also a specialized field, and when correct techniques are used, it causes less noise than using a rock-breaker.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast.

- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relatively fast, resulting in a higher acceptance of the noise.

5.1.4 Construction Traffic

The last significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to traffic were estimated using the methodology stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise). Traffic volumes were estimated using up to 10 trucks and cars each, travelling on a gravel road at 40 km/hr.

Table 5-2: Potential maximum noise levels generated by construction equipment

Equipment Description[18]	Impact Device?	Maximum Sound Power Levels (dBA)	**Operational Noise Level at given distance considering potential maximum noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modeling only considering distance) (dBA)**											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator (>25KVA)	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Tractor	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vacuum Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vacuum Street Sweeper	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

[18] Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Table 5-3: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Air compressor	92.6	67.6	61.6	55.5	47.6	41.6	38.0	35.5	32.0	27.6	24.1	21.6	15.5
Bulldozer CAT D10	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
Cement truck (with cement)	111.7	86.7	80.7	74.7	66.7	60.7	57.2	54.7	51.2	46.7	43.2	40.7	34.7
Crane	107.5	82.5	76.5	70.5	62.5	56.5	53.0	50.5	46.9	42.5	39.0	36.5	30.5
Diesel Generator (Large - mobile)	106.1	81.2	75.1	69.1	61.2	55.1	51.6	49.1	45.6	41.2	37.6	35.1	29.1
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
FEL (988) (FM)	115.6	90.7	84.6	78.6	70.7	64.6	61.1	58.6	55.1	50.7	47.1	44.6	38.6
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Road Truck average	109.6	84.7	78.7	72.6	64.7	58.7	55.1	52.6	49.1	44.7	41.1	38.7	32.6
Rock Breaker, CAT	120.7	95.7	89.7	83.7	75.7	69.7	66.2	63.7	60.2	55.7	52.2	49.7	43.7
Vibrating roller	106.3	81.3	75.3	69.3	61.3	55.3	51.8	49.3	45.8	41.3	37.8	35.3	29.3
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8
Wind Turbine: Acciona AW125/3000	108.4	85.4	79.4	73.4	65.4	59.4	55.9	53.4	49.9	45.4	41.9	39.4	33.4
Wind Turbine: Vestas V150-4.2 MW	104.9	79.9	73.9	67.9	60.0	54.0	50.4	48.0	44.5	40.0	36.5	34.0	28.0
Wind Turbine: Vesta V90 2 MW VCS	104.0	79.0	73.0	67.0	59.0	53.0	49.5	47.0	43.5	39.0	35.5	33.0	27.0
Wind Turbine: Vesta V66, ave	102.6	77.7	71.6	65.6	57.7	51.6	48.1	45.6	42.1	37.7	34.1	31.6	25.6
Wind Turbine: Vesta V66, max	108.0	83.0	77.0	71.0	63.0	57.0	53.5	51.0	47.5	43.0	39.5	37.0	31.0
Wind Turbine: Vesta V66, min	96.3	71.3	65.3	59.3	51.3	45.3	41.8	39.3	35.8	31.3	27.8	25.3	19.3
Wind Turbine: Vestas V117 3.3MW	107.0	82.0	76.0	70.0	62.0	56.0	52.5	50.0	46.4	42.0	38.5	36.0	30.0

5.2 POTENTIAL NOISE SOURCES: OPERATION PHASE

The proposed development would be designed to have an operational life of up to 25 years with the possibility to further expand the lifetime of the Project. The only development related activities on-site will be routine servicing (access roads and light traffic) and unscheduled maintenance. The noise impact from maintenance activities is insignificant, with the main noise source being the wind turbine blades and the nacelle (components inside) as highlighted in the following sections.

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources which are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources normally have different characteristics and can be considered separately. In addition, there are other noise sources of lower levels, such as the substations and traffic (maintenance).

The maximum noise emission levels (PWL) and the octave sound power emission levels of the Envision EN182-8.0 MW WTG used for the operational noise model are highlighted in **Table 5-1**.

5.2.1 Wind Turbine Noise: Aerodynamic sources [7, 18, 31, 41, 108]

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

1. Self-noise due to the interaction of the turbulent boundary layer with the blade trailing edge.
2. Noise due to inflow turbulence (turbulence in the wind interacting with the blades).
3. Discrete frequency noise due to trailing edge thickness.
4. Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade).
5. Noise generated by the rotor tips.

Therefore, as the wind speed increases, noises created by the wind turbine also increase. At a low wind speed the noise created by the wind turbine is generally (relatively) low, and increases to a maximum at a certain wind speed when it either remains constant, increase very slightly or even drops as illustrated in **Figure 5-1**.

The Developer is investigating a number of different wind turbine models; not excluding the possibility of larger models that are not yet available in the commercial market. Therefore,

for the purpose of this noise assessment, the maximum PWL of the Envision EN182-8.0 MW WTG (PWL of 111.2 dBA re 1 pW) will be used. No uncertainty was included in this assessment.

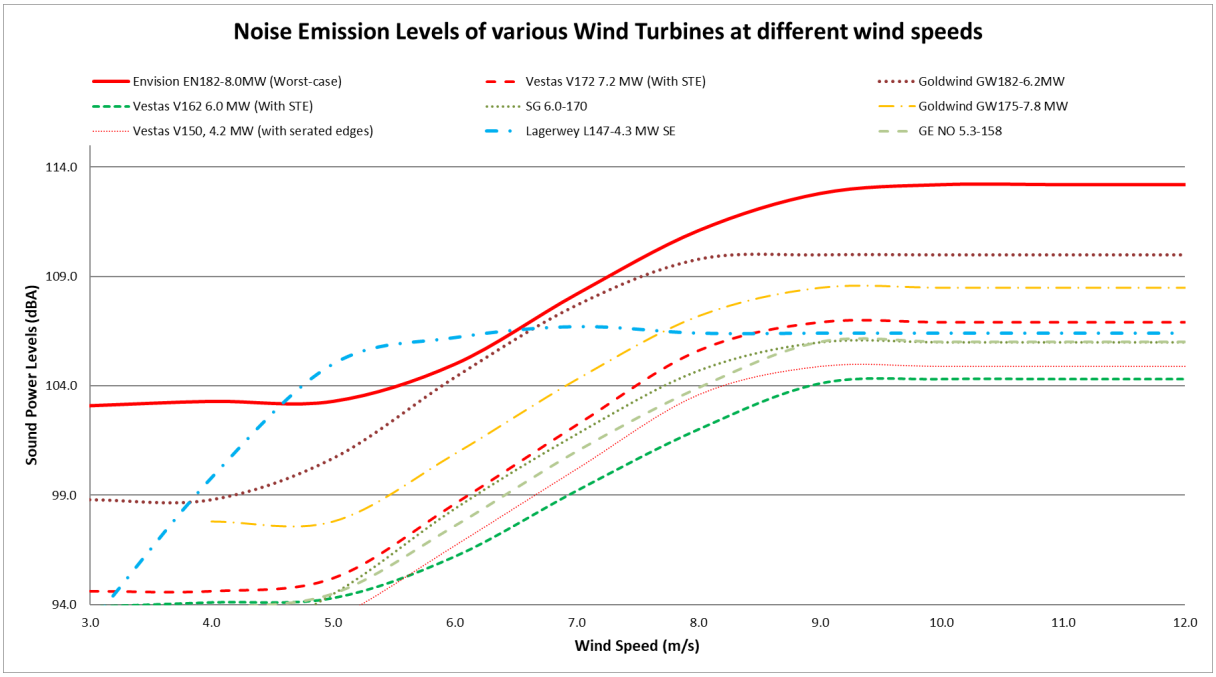


Figure 5-1: Noise Emissions Curve of a number of different wind turbines (figure for illustration purposes only)

The propagation model also makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions providing a higher accuracy than models that only use the total sound power level. The octave sound power emission levels for various wind turbines are presented on **Figure 5-2**.

5.2.1.1 Control Strategies to manage Noise Emissions during operation

Wind turbine manufacturers also provide their equipment with control mechanisms to allow for a certain noise reduction during operation that can include:

- A reduction of rotational speed;
- The increase of the pitch angle and/or reduction of nominal generator torque to reduce the angle of attack;
- Implementation of blade technologies such as serrated edges, changing the shape of the blade tips or the edge (proprietary technologies); and
- The insulation of the nacelle.

These mechanisms are used in various ways to allow the reduction of noise levels from the wind turbines, although this may also result in a reduction of power generation.

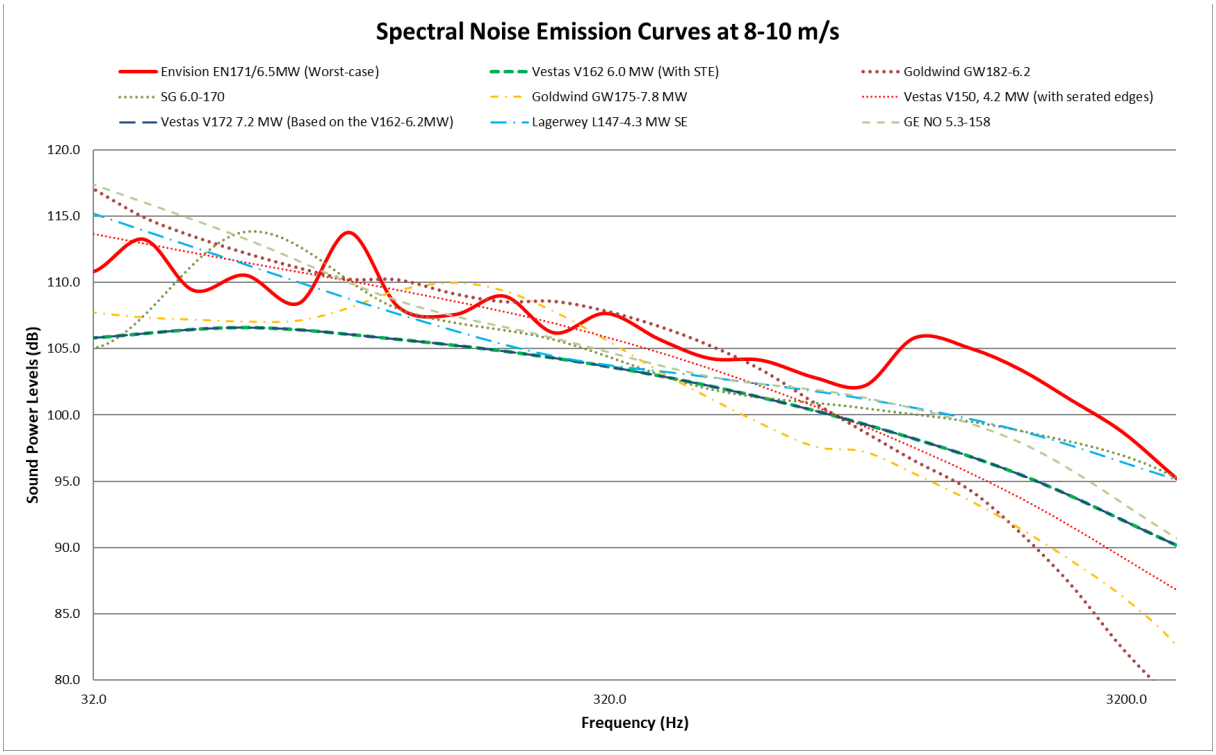


Figure 5-2: Octave sound power emissions of various wind turbines

5.2.2 Wind Turbine: Mechanical sources [45, 63, 108, 111]

Mechanical noise is normally perceived within the emitted noise from wind turbines as an audible tone(s) which is subjectively more intrusive than a broad band noise of the same sound pressure level. Sources for this noise are normally associated with:

- the gearbox and the tooth mesh frequencies of the step-up stages;
- generator noise caused by coil flexure of the generator windings which is associated with power regulation and control;
- generator noise caused by cooling fans; and
- control equipment noise caused by hydraulic compressors for pitch regulation and yaw control.

Tones are noises with a narrow sound frequency composition (e.g., the whine of an electrical motor). Annoying tones can be created in numerous ways: machinery with rotating parts such as motors, gearboxes, fans and pumps often create tones. An imbalance or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones. Pulsating flows of liquids or gases can also create tones, which may be

caused by combustion processes or flow restrictions. The best and most well-known example of a tonal noise is the buzz created by a flying mosquito.

Where complaints have been received due to the operation of wind farms, tonal noise from the installed wind turbines appears to have increased the annoyance perceived by the complainants and has indeed been the primary cause for complaint.

However, tones were normally associated with the older models of turbines. All turbine manufacturers have started to ensure that sufficient forethought is given to the design of quieter gearboxes and the means by which these vibration transmission paths may be broken. Through the use of careful gearbox design and/or the use of anti-vibration techniques, it is possible to minimize the transmission of vibration energy into the turbine supporting structure. The benefits of these design improvements have started to filter through into wind farm developments which are using these modified wind turbines. ***New generation wind turbine generators do not emit any clearly distinguishable tones***.

5.2.3 Low Frequency Noise

Low frequency sound is the term used to describe sound energy in the region below ~200 Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range. Infrasound is often used to describe sound energy in the region below 20 Hz [**34**, **62**, **96**, **135**].

Almost all noise in the environment has components in this region although they are of such a low level that they are not significant (wind, ocean, thunder). See also **Figure 5-3**, which indicates the sound power levels in the different octave bands from measurements taken at different wind speeds with no other audible noise sources. Sound that has most of its energy in the 'infrasound' range is only significant if it is at a very high level, far above normal environmental levels [**11**, **34**, **74**].

Ambrose (2011) [**1**] and other authors have confirmed modulations consistent with the frequency that the blade pass the tower. Because of the low rotational rates of the blades of a WTG, the peak acoustic energy radiated by large wind turbines is in the infrasonic range with a peak in the 8-12 Hz range. For smaller machines, this peak can extend into the low-frequency "audible" (20-20KHz) range because of higher rotational speeds and multiple blades [**17**, **30**, **62**].

The British Wind Energy Association (BWEA) [**17**] highlighted that these sounds are below the threshold of perception, although this should be clarified. Most acousticians would agree

that the low frequency sounds are inaudible to most people, yet, there are a number of studies that highlight that it can be more perceptible to people inside their houses as well as people that are more sensitive to low frequency sounds [**32**, **47**, **64**, **98**].

In February 2013, the Environmental Protection Authority of South Australia published the results of a study into low-frequency noise near wind farms [**46**, **47**]. This study measured infrasound levels at urban locations, rural locations with wind turbines close by, and rural locations with no wind turbines in the vicinity. It found that infrasound levels near wind farms are comparable to levels away from wind farms in both urban and rural locations. Infrasound levels were also measured during organized shut-downs of the wind farms; the results showed that there was no noticeable difference in infrasound levels whether the turbines were active or inactive.

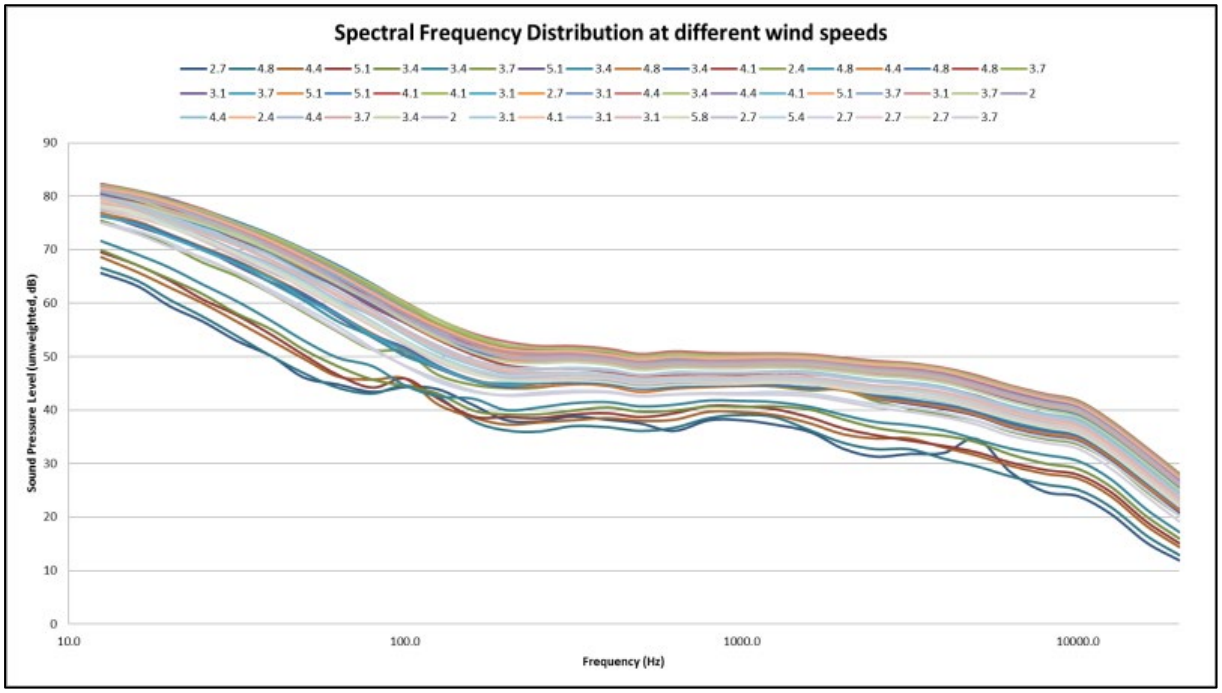


Figure 5-3: Third octave band sound power levels at various wind speeds at a location where wind induced noises dominate

Low Frequency Noise however has been very controversial in the last few years with the anti-wind fraternity claiming measurable impacts, with governments and wind-energy supporter studies indicating no link between low-frequency sound and any health impacts. This study notes the various claims.

5.2.4 Amplitude modulation

Wind Turbine Noise (WTN) includes a steady component (see also the preceding section **5.2.1** and **5.2.2**) as well as, in some circumstances, a periodically fluctuating or Amplitude

Modulated (AM) component or character [**112**]. Although generally considered rare, it is a characteristic of WTN that increases the annoyance with a project above that of other long-term noise sources [**13**, **21**, **33**, **92**, **124**].

The amplitude modulation (AM) of the sound emissions from the wind turbines creates a repetitive rise and fall in sound levels synchronized to the blade rotational speed, sometimes referred to as a "swish" or "thump".

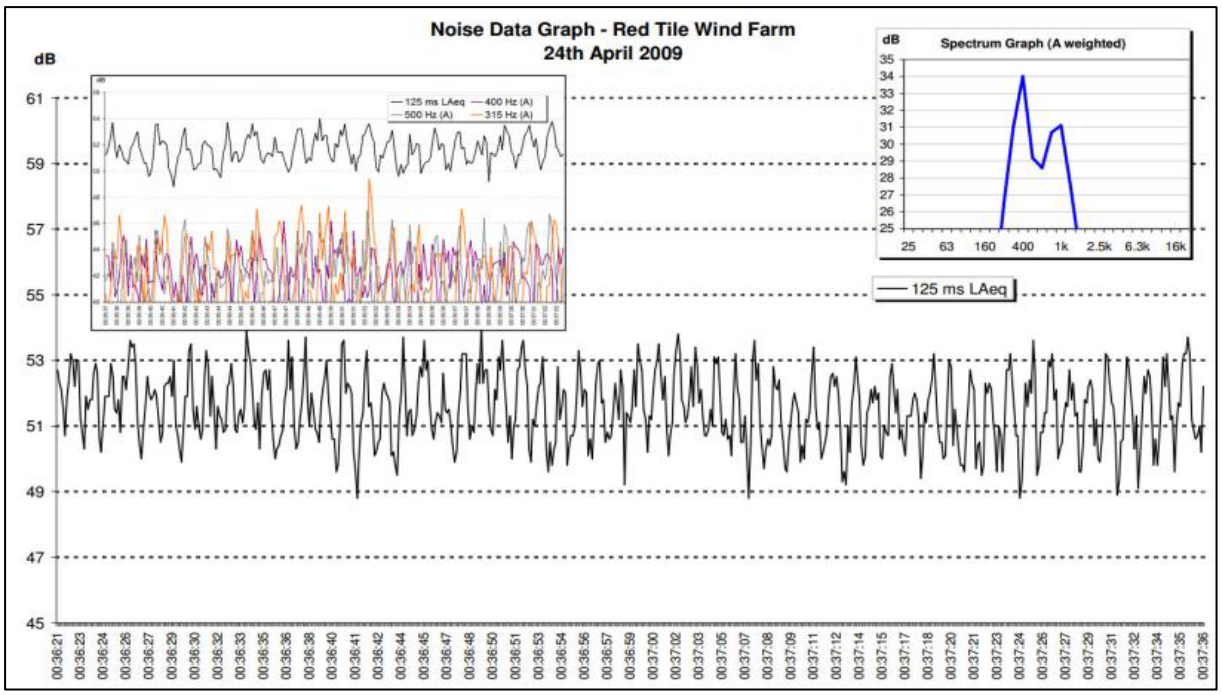


Figure 5-4: Example time-sound series graph illustrating AM as measured by Stigwood (2013) [125]

Pedersen (2003) [**104**] highlighted a weak correlation between sound pressure level and noise annoyance caused by wind turbines. Residents complaining about wind turbines noise perceived more sound characteristics than noise levels, with people able to distinguish between background ambient sounds and the sounds that the blades made. The noise produced by the blades lead to most complaints. Most of the annoyance was experienced between 16:00 and midnight. This could be an issue as noise propagation modelling would be reporting an equivalent, or "average" sound pressure level, a parameter that ignores the "character" of the sound.

That AM can be a risk and significantly increase the annoyance with WEFs that cannot be disputed. It has been reported with a number of recent studies confirming this significant noise characteristic [**104**]. However, even though there are thousands of wind turbine

generators in the world, amplitude modulation is still one subject receiving the least complaints and due to these very few complaints, less research went into this subject. It is also a complex source of wind turbine noise, with studies highlighting that time of year, atmospheric conditions, wind direction and atmospheric conditions all play a role in the generation of AM [**18, 30, 31, 112**].

How people may respond to AM is also complex. WSP (2016) [**147**], in a study done for the Department of Energy and Climate Change summarized that:

- Within both laboratory and field test environments there is a strong association between increasing overall time-average levels of AM WTN-like sounds with increasing ratings of annoyance.
- Within a laboratory test environment:
    - subjects rated noticeable modulating WTN-like sounds as more annoying than similar noise without significant modulation;
    - the onset of fluctuation sensation for a modulating WTN-like sound appeared to be in the region of around 2 dB modulation depth;
    - increasing modulation depth above the onset of fluctuation sensation showed a broadly increasing trend in mean ratings of annoyance, but changes in mean annoyance rating tended to be relatively small and, in some cases, inconsistent;
    - equivalent annoyance ratings of AM and steady WTN-like sounds derived by level adjustment did not show a strong increasing trend with increasing depth of modulation; and
    - equivalent 'noisiness perception' of WTN-like AM sounds compared with a steady sound showed a gradually increasing trend with modulation depth.

WSP (2016) also concluded that the results from both the laboratory and field studies should be approached with caution, since they may not readily translate to how people respond to WTN exposure in their homes [**147**].

This assessment notes the various findings from these studies, and recommend a more precautious approach, raising the probability of a noise impact occurring with one point for all night-time operational activities where (whichever is the lowest):

- the projected noise levels exceed the long-term fast-weighted ambient sound levels with more than 3 dB, or
- the projected noise levels exceed the typical rating levels for the area with more than 5 dBA.

5.2.5 Transformer noises (Substations)

Also known as magnetostriction[19], is when the sheet steel used in the core of the transformer tries to change shape when being magnetised. When the magnetism is taken away, the shape returns, only to try and deform in a different manner when the polarity is changed.

This deformation is not uniform; consequently, it varies all over a sheet. With a transformer core being composed of many sheets of steel, these deformations are taking place erratically all over each sheet, and each sheet is behaving erratically with respect to its neighbour. The resultant is the "hum" frequently associated with transformers. While this may be a soothing sound in small home appliances, various complaints are logged in areas where people stay close to these transformers. At a voltage frequency of 50 Hz, these "vibrations" take place 100 times a second, resulting in a tonal noise at 100Hz.

However, this is a relatively easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer and will not be considered further in this ENIA study. Substations in addition generate low noise levels, with the hum from the transformers inaudible further than 200 m from the transformers.

5.2.6 Transmission Line Noise (Corona noise)

Corona noise[20] is caused by the partial breakdown of the insulation properties of air surrounding the conducting wires. It can generate an audible and radio-frequency noise, but generally only occurs in humid conditions, as provided by fog or rain. A minimum line potential of 70kV or higher is generally required to generate corona noise depending on the electrical design. Corona noise does not occur on domestic distribution lines.

Corona noise has two major components: a low frequency tone associated with the frequency of the AC supply (100 Hz for 50 Hz source) and broadband noise. The tonal component of the noise is related to the point along the electric waveform at which the air begins to conduct. This varies with each cycle and consequently the frequency of the emitted tone is subject to great fluctuations. Corona noise can be characterised as broadband 'crackling' or 'buzzing', but ***fortunately it is generally only a feature that occurs during fog or rain***.

It will not be further investigated, as corona discharges results in:

- Power losses,

[19] https://en.wikipedia.org/wiki/Magnetostriction
[20] https://en.wikipedia.org/wiki/Corona_discharge

- Audible noises,
- Electromagnetic interference,
- A purple glow,
- Ozone production; and
- Insulation damage.

As such Electrical Service Providers, such as ESKOM, go to great lengths to design power transmission equipment to minimise the formation of corona discharges. In addition, it is an infrequent occurrence with a relatively short duration compared to other operational noises.

6 METHODS: NOISE IMPACT ASSESSMENT

6.1 NOISE IMPACT ON ANIMALS

A significant amount of research was undertaken during the 1960's and 70's on the effects of aircraft noise on animals [**2, 93**]. While aircraft noise has a specific characteristic that might not be comparable with industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response with the strength and length of the startle response to be dependent on the following:

- which species is exposed;
- whether there is one animal or a group of animals, and
- whether there have been some previous exposures.

Overall, the research suggests that species differ in their response to noise depending on the duration, magnitude, characteristic and source of the noise, as well as how accustomed the animals are to the noise (previous exposure).

Extraneous noises impact on animals as it can increase stress levels and even impact on their hearing. Masking sounds may affect their ability to react to threats, compete and seek mates and reproduce, hunt and forage, communicate and generally to survive.

Unfortunately, there are numerous other factors in the faunal environment that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

The only animal species studied in detail are humans, and studies are still continuing in this regard. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as humans age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar with all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals as indicated on **Figure 6-1**.

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research [**133**] that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in their environment

(excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

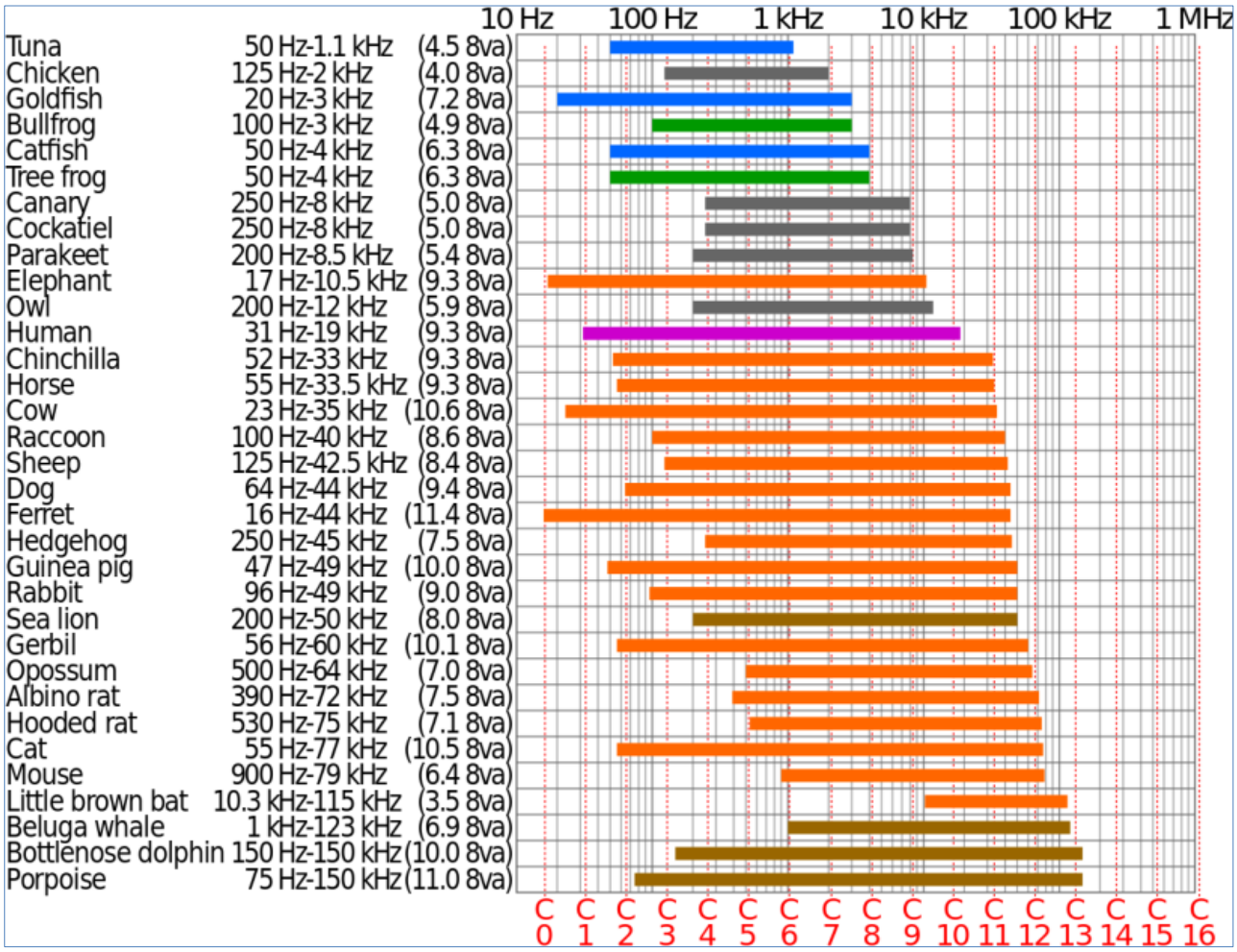


Figure 6-1: Logarithmic Chart of the Hearing Ranges of Some Animals[21]

6.1.1 Domesticated Animals

Excluding loud impulsive noises, considering the environmental noise levels (the noise levels were not defined, but levels of up to 100 dB were reported), it has been observed that most domesticated animals are generally not bothered by noise and generally can acclimatize relatively quickly to loud noises [**120**]. Considering the expected wind turbine noise (WTN) levels (well less than 60 dBA at all locations), WTN will not impact on domestic animals [**93**].

6.1.2 Wildlife

Studies indicated that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might

[21] https://en.wikipedia.org/wiki/Hearing_range

be impacted by noise would most likely relocate to a quieter area. Helldin (2012) [**60**] however highlights that the network of access road could be a significant factor impacting on animals. Noise impacts are therefore very highly species-dependent [**10**, **30**, **31**, **79**, **93**, **110**], but there are also other factors that could impact on animals (such as visibility and increased movement of people and vehicles).

6.1.3 Avifauna

As with other terrestrial faunal species, noise (character of sound or change in level) will impact on avifauna (birds of a particular region and/or habitat). Anthropogenic noises result in physical damage to ears, increased stress, flight or flushing, changes in foraging and other behavioural reactions. Ortega (2012) [**97**] summarized that additional responses (with ecological similar controls) include the avoidance of noisy areas, changes in reproductive success and changes in vocal communication. However, as with other faunal species, there are no guidelines to assess at which sound pressure level avifaunal will start to exhibit any response [**2**, **31**, **37**, **78**, **97**, **118**, **148**].

6.1.4 Concluding Remarks - Noise Impacts on Animals

From these and other studies the following can be concluded:

- To date there are no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals (Blickley *et al.* 2010) [**10**].
- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Dooling, 2007) [**37**].
- Terrestrial wildlife responses begin at noise levels of approximately 40 dBA, with 20% of papers documenting impacts below 50 dBA (Shannon *et al.* 2015) [**121**].
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2010) [**5**], with Helldin *et al.* (2012) [**60**] reporting that levels of 60–75 dBA have been shown to cause stress, e.g., increased respiration and heart rate, increased vigilance, and decreased time for grazing in domestic animals such as sheep and horses.
- Animals of most species exhibit adaptation with noise (Broucek, 2014) [**16**], including impulsive noises, by changing their behaviour.
- There may be a possible impact on the health of animals (Mikolajczak, 2013; Karwowska, 2015) caged very close to an operating WTG (within 500 m) [**75**, **86**];
- Songbirds may change the spectral character of songs and calls used for communication and defence in areas very close to WTGs. This is similar to the effects of other anthropogenic noise sources such as traffic, which can disrupt bird 'chatter'

to the point of being detrimental to reproductive success (Szymański, 2017; Zwart, 2014) [**127** ,**148**];

- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Dooling, 2007) [**37**, **79**].
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals (startle response). This is due to the sudden and significant increase in noise levels due to these activities [**2**, **133**];
- Łopucki (2016) [**79**] reported that roe deer and European hare did prefer proximity to WTG, but that the common pheasant showed a positive reaction to WTG proximity. Red fox had no response to WTG; and
- Helldin *et al*. (2012) [**60**] also report that large terrestrial mammals appear to acclimatise to wind farms during the operational phase.

With regard to Low-Frequency Noise (LFN) and Infrasound, it is summarized that:

- There are no scientific papers available in reputable journals highlighting the impact of LFN from WTG on wildlife;
- Animal communication is generally the highest during no and low wind conditions. It has been hypothesised that this is one of the reasons why birds sing so much in the mornings (their voices carry the farthest and there are generally less observable wind);
- Background noise levels (ambient sound levels) in remote areas are not always low in space or time. The site is windy and this generates significant noise itself and also significantly changes the ability of fauna to hear the environmental noises around them;
- Wind is a significant source of natural noise, with a character similar to the noise generated by wind turbines, with a significant portion of the acoustic energy in the low frequency and infrasound range;
- Wind turbines do not emit broad-band sound on a continual basis as the turbines only turn and generate noise when the wind speeds are above the cut-in speed;
- The wind turbines will only operate during periods of higher wind speeds, a period when background noise levels are already elevated due to wind-induced noises; and
- The elevated background noise relating with wind also provide additional masking of the wind turbine noise, with periods of higher winds also correlating with lower faunal activity, particularly with regard to communication.

It should be noted that LFN and Infrasound is present in the environment and is generated by a wide range of natural sources (e.g., wind, waves etc.). In February 2013, the

Environmental Protection Authority of South Australia published the results of a study into infrasound levels near wind farms (Evans, 2013). This study measured infrasound levels at urban locations, rural locations with wind turbines close by, and rural locations with no wind turbines in the vicinity. It found that infrasound levels near wind farms are comparable to levels away from wind farms in both urban and rural locations. Infrasound levels were also measured during organized shut-downs of the wind farms; the results showed that there was no noticeable difference in infrasound levels whether the turbines were active or inactive.

6.2 WHY NOISE CONCERNS COMMUNITIES [3, 15, 20, 25, 31, 52, 76, 92, 108, 122]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, and in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would prefer to sleep. Noise impacts are also complex to evaluate as numerous issues could cumulatively contribute to the severity of the impact, as discussed in the following subsections.

How a noise may impact (with this assessment using annoyance about the noise) on a receptor is also very complex to assess for the reasons highlighted in **section 6.2.1** below. Only considering the intensity of a sound (or noise) level, some people may become annoyed without hearing any noise (perceived impacts) where others may not even be reporting noise to be a concern, even when subjected to very high levels.

6.2.1 Noise Annoyance

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that the non-acoustic factors play a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity [**4**, **24**, **40**, **56**, **57**, **69**, **76**, **83**, **84**, **87**, **91**, **102**, **103**, **104**, **105**, **107**, **119**, **136**, **137**, **145**].

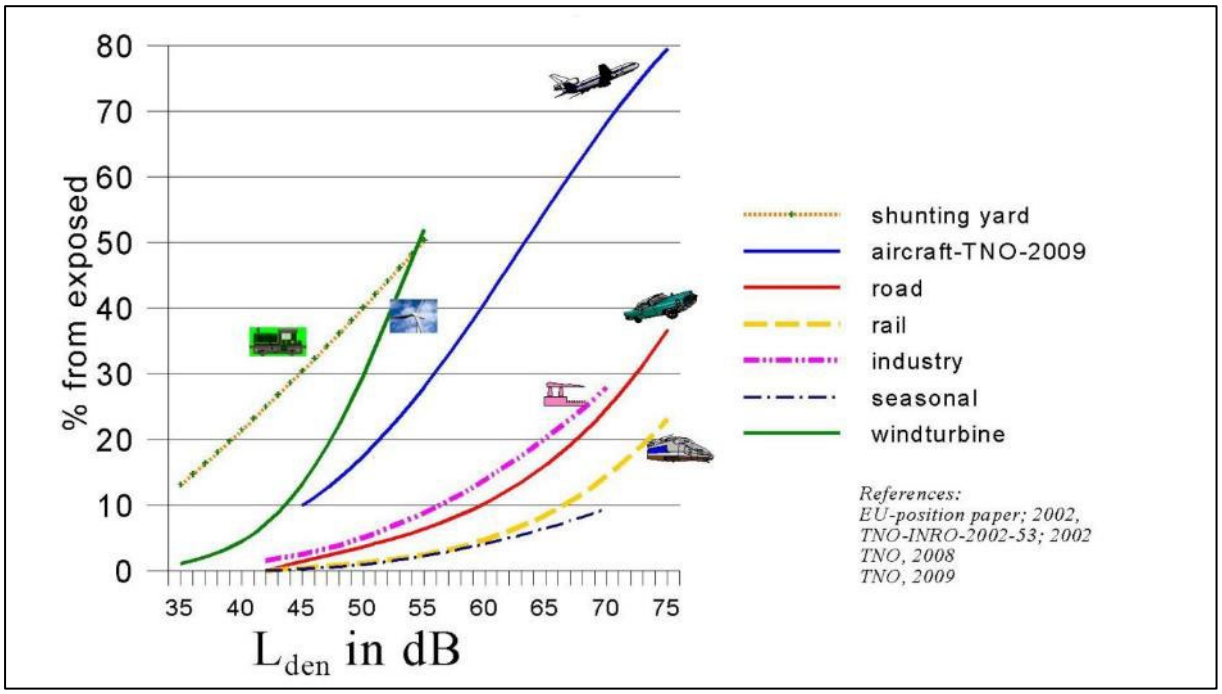


Figure 6-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling[22]

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 6-2**, are recommended in a European Union position paper published

[22] Image from https://rigolett.home.xs4all.nl/ENGELS/topic.htm. Wind Turbine Annoyance curve from Pedersen (2007)

in 2002, stipulating policy regarding the quantification of annoyance. This can be used in environmental health impact assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long-term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise levels.

Severity of the annoyance depends on factors such as:

- Background sound levels and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological and health state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

6.2.1.1 Disturbance to Sleep

Sleep is essential for mental and physical health, and noise is one of the most reported reasons why people may experience sleep interruptions at night. This may be sudden loud noises, with the WHO (2009) [**145**] reporting that, when maximum noises exceed 60 dBA, with average noise levels exceeding 40 dBA, it may increase the probability of being awakened. People report that quality of life suffer with increased instances of disturbed sleep that may also increase annoyance with a project [**4**, **137**]. It should be noted that Van den Berg [**136**, **137**] showed an indirect effect between sleep disturbances and annoyance, but not between sleep disturbance and the noise level. It is postulated that this is due to increased annoyance due to the visual impact from WTG.

6.2.1.2 Potential Health Effects from WTN

While there has been a number of complaints about the impact of WTN on the health of people living close to WTG [**56**, **57**, **69**, **91**, **107**], other than annoyance and sleep disturbances, there is no evidence of any direct health effects [**24**, **40**, **76**, **76**, **87**, **82**, **83**, **104**, **119**].

The WHO (2009 [**145**]) however does report threshold levels where people may report or experience effects from noise, with these thresholds highlighted in **Table 6-1**. The WHO does use the L_{Amax} and L_{night}[23] descriptors to describe these levels.

[23] Refers to the European Union definition in Directive 2002/49/EC – equivalent outdoor sound pressure level associated with a particular type of noise source to which a receptor is exposed to over the 8-hour night-time period, calculated over a period of a year

Table 6-1: Threshold levels reported by the WHO (2009)

Effect	Indicator	Threshold (dBA)
EEG awakening	$L_{Amax,inside}$	35
Onset of motility	$L_{Amax,inside}$	32
Changes in sleep patterns	$L_{Amax,inside}$	35
Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
Increased average motility when sleeping	$L_{night,outside}$	42
Self-reported sleep disturbances	$L_{night,outside}$	42
Environmental insomnia	$L_{night,outside}$	42
Hypertension	$L_{night,outside}$	50
Myocardial infarction	$L_{night,outside}$	50
Psychic disorders	$L_{night,outside}$	60

6.2.1.3 Situational and Personal Factors

There are a few other aspects, collectively referred to as non-acoustical factors that may increase annoyance with a project [**84**, **103**]. These could include:

- Situational factors (visual issues, attractiveness of area) [**83**, **85**, **136**];
- Socio-economic factors (age, gender, income, level of education) [**84**, **85**];
- Social factors (attitude towards the applicant/producer/government, media coverage) [**103**, **126**];
- Personal factors (fear or worry in relation to noise source, sensitivity to noise, economic benefit from project, existing health condition) [**84**, **138**]; and
- Attitude towards the project and exposure to negative sentiment [**9**, **25**, **26**].

6.3 IMPACT ASSESSMENT CRITERIA

6.3.1 Overview: The Common Characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one that is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

6.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations of 2014 in terms of the NEMA, SANS 10103:2008, and guidelines from the WHO.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, caused by a new source of noise. With regards to the NCR, an increase of more than 7 dBA is considered a disturbing noise. See also **section 3.1.1** and **Figure 3-1**..
- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, sets acceptable noise levels for various areas. See also **Table 3-2**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

in **Table 3-2**). The probable community or group response to the excess ($\Delta L_{Req,T}$) is given in **Figure 3-1**.

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also **Table 3-2**). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

6.4 SETTING APPROPRIATE NOISE LIMITS

Onsite ambient sound measurements (see **Section 4.3**) indicated an area with a potential to be very quiet, with ambient sound levels typical of a rural noise district.

SANS 10103 unfortunately does not cater for instances when background noise levels change due to the impact of external forces. Locations close to the sea for instance always have a background noise level exceeding 35 dBA, and, in cases where the sea is rather turbulent, it can easily exceed 45 dBA. Similarly, noise induced by high winds is not considered.

Setting noise limits relative to the background noise level is relatively straightforward when the prevailing background noise level and source level are constant. However, wind turbines emit noise that is related to wind speed, and the ambient sound levels in the environment within which they are heard will probably also be dependent on the strength of the wind and the noise associated with its effects. It is therefore necessary to derive a background noise level that is indicative of the noise environment at the receiving property for different wind speeds so that the turbine noise level at any particular wind speed can be compared with the background noise level in the same wind conditions.

6.4.1.1 Using International Guidelines to set Noise Limits – ETSU-R97

When assessing the overall noise levels emitted by a WEF, it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5 m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35 m/s measured at the hub height of a wind turbine. However, ETSU-R97 (1996) proposes that noise limits only be placed up to a wind speed of 12 m/s for the following reasons:

1. Wind speeds are not often measured at wind speeds greater than 12 m/s at 10 m height;
2. Reliable measurements of background ambient sound levels and turbine noise will be difficult to make in high winds due to the effects of wind noise on the microphone and the fact that one could have to wait several months before such winds were experienced;
3. Turbine manufacturers are unlikely to be able to provide information on sound power levels at such high wind speeds for similar reasons; and
4. If a wind farm meets noise limits at wind speeds lower than 12m/s, it is most unlikely to cause any greater loss of amenity at higher wind speeds. Turbine noise levels increase only slightly as wind speeds increase; however, background ambient sound levels increase significantly with increasing wind speeds due to the force of the wind.

Available data indicates that wind-induced noises start to increase at wind speeds 3 – 4 m/s, becoming a significant (and frequently the dominant noise source in rural areas) at wind speeds higher than 10 – 12 m/s. Most wind turbines reach their maximum noise emission level at a wind speed of 8 – 10 m/s. At these wind speeds increased wind-induced noises (wind howling around building, rustling of leaves in trees, rattling noises, etc) could start to drown other noises, including that being generated by wind turbines[24].

Sound level vs. wind speed data is presented in **Figure 4-31**[25] and **Figure 4-32** (summary of measurements done from the Emvelo WEF project), as well as **Figure 4-33** and **Figure 4-34** (measurements done during September 2023).

Also illustrated on these figures area approximately 38,000 measurements collected at various quiet locations in South Africa (locations further than 10 km from the ocean), with the data analysed to fit the best linear line through this significant dataset. This linear regression analysis was also used to derive the likely ambient sound levels for different wind speeds.

Considering this data as well as the international guidelines (MOE, see Table 3-3; IFC, see **Table 3-4**), noise limits starting at 40 dB that increases to more than 45 dB (as wind speeds increase) could be acceptable. Project participants could be exposed to noise levels up to 45 dBA (ETSU-R97) at night.

6.4.1.2 Considering the latest WHO (2018) recommendations

The WHO (2018) [**146**] recommends a guideline night-time noise level of 38.7 dBA (based on the 45 dBA L_{DEN} level) to minimize sleep-disturbance and receptors being highly-annoyed (see **section 3.5.9**).

6.4.1.3 Using the NCR to set noise limits

The local Noise Control Bylaw (see **section 3.1.1**) as well as the National NCRs (GN R154 of 1992 – **section 3.3.1**) defines a "**disturbing noise**" as the Noise Level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more. Accepting that the sound levels during periods with no or low winds may be typical of a rural noise district:

[24] It should be noted that this does not mean that the wind turbines are inaudible.
[25] The sound level measuring instruments were located at a quiet location in the garden of the various houses. Data was measured in 10-minute bins and then co-ordinated with the 10 m wind speed derived from the wind mast of the developer. This wind mast was not close to the dwellings, being approximately 3,500m from the measurement locations.

- the daytime rating level would be 45 dBA and a noise level exceeding 52 dBA may be a disturbing noise (therefore the upper daytime noise limit during low, or no-wind conditions); and
- night-time rating levels would be 35 dBA and a noise level exceeding 42 dBA may be a disturbing noise (therefore the upper night-time noise limit during low, or no-wind conditions).

However, as can be observed from **Figure 4-31**, **Figure 4-32**, **Figure 4-33** and **Figure 4-34**, if ambient sound levels were measured at increased wind speeds, ambient sound levels will be higher as wind-induced noises increase. These potential ambient sound levels will be used to determine the probability for a noise impact to occur (during the operational phase). Appropriate noise limit should consider changing ambient sound levels, and the noise limits will increase as wind speed increase. For modelling and assessing the potential noise impact, the values as proposed in **Table 6-2** will be recommended.

In addition, considering the recommendations of the IFC, an upper night-time noise limit of 45 dBA is recommended, with the rating levels proposed in **Table 6-2** considered for this report. The recommended daytime noise limit is 52 dBA, though it should be noted that the World Bank Group allowing noise levels up to 55 dBA.

Table 6-2: Proposed ambient sound levels and acceptable rating levels

10 meter Wind Speed (m/s)	Estimated ambient sound levels (night-time) (dBA)	MoE Sound Level Limits of Class 3 areas (Table 3-3) (dBA)	ETSU-R97 limit for project participants (dBA)	Night-time Zone Sound Level (SANS 10103:2008) (dBA)	Proposed Night Rating Level (dBA)
4	37.6	40	45	35 (at low wind speeds, this will increase as wind speeds increase)	40
5	38.6	40	45		40
6	39.5	40	45		40
7	40.5	43	45		43
8	41.5	45	45		45
9	42.5	49	45		45

6.5 DETERMINING THE SIGNIFICANCE OF THE NOISE IMPACT

The level of detail as depicted in the EIA Guidelines (CSIR, 2002) [**28**] was fine-tuned by assigning specific values to each impact, considering the impact rating methodology recommended by the EAP. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria.

This scale takes into consideration the following variables:

Nature: Whether the activity have a negative or positive impact on the environment.

Type: A direct, indirect and/or cumulative effect of impact on the environment.

Magnitude: The intensity of the impact on the surrounding receptors.

Extent: the spatial scale defines the physical extent of the impact.

Duration: The temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

Consequence: The consequence scale is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.

Probability: The likelihood of impacts taking place as a result of project actions arising from the various alternatives.

Significance: The criteria in **Table 6-7** and **Table 6-8** are used to determine the overall significance of an activity. The impact effect (which includes duration; extent; consequence and probability) and the reversibility/mitigation of the impact are then read off the significance matrix in order to determine the overall significance of the issue. The overall significance is either negative or positive and will be classified as low, moderate or high.

Reversibility: The degree to which an environment can be returned to its original/partially original state.

Irreplaceable loss: The degree of irreplaceable loss which an impact may cause, e.g., loss of non-regenerative vegetation or removal of rocky habitat or destruction of wetland.

Mitigation potential: The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

The impact consequence is determined by summing the scores of Consequence (**Table 6-3**), Duration (**Table 6-4**) and the Spatial Extent (**Table 6-5**) with the Probability score (**Table 6-6**) to obtain the final Impact Significance.

It should be noted that while intensity can be calculated to an extent, probability of an impact occurring, or a receptor being annoyed is difficult to determine with this assessment making use an empirical method as defined in **Table 6-6**.

$$Significance\ Rating = (Extent + Intensity + Duration)\ x\ Probability$$

Table 6-3: Impact Assessment Criteria – Consequence

This defines the impact as experienced by any receptor. In this report, the NSR is defined as any resident in the area but excludes faunal species (because guideline levels are not available for animals).		
Rating	**Description**	**Score**
Minor	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels.	2
Low	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels.	4
Medium / Moderate	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels.	6
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level.	8
Very High	Increase in average ambient sound pressure levels higher than 10 dBA.	10

Table 6-4: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period significantly shorter than that of the construction phase (less than 6 months).	1
Short term	The impact will be relevant through to the end of a construction phase (less than 5 years).	2
Medium term	The impact will last up to the end of the development phases, where after it will be entirely negated. The impact could last between 5 and 20 years.	3
Long term	The impact will continue or last for the entire operational lifetime i.e., exceed 20 years of the development.	4
Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.	5

Table 6-5: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.	1
Local	The proposed site and its immediate environments.	2
Regional	Impacts affect the area more than 1,000m from the project boundary, up to the larger municipality.	3
Municipal	Impacts affect the wider district municipality or the Province.	4

National	Impacts affect the entire country.	5

Table 6-6: Impact Assessment Criteria – Probability

This describes the likelihood of a noise impact (receptors being annoyed) actually occurring and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Improbable	Daytime noise levels are less than 45 dBA, with night-time noise levels being less than 38.7 dBA.	1
Possible	Daytime noise levels are between 45 and 50 dBA, with night-time noise levels being between 38.7 and 45 dBA.	2
Probable	Daytime noise levels are between 50 and 55 dBA, with night-time noise levels being between 45 and 47.5 dBA.	3
Highly Likely	Daytime noise levels are between 55 and 60 dBA, with night-time noise levels being between 47.5 and 50 dBA.	4
Definite	Daytime noise levels are higher than 60 dBA, with night-time noise levels higher than 50 dBA.	5

6.5.1 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures) as highlighted in **Table 6-7**.

Table 6-7: Impact Assessment Criteria – Significance without Mitigation

SR<30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30<**SR** <60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR>60	High (H)	The impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

6.5.2 Identifying the Potential Impacts with Mitigation Measures (WM)

All noise impacts can be managed to acceptable levels with sufficient capital and management commitments. Determination of significance refers to the foreseeable

significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the scale defined in **Table 6-8**.

Table 6-8: Impact Assessment Criteria – Significance with Mitigation

SR<30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30<**SR** <60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR>60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance after mitigation could render the entire development option or entire project proposal unacceptable.

7 METHODS: CALCULATION OF NOISE LEVELS

7.1 POINT[26] AND AREA[27] NOISES – CONSTRUCTION AND OPERATIONAL ACTIVITIES

The noise emissions from various sources were calculated in detail for the conceptual construction and operational activities by using the sound propagation algorithms described by the ISO 9613-2 model. The following were considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receivers from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed Project, such as projected areas where activities will be taking place;
- Screening corrections where applicable;
- Topographical layout; and
- Acoustical characteristics of the ground.

Potential operational cycles were not considered and a worst-case scenario was evaluated, assuming that all activities and equipment generate the maximum noise level 100% of the time.

The ISO 9613-2 noise propagation model is used, as it is the noise model most recommended to calculate WTN. The uncertainties and limitations of the ISO 9613 model is well defined; and while there are a number of different noise propagation models that one can use, all of them have uncertainties and limitations.

Therefore, the ISO 9613 noise propagation model is the model most frequently recommended, with this noise propagation model preferred in Australia (EPA, 2009) [**43**], the United Kingdom (IOA, 2013) [**67**], Canada (CanWEA, 2007) [**18**], United States of America (NARUC, 2011) [**90**] and the European Union (Directive 2002/49/EC)[28] [**27**, **38**].

This assessment considers two potential operational scenarios, including a potential worst-case as well as a potential "average" case scenario, with the main difference being receiver height and ground surface constant. During periods with high noise emission levels (WTG emitting highest noise levels), actual noise levels is expected to be between these two values, with site specific parameters such as ground level wind speeds and wind speed

[26] Typically a WTG, or a stationary noise generating activity or piece of equipment.
[27] Such as a large surface vibrating, up to a defined area where equipment is moving around. It can include an industrial project where the locations of noise generating activities or equipment cannot be defined. This is used as a worst-case, as the inclusion of a large area source(s) tend to over model noise levels.
[28] This directive does not recommend but actually stipulate the use of this noise model for industrial noise sources.

profile (at different heights), vegetation characteristics in the area between the WTG and the calculation location, air temperature and humidity influencing actual noise levels (from the WTG). The modelling parameters used are:

- Worst-case scenario: Receiver height 4m and a ground surface constant of 25% (ground surface medium-hard); and,
- "Average"-case scenario: Receiver height 2m and a ground surface constant of 50% (ground surface medium-hard).

7.2 ROAD TRAFFIC NOISE LEVELS

The noise emission into the environment due to project road traffic (mainly construction traffic) will be estimated using a simplified noise propagation model described in SANS 10210:2004, considering average vehicle volumes. It mainly considers the distance of receptor from the road as well as average speeds of travel. Factors that are not considered include:

- Topography and barrier effects (noise levels could be over-estimated);
- Road construction material (noise levels could be over-estimated);
- Types of vehicles used (noise levels could be under-estimated);
- Road gradient (noise levels could be over- or under-estimated); and
- Ground acoustical conditions (noise levels could be over-estimated).

8 ASSUMPTIONS AND LIMITATIONS

8.1 LIMITATIONS - ACOUSTICAL MEASUREMENTS

Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. 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 day, dependant on faunal characteristics (mating season, dawn chorus[29] early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind).

Selecting an ideal measurement location could be difficult, with various criteria assessed to identify the viability of a certain location as a point to define ambient sound levels. When selecting a measurement location, the most important criteria would be:

1. Security of the instrument (minimise risk to the technician; prevent theft; sabotage of the equipment);
2. Safety of the equipment (ensure that it does not prevent, interfere or limit typical agricultural or household activities; ensure that the instrument are not in a location where an animal could damage the instrument); and lastly,
3. The suitability of the measurement location to define ambient sound levels (the presence of certain trees or equipment, wetland or other water resources will influence ambient sound level significantly).

As such, after ensuring that the instrument is safe and secure, there are various environmental factors that could influence ambient sound levels measured. These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer 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 tymbals[30];
- Defining ambient sound levels using the result of one 10-minute measurement may be very inaccurate (very low confidence level in the results) relating to the reasons mentioned above, and measurements over a longer-term period is critical;

[29] Environ. We Int. Sci. Tech. *Ambient noise levels due to dawn chorus at different habitats in Delhi*. 2001. Pg. 134.
[30] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

- Some equipment that could influence measurements may be missed when deploying instruments, or, the equipment may not the audible. This could include equipment such as hidden water pumps and associated pipelines and outflows, ESKOM stepdown transformers, hidden compressors, inverters, condensers or other electrical equipment, etc. While not audible during deployment, such equipment may significantly influence ambient sound levels during quiet periods;
- Type, the number and sizes of trees in the vicinity of the instrument, as well as the distances between the microphone and these trees. Certain trees, especially fruiting trees could attract birds and other animals that will significantly impact on ambient sound levels;
- Type and number of animals in the vicinity of the microphone. Dogs, chickens, geese, etc. generate different noises randomly both night and day, and other livestock (sheep, goats, cattle, horses, etc.) kept in enclosures will also raise noise levels, especially if these animals are penned in large numbers;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. However, when determining the ambient sound levels associated with increased wind speeds, it is desired to measure ambient sound levels at higher wind speeds;
- 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 dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural environment, and in various cases sought after and pleasing. Ambient sound level data measured in such area however should not be used to develop an opinion in the potential prevailing ambient sound levels in the larger area;
- 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 environmental ambient baseline contributors of significance (faunal, 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 noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

8.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

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

- 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), and low frequency octave sound power levels are frequently not reported by equipment manufacturers. This would be relevant to facilities with a potential 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;
- Acoustical characteristics of the ground are over-simplified, with ground conditions accepted as uniform; and
- Average hourly traffic volumes are assumed for the construction period, though, in practice there may be no traffic during an hour, with significantly higher traffic during a different period.

8.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds is also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor but to calculate a noise rating level that is used to identify potential issues of concern.

8.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

Any noise impact can be mitigated to have a low significance; however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of an NSR). These mitigation measures may be engineered, technological or due to management commitment.

For the purpose of the determination of the significance of the noise impact mitigation measures were selected that are feasible, mainly focussing on management of noise impacts using rules, policy and require a management commitment. This, however, does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management). The potential significance of a noise impact can also be reduced by changing the probability of increase noise levels annoying NSR. This can be done by a reduction in the noise levels, but also by improving attitudes towards the project.

It was assumed the mitigation measures proposed for the construction phase, if any is included and proposed in this report, will be considered during the planning phase, implemented during the construction phase and continued during the operational phase.

8.5 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is especially challenging to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment changes depending on the load the process and equipment are subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worst-case scenario;
- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise levels would likely be over-estimated;

- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor, nor the potential effect of the modulation of amplitude of the noise;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (DEM) data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- 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;
- Worst-case noise levels will be calculated, assuming a receiver height at a 4m height above surface level as recommended by the Institute of Acoustics (IOA, 2013) [**67**]. Together with a 75% hard ground conditions, this will represent worst-case noise levels, only expected a few times per year (if ever);
- Average case noise levels will be calculated assuming a receiver height at a 2m height above surface level, together with a 50% medium ground conditions. This is based on a number of measurements conducted by the author, with this input parameters providing the potential typical maximum noise levels expected from the project at high wind speeds;
- Atmospheric conditions relating to an air temperature of 10°C and a 70% air humidity will be used to minimize the effect of air absorption as recommended by the Institute of Acoustics (IOA, 2013) [**6**, **67**, **72**]; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty (50%) and Seventy-five percent (75%) hard ground conditions will be modelled for the construction and operational phases respectively, representing a potential worst-case scenario [**6**, **67**, **72**].

Due to the uncertainties highlighted in section **8.2** and **8.5**, modelling generally could be out with as much as +10 dBA (the potential noise level is rather over-modelled), although realistic values ranging from less than 3 dBA to 5 dBA are more common in practice.

8.6 CONDITIONS TO WHICH THIS STUDY IS SUBJECT

This study is not subject to any conditions.

9 PROJECTED NOISE RATING LEVELS

9.1 CONCEPTUAL SCENARIOS – NOISE DUE TO FUTURE CONSTRUCTION ACTIVITIES

A noise model was developed considering the conceptual construction activities as discussed in **Section 5.1**. The proposed layout as provided by the applicant for the Emvelo WEF is presented in **Figure 9-1**. As can be seen from this layout, a number of different construction activities might take place close to potentially sensitive receptors, each activity with a specific noise level.

Potential noises associated with the construction (or upgrading) of access roads were calculated using a basic noise model, assuming an equivalent noise level of 103.5 dBA (re 1 pW) from such construction activities, with the potential noise levels illustrated against distance in **Figure 9-2**. Noises created due to construction traffic (road traffic noises) estimated and plotted against distance as illustrated in **Figure 9-3**[31].

As it is unknown where the different activities may take place it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact – various equipment operating simultaneously – see **Table 5-1**) at all locations where wind turbines may be erected, calculating how this may impact on noise levels at NSR[32] (see **Figure 9-4**).

The projected noise levels relating to the various construction activities are defined in:

- **Appendix E, Table 2** for the construction of the access roads;
- **Appendix E, Table 3** relating to daytime construction traffic passing receptors in the area;
- **Appendix E, Table 4** for daytime construction activities at Emvelo WEF; and
- **Appendix E, Table 5** for night-time construction activities at Emvelo WEF (even though night-time construction activities are unlikely to occur).

[31] Sound level at a receiver set at a certain distance from a road
[32] The potential cumulative (worst-case) noise level due to construction activities at an NSR are plotted against the distance from the NSR and a potential construction activity. As the expected noise level is expected to be less than 35 dBA at NSR further than a 1,500m from a construction activity or an operational WTG, NSR further than 1,500m from the closest WTG were not included in this figure

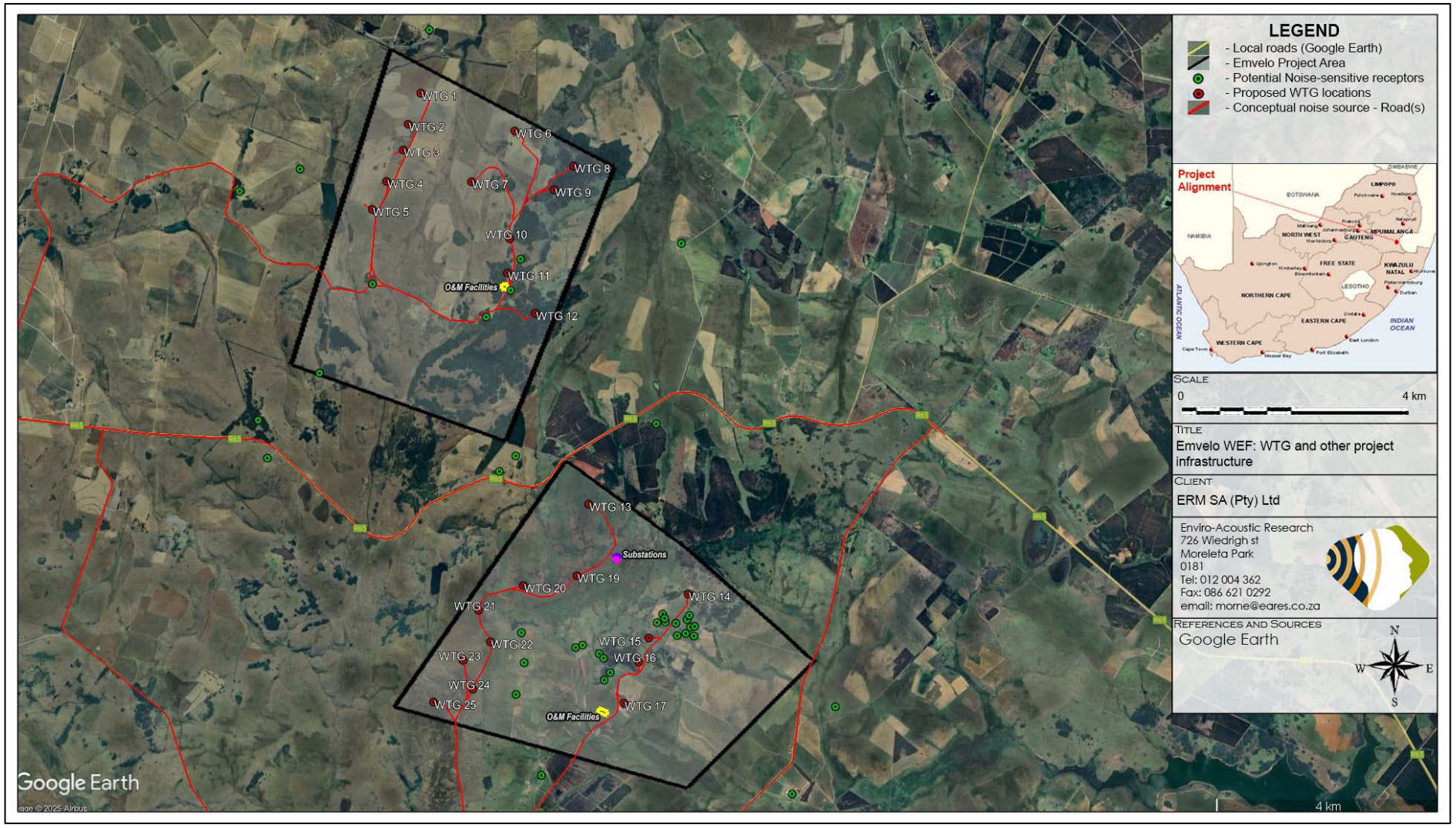


Figure 9-1: Project layout, proposed roads and other infrastructure locations for Emvelo WEF

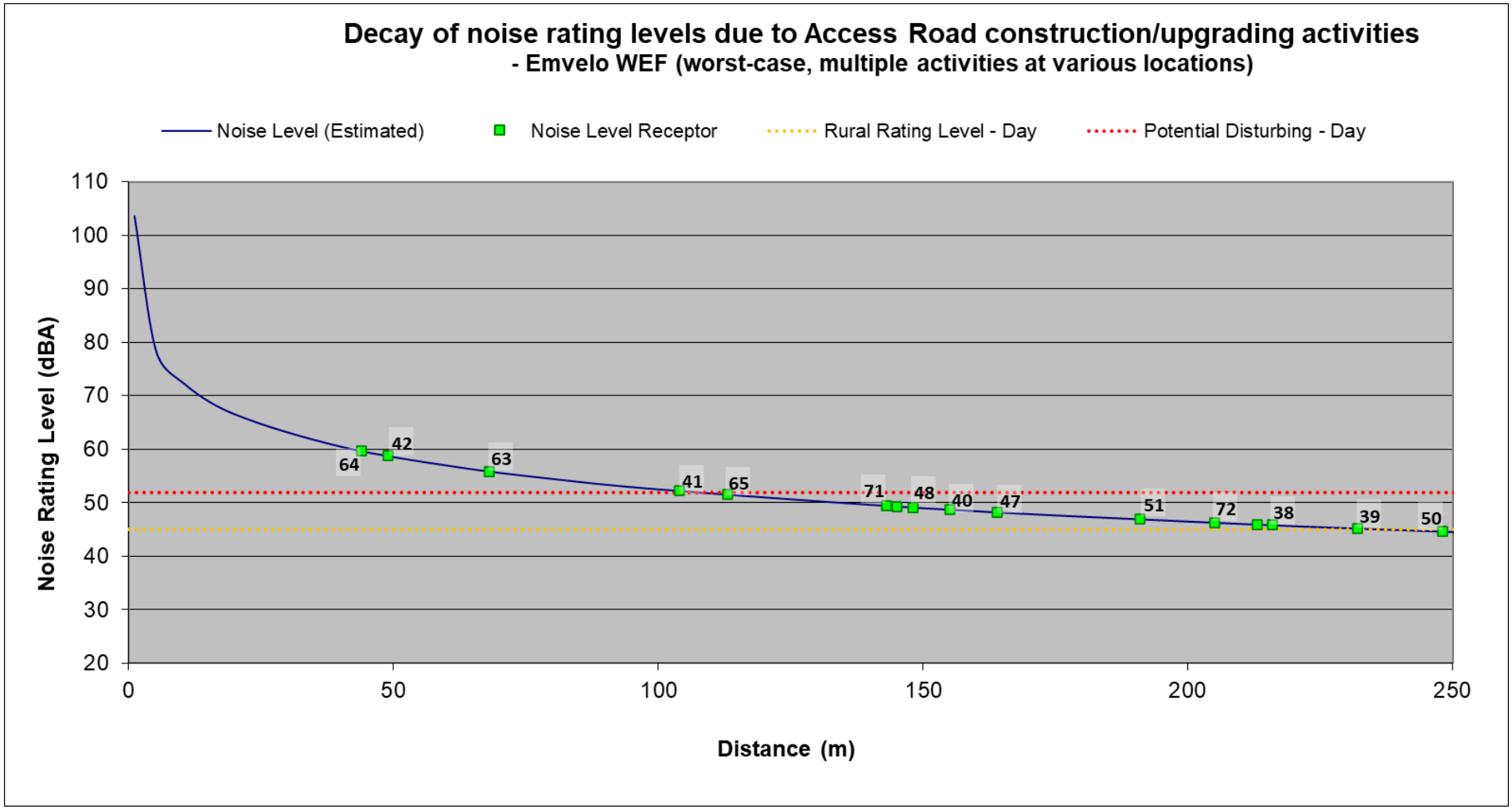


Figure 9-2: Projected conceptual construction noise levels – Road upgrading or construction activities

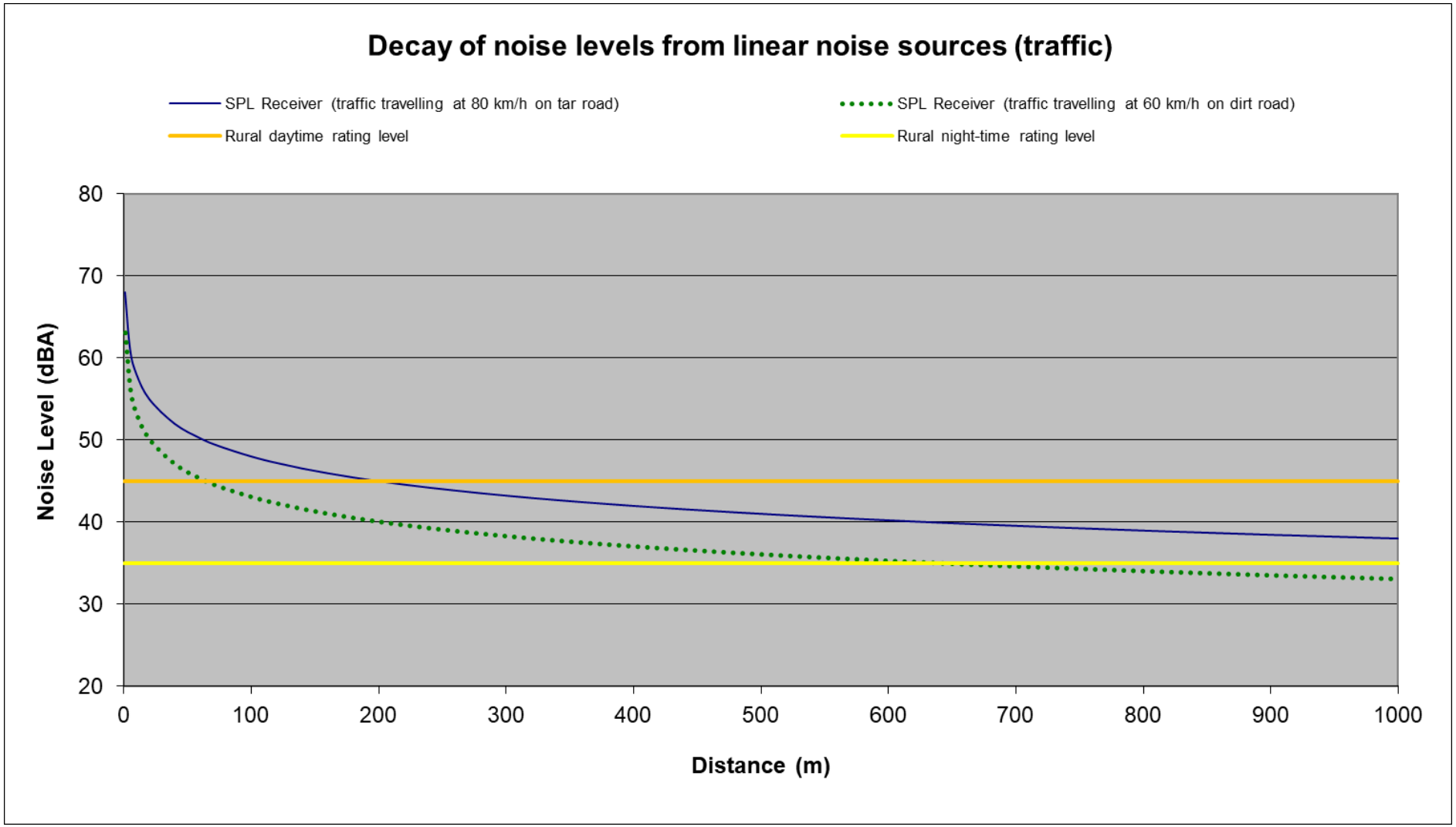


Figure 9-3: Projected conceptual construction noise levels – Decay over distance from linear activities (roads)

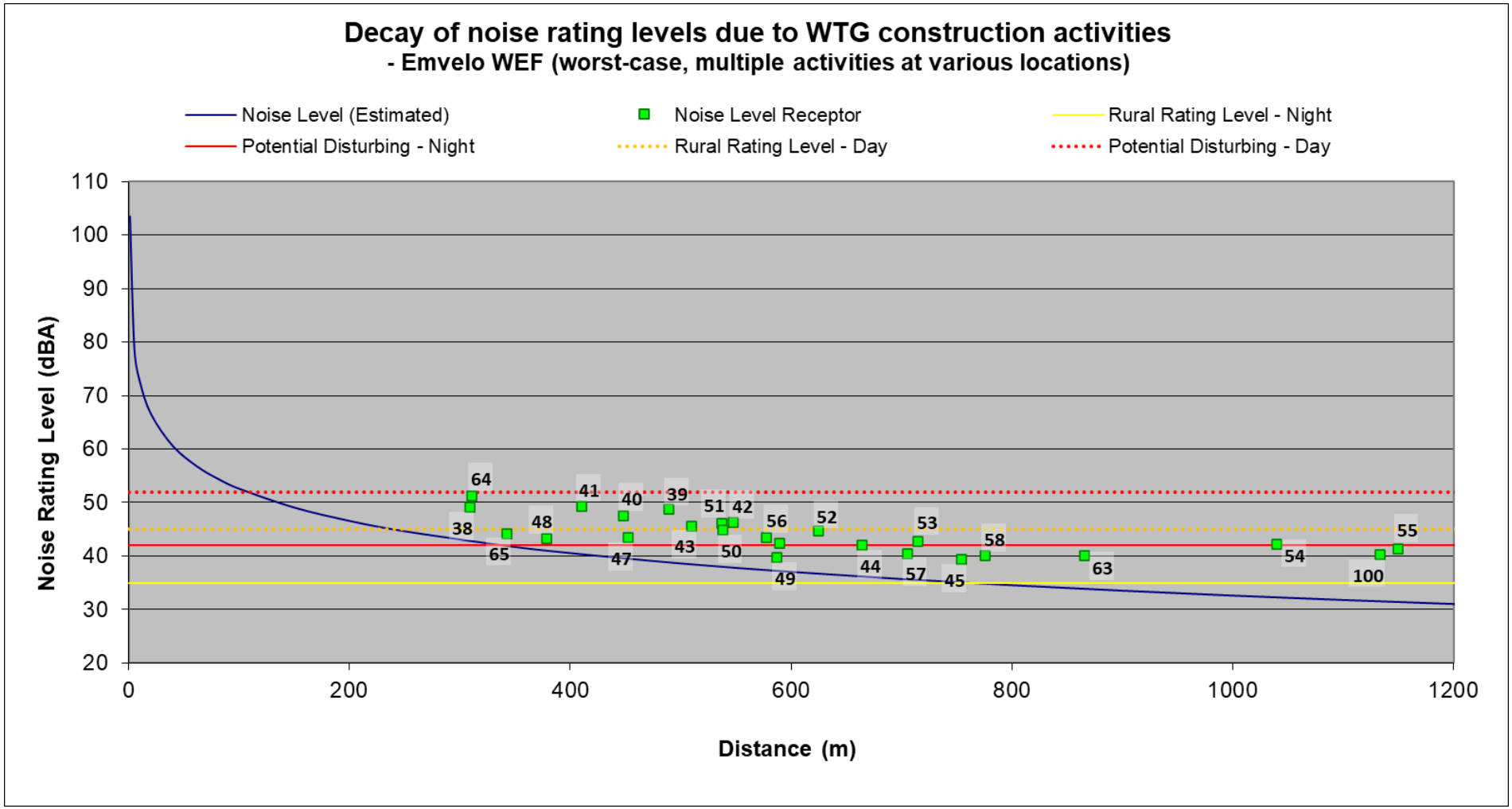


Figure 9-4: Projected conceptual construction noise levels – Emvelo WEF

9.2 CONCEPTUAL SCENARIOS – NOISE DUE TO FUTURE OPERATIONAL ACTIVITIES

While the significance of daytime noise impacts was considered (see **Table 10-5** and **Appendix E, Table 6**), times when a quiet environment is desired (at night for sleeping, relaxation in the evenings and weekends) are more critical. Surrounding receptors would desire and require a quiet environment during the night-time (22:00 – 06:00) timeslot and noise levels during the night-time period is critical. It should be noted that maintenance activities normally take place during the day, but normally involve a few light-delivery vehicles moving around during the course of the day, an insignificant noise source. As such maintenance activities will not be considered.

The worst- and "average"-case scenario was considered (discussed in **sections 5.2.1** and **7.1**) and included in this report to illustrate the effect of the WTG operating simultaneously, with the noise levels defined per NSR in **Appendix E, Table 7**. The worst-case noise rating levels are illustrated in **Figure 9-6** (the noise level contours with an approximate 2 dB uncertainty) associated with a wind speed of approximately 10 m/s at hub height, with the average noise level contours illustrated in **Figure 9-7** (the expected typical noise levels).

How the noise levels may change as wind speeds change are illustrated in **Figure 9-5**. It should be noted that graph is based on the PWL characteristics of the Envision EN182-8.0 WTG, as the details of the final WTG to be selected was not available.

9.3 POTENTIAL CUMULATIVE NOISE IMPACTS

Cumulative noise impacts generally only occur when noise sources (such as other wind turbines) are closer than 5,000m from each other (around 2,500m 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 5,000m 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 adjacent wind farms are further than 5,000m, cumulative noise impacts are non-existent. This is illustrated in **Figure 9-8**. Therefore, any other WEF, not located within 5,000m will not cumulatively add to noise levels associated with this project. Cumulative effects are also only related to the NSR located between, and within approximately 2,500m from the WTG of the WEFs under investigation.

At the time this report was drafted, the author only has knowledge of the proposed Sheepmoor WEF located directly south of the Emvelo WEF. There are other projects in the area, but details of these projects are not in the public domain (and confidential) and the potential cumulative effect from these WEFs will not be considered.

The layout of these two WEFs were included in the cumulative noise model, also using a PWL of 111.2 dBA (re 1 pW), with the potential noise rating level contours illustrated in **Figure 9-9**. As can be noted from **Appendix E, Table 8**, the cumulative effect is mainly restricted to NSR E082 and E066. Potential cumulative worst-case noise rating level contours are also depicted from **Figure 9-9**.

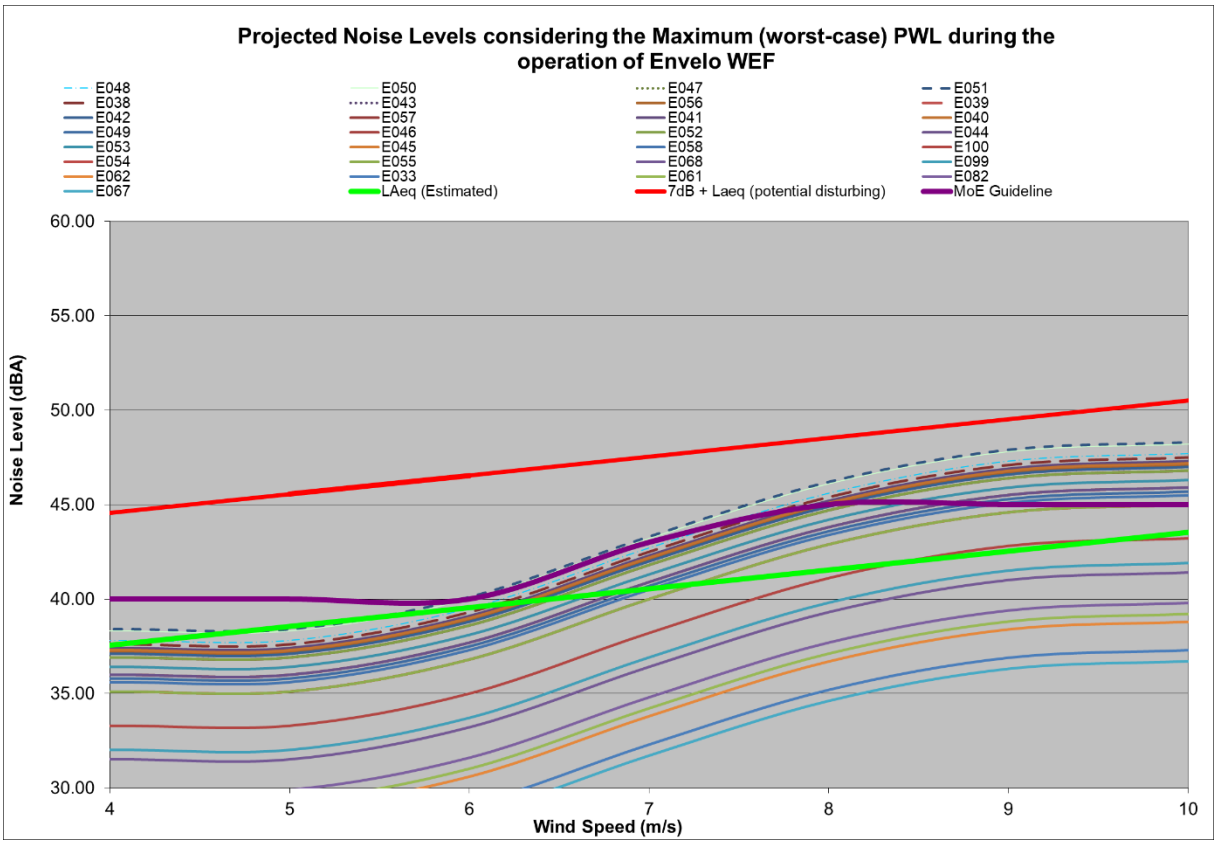


Figure 9-5: Projected noise levels at different wind speeds (worst-case PWL)

9.4 POTENTIAL DECOMMISSIONING, CLOSURE AND POST-CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and/or operational phases. This is because:

- Decommissioning activities normally are limited to the daytime period, due to the lower urgency to complete this phase; and
- Decommissioning activities normally use smaller and less equipment, generating less noise than the typical construction or operational phases.

If required, the noise levels for decommissioning can be compared with the daytime construction phase noise level and the noise impact is similar or less.

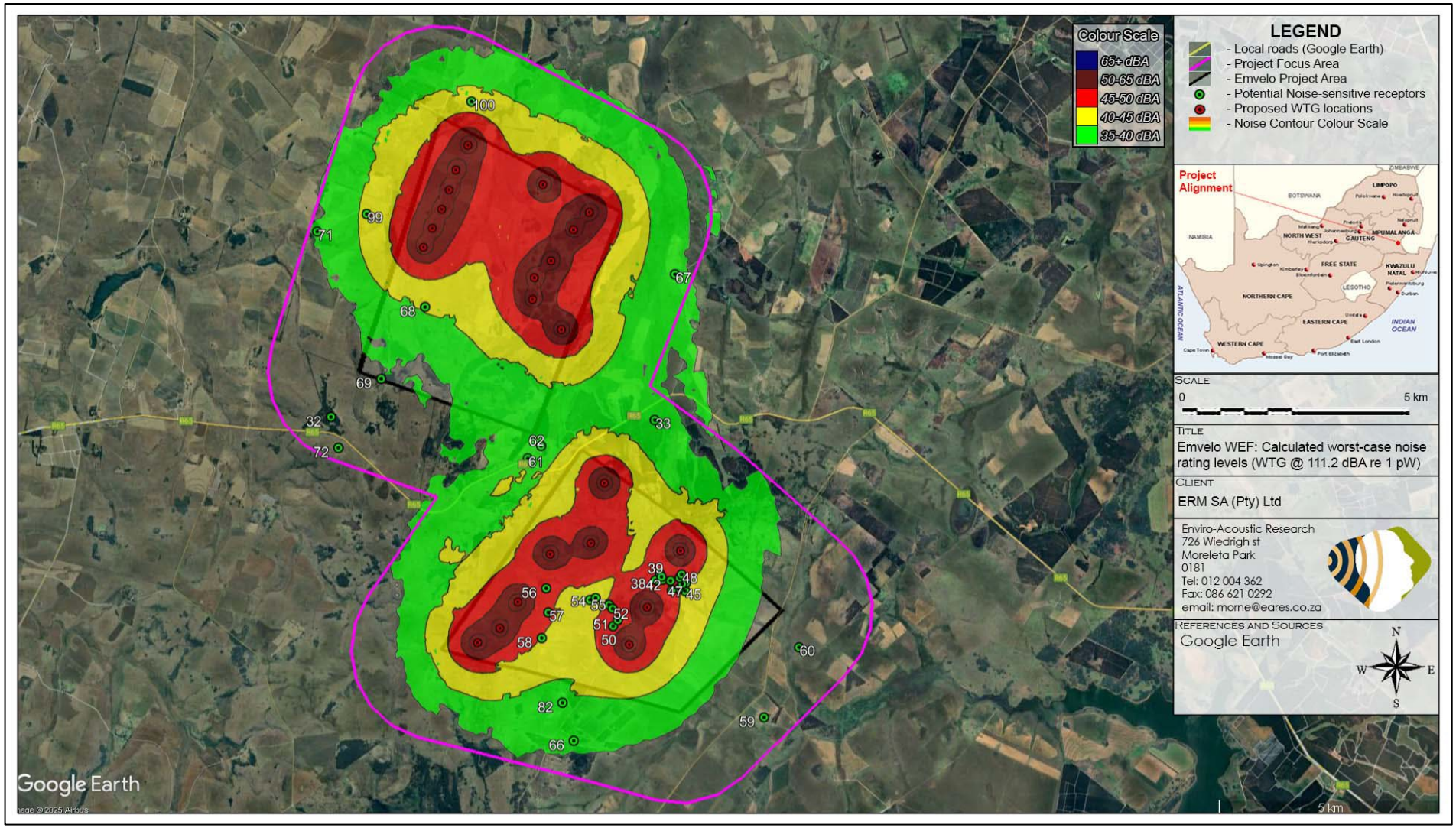


Figure 9-6: Projected future operational worst-case noise rating level contours (WTG with a PWL of 111.2 dBA re 1 pW)

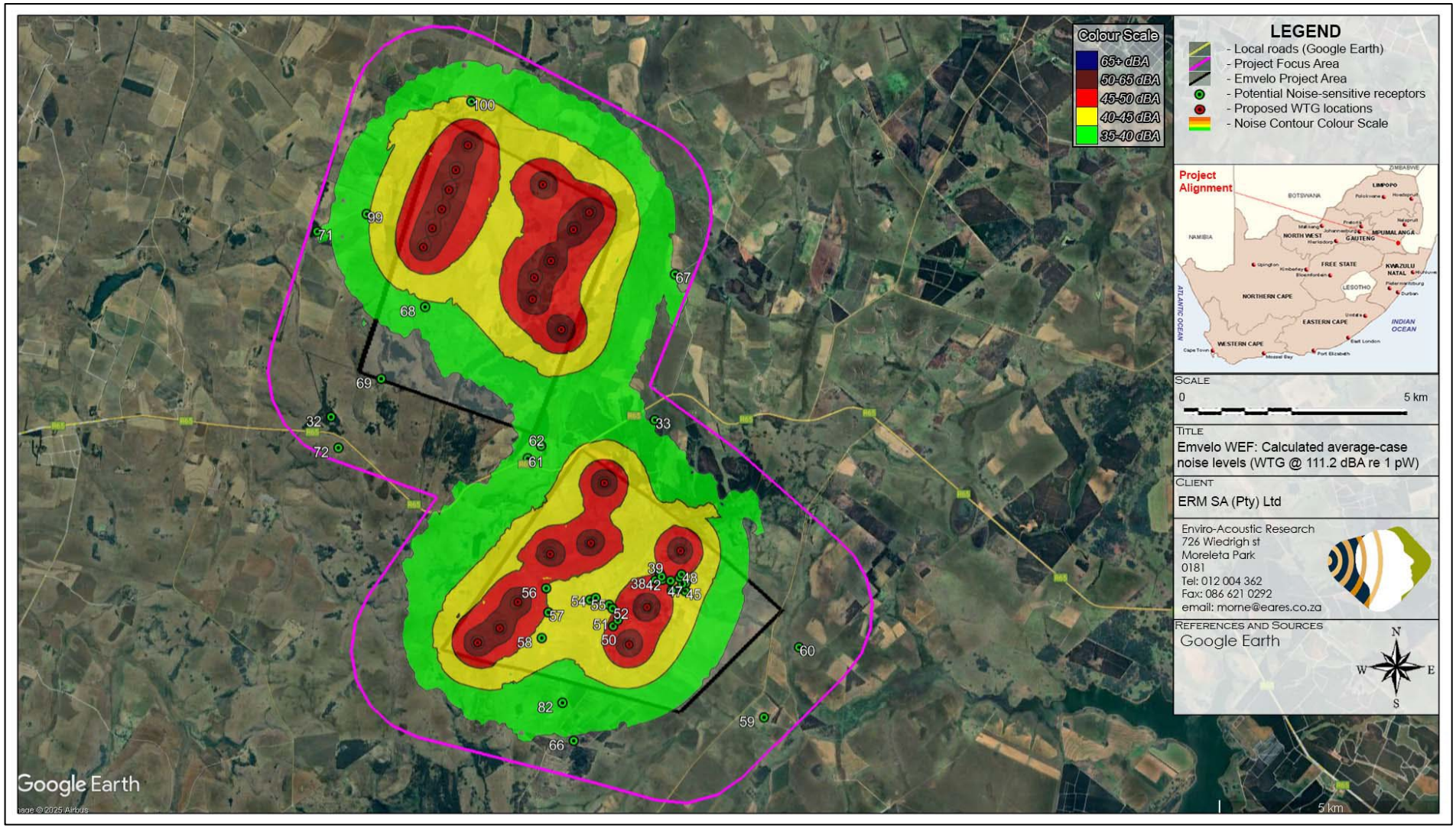


Figure 9-7: Projected future operational worst-case noise rating level contours (WTG with a PWL of 111.2 dBA re 1 pW)

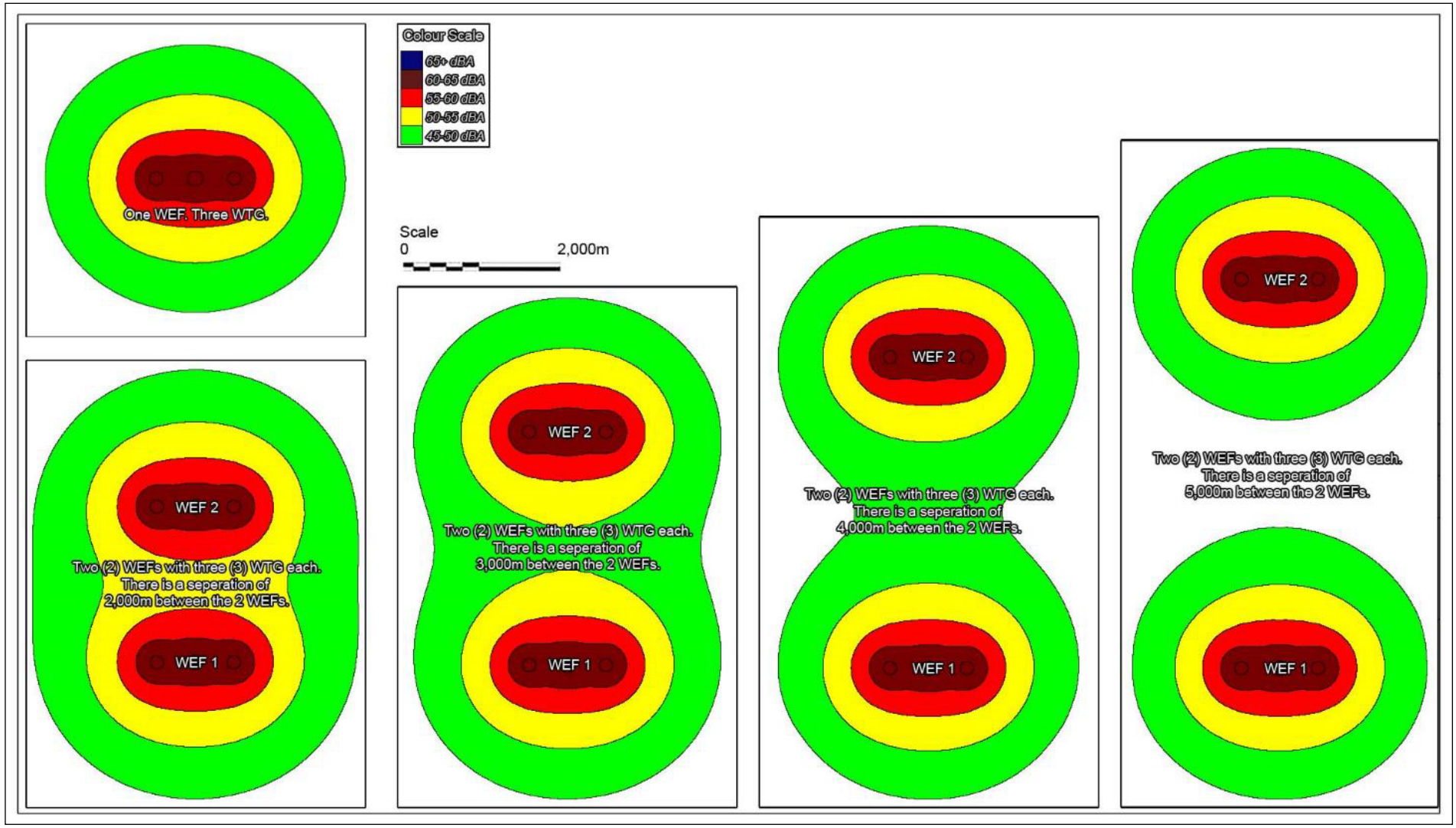


Figure 9-8: Effect of distance between wind turbines – potential cumulative noise

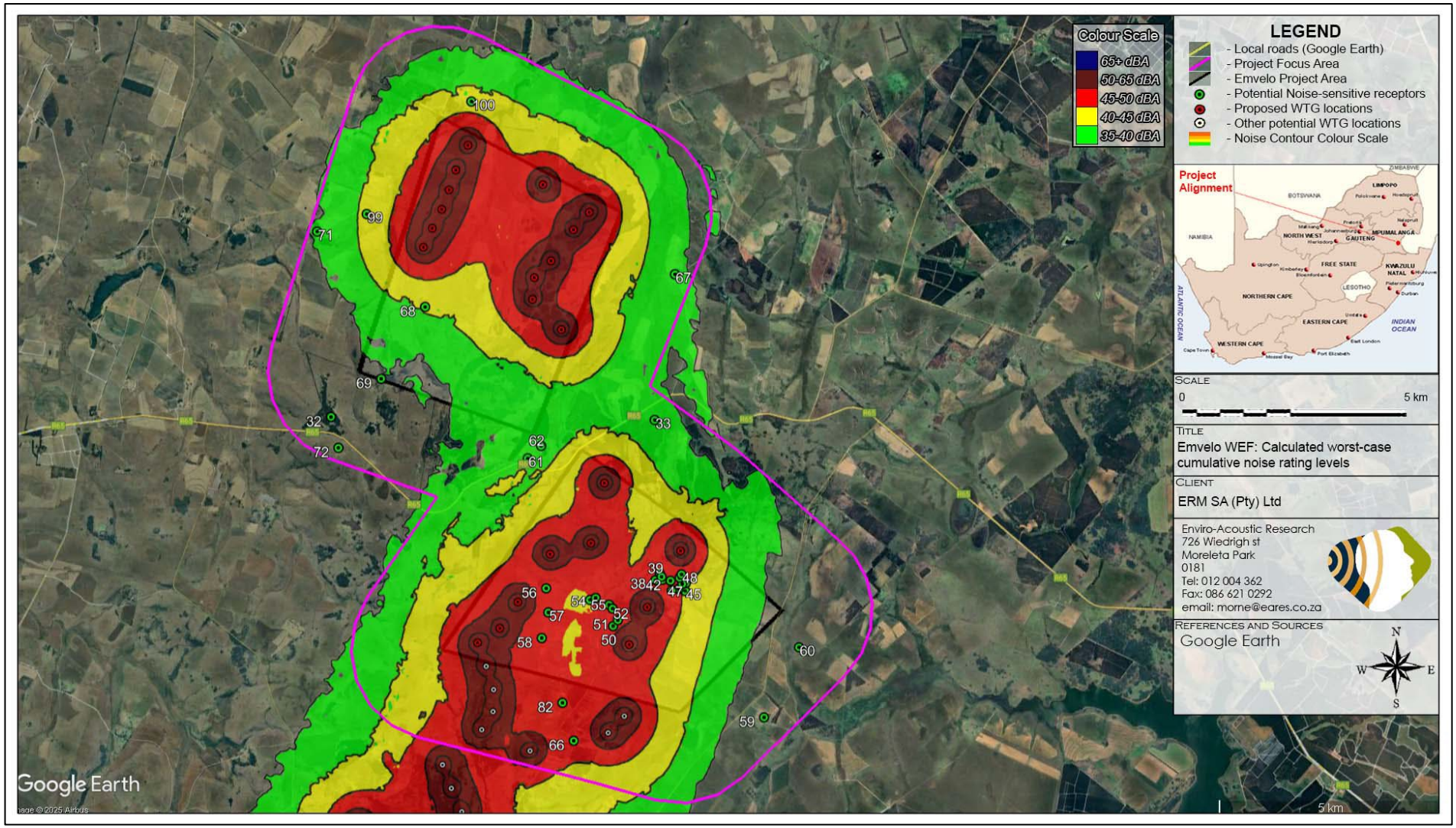


Figure 9-9: Projected future cumulative noise rating level contours – Operation of the Emvelo and Sheepmoor WEFs

10 SIGNIFICANCE OF THE NOISE IMPACT

10.1 NOISES IMPACT RELATING TO THE PLANNING AND DESIGN PHASE

Activities that relate to the planning and design phases are normally limited to surveying and site visits. These activities are normally limited to the daytime period, with the activities normally having temporary noise impacts of a minor consequence. The significance of the noise impact for the planning and design phase will be negative low and will not be considered in this assessment.

10.2 NOISE IMPACT DUE TO FUTURE CONSTRUCTION ACTIVITIES

10.2.1 Construction activities relating to the Access Roads

The possible noise levels due to the construction of the access roads was estimated in **section 9.1** for the development of the Emvelo WEF with the potential significance of the noise impact estimated per NSR in **Appendix E, Table 2** and summarized in **Table 10-1**.

10.2.2 Noises relating to Construction Traffic passing NSR

The possible noise impact relating to construction traffic passing NSR were estimated in **section 9.1**, with the potential significance of the noise impact estimated per NSR in **Appendix E, Table 3** and summarized in **Table 10-2**.

10.2.3 Construction activities at the WEF

The potential noise levels for the various construction activities at the Emvelo WEF (as conceptualised) was calculated in **section 9.1**. The potential significance of the noise impact is estimated per NSR in **Appendix E, Table 4** and summarized in **Table 10-3** for the daytime scenario, with the potential significance of the noise impacts is summarized in **Table 10-4** for the night-time scenario (detailed noise levels and significance defined per NSR in **Appendix E, Table 5**).

10.3 NOISE IMPACT DUE TO FUTURE OPERATIONAL ACTIVITIES

The noise levels associated with the operating WTG was calculated in **section 9.2** considering a WTG with a PWL of 111.2 dBA (re 1 pW), with the potential significance of the:

- daytime noise impact estimated per NSR in **Appendix E, Table 6** and summarized in **Table 10-5**; and
- night-time noise impacts estimated per NSR in **Appendix E, Table 7** and summarized in **Table 10-6**.

10.4 CUMULATIVE NOISE IMPACT

The potential effect of cumulative noises during the construction phase was considered, evaluating the impact from numerous simultaneous activities taking place at all locations where WTG will be developed.

Considering noise emission from both the Emvelo and Sheepmoor WEFs, potential cumulative noise rating levels were calculated and the potential night-time (the most sensitive time period) significance estimated per NSR in **Appendix E, Table 8** and summarized in **Table 10-7**.

10.5 NOISE IMPACT DUE TO FUTURE DECOMMISSIONING ACTIVITIES

The noise levels associated with future decommissioning activities was discussed in **section 9.4**, and decommissioning activities generally have a lower significance than typical daytime construction noise impacts for reasons as motivated in **section 9.4**. The potential significance of decommissioning activities is summarized in **Table 10-8**.

10.6 EVALUATION OF ALTERNATIVES

10.6.1 Alternative 1: No-go option

The ambient sound levels will remain as is and the area would keep the rural noise character during periods of low- and no-winds. There will be no noise impact during the operational phase.

10.6.2Alternative 2: Proposed Renewable Power Generation activities

The proposed renewable energy activities (worst-case evaluated) will slightly raise the noise levels at a number of the closest potential NSR. There is no alternative location where the wind farm can be developed as the presence of a viable wind resource determines the viability of a commercial WEF. While the location cannot be moved, the wind turbines within the WEF can be moved around, although this layout is the result of numerous evaluations and modelling to identify the most economically feasible and environmentally sustainable layout.

Considering the ambient sound levels measured on-site, the projected noise rating levels will be similar or less than the on-site ambient sound levels. It is slightly possible that the noise rating levels could exceed the ambient sound levels during certain periods although it is unlikely to impact on the quality of living (at night) for the closest receptors. The closest receptors should not lose the peace or quiet that they are used to.

The project will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa and locally. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa and locally. People in the area that are not directly affected by increased noises generally have a more positive perception of the renewable projects and understand the need and desirability of the project.

10.7 IMPACT ASSESSMENT TABLES

Table 10-1: Impact Assessment: Daytime activities relating to the construction of access roads

Impact Phase: Construction							
Potential impact description: Construction noises from access road upgrading or construction activities Based on the site measurements, daytime ambient sound levels ranged from 24.8 to more than 72 dBA, averaging at 43.3 dBA (for the six measurement locations). Daytime ambient sound levels are thus typical of a rural noise district. Construction noises might be audible over large distances during quiet periods (during low wind conditions). Daytime construction activities should not change the existing ambient sound levels, with this report recommending a daytime noise limit of 52 dBA (see also **section 6.4.1.3**). The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 2** and summarized in this table.							
	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	Very High	Local	Temporary	Negative	Highly Likely	Medium	Medium
With Mitigation	Very High	Local	Temporary	Negative	Possible	Low	Medium
Can the impact be reversed?	Impact is fully reversible once construction activities cease						
Will impact cause irreplaceable loss or resources?	Low loss of resource (quiet environment away from busy roads).						
Can impact be avoided, managed or mitigated?	Potential construction impacts can be mitigated						
Mitigation measures to reduce residual risk or enhance opportunities: 1. The applicant should discuss the potential noise levels associated with road construction activities with NSR staying within 60m from proposed access roads; 2. The applicant can locate access roads further than 60 m from NSR.							
Residual impact	There will be a residual impact stemming from future operational activities, though the nature of the noises will be different from construction activities. There will be no residual noise impact after the WEF cease to operate.						

Table 10-2: Impact Assessment: Daytime construction traffic passing NSR

Impact Phase: Construction
Potential impact description: Noises due to construction traffic passing NSR Based on the site measurements, daytime ambient sound levels ranged from 24.8 to more than 72 dBA, averaging at 43.3 dBA (for the six measurement locations). Daytime ambient sound levels are thus typical of a rural noise district. Construction traffic noises might be audible over large distances during quiet periods (during low wind conditions).

Noises from construction traffic passing NSR should not change the existing ambient sound levels, with this report recommending a daytime noise limit of 52 dBA (see also **section 6.4.1.3**). The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 3** and summarized in this table.

	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	High	Local	Short-term	Negative	Likely	Medium	Medium
With Mitigation	Low	Local	Short-term	Negative	Possible	Low	Medium

Can the impact be reversed?	Impact is fully reversible once construction activities cease
Will impact cause irreplaceable loss or resources?	Low loss of resource (quiet environment away from busy roads).
Can impact be avoided, managed or mitigated?	Potential construction impacts can be mitigated

Mitigation measures to reduce residual risk or enhance opportunities:

1. The applicant should discuss the project activities with NSR staying within 60 from the access roads;
2. The applicant can locate access roads further than 60 m from NSR;
3. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people.

Residual impact	There will be a residual impact stemming from future operational activities, though the nature of the noises will be different from construction activities. There will be no residual noise impact after the WEF cease to operate.

Table 10-3: Impact Assessment: Daytime construction activities

Impact Phase: Construction

Potential impact description: ***Numerous simultaneous future daytime construction activities***

Based on the site measurements, daytime ambient sound levels ranged from 24.8 to more than 72 dBA, averaging at 43.3 dBA (for the six measurement locations). Daytime ambient sound levels are thus typical of a rural noise district. Construction traffic noises might be audible over large distances during quiet periods (during low wind conditions).

Daytime construction activities should not change the existing ambient sound levels, with this report recommending a daytime noise limit of 52 dBA (see also **section 6.4.1.3**). The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 4** and summarized in this table.

	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	Low	Local	Short-term	Negative	Improbable	Low	Medium
With Mitigation	Low	Local	Short-term	Negative	Improbable	Low	Medium

Can the impact be reversed?	Impact is fully reversible once construction activities cease
Will impact cause irreplaceable loss or resources?	Low loss of resource (quiet environment away from busy roads).
Can impact be avoided, managed or mitigated?	Potential construction impacts can be mitigated

Mitigation measures to reduce residual risk or enhance opportunities:

Noise impact associated with daytime construction activities are low and additional mitigation measures are not required.

Residual impact	There will be a residual impact stemming from future operational activities, though the nature of the noises will be different from construction activities. There will be no residual noise impact after the WEF cease to operate.

Table 10-4: Impact Assessment: Night-time construction activities

Impact Phase: Construction							
Potential impact description: ***Numerous simultaneous future night-time construction activities***							
Based on the site measurements, night-time ambient sound levels ranged from 24.8 to more than 72 dBA, averaging at 43.3 dBA (for the six measurement locations). Daytime ambient sound levels are thus typical of a rural noise district. Construction traffic noises might be audible over large distances during quiet periods (during low wind conditions). Night-time construction activities should not change the existing ambient sound levels, with this report recommending a night-time noise limit of 52 dBA (see also **section 6.4.1.3**). The projected noise levels, the change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 5** and summarized in this table.							
	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	High	Regional	Short-term	Negative	Likely	Medium	Medium
With Mitigation	Moderate	Regional	Short-term	Negative	Possible	Low	Medium
Can the impact be reversed?	Impact is fully reversible once construction activities cease						
Will impact cause irreplaceable loss or resources?	Medium to low loss of resource (quiet environment away from busy roads).						
Can impact be avoided, managed or mitigated?	Potential construction impacts can be mitigated						
Mitigation measures to reduce residual risk or enhance opportunities: 1. Where possible, night-time construction activities closer than 1,000m from NSR should not be permitted without prior warning the NSR about the proposed activities as well as the duration; 2. Plan construction schedule that such simultaneous activities are only required at one WTG location (WTG located within 1,000m from an NSR). Other simultaneous construction activities can continue, but should take place further than 1,000m from NSR; 3. Minimise active construction equipment at night, planning the completion of noisiest activities (such a pile driving, rock breaking and excavation) during the daytime period; and 4. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people.							
Residual impact	There will be a residual impact stemming from future operational activities, though the nature of the noises will be different from construction activities. There will be no residual noise impact after the WEF cease to operate.						

Table 10-5: Impact Assessment: Daytime operation of numerous WTG

Impact Phase: Operational							
Potential impact description: ***Numerous WTG operating simultaneously at Emvelo WEF***							
WTG will only operate during period with increased winds, when ambient sound levels could be higher than periods with no or low winds. As discussed and motivated in **section 6.4** (as proposed in **Table 6-2** and illustrated in **Figure 4-31**), ambient sound levels will likely be higher, with this assessment assuming an ambient sound level of 41.5 dBA (ambient sound level measurements indicate that actual ambient sound levels may be higher) at a wind speed of 8 m/s (at a height of 10m). This assessment recommends a daytime upper noise limit of 52 dBA (see also **section 6.4.1.3**). Numerous WTG of the 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 the identified NSR in **Appendix E, Table 6** and summarized in this table.							
	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	High	Local	Long-term	Negative	Possible	Low	High
With Mitigation	Moderate	Local	Long -term	Negative	Possible	Low	Medium
Can the impact be reversed?	Impact is fully reversible once operational activities cease						
Will impact cause irreplaceable loss or resources?	Low loss of resource (quiet environment away from busy roads).						

Can impact be avoided, managed or mitigated?	Potential operational impacts can be mitigated
Mitigation measures to reduce residual risk or enhance opportunities: *While the risk of daytime operational noises activities is low, some of the mitigation measures proposed for night-time operational activities will also reduce daytime noise levels.*	
Residual impact	There will be a residual impact stemming from operational activities, with the residual noise impact stopping once the WEF cease to operate.

Table 10-6: Impact Assessment: Night-time operation of numerous WTG

Impact Phase: Operational

Potential impact description: ***Numerous WTG operating simultaneously at Emvelo WEF***

WTG will only operate during period with increased winds, when ambient sound levels could be higher than periods with no or low winds. As discussed and motivated in **section 6.4** (as proposed in **Table 6-2** and illustrated in **Figure 4-32**), ambient sound levels will likely be higher, with this assessment assuming an ambient sound level of 41.5 dBA at a wind speed of 8 m/s (at a height of 10m).

Numerous WTG of the WEF operating simultaneously at night will increase ambient sound levels due to air-borne noise from the WTG. The projected noise levels, the potential change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 7**.

	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	High	Regional	Long -term	Negative	Highly Likely	High	Medium
With Mitigation	Moderate	Regional	Long -term	Negative	Possible	Low	Medium

Can the impact be reversed?	Impact is fully reversible once operational activities cease
Will impact cause irreplaceable loss or resources?	Medium loss of resource (quiet environment away from busy roads).
Can impact be avoided, managed or mitigated?	Potential operational impacts can be mitigated

Mitigation measures to reduce residual risk or enhance opportunities:

1. Considering potential future night-time operational noise levels, the applicant can relocate certain NSR (such as NSR E048, E050, E051, E038, E056, E039, E041 and/or E040) where operational noise levels will be high;
2. The applicant can reduce the number of WTG closer than 800m from certain NSR;
3. The applicant can relocate WTG further from identified NSR where operational noise levels will be high (reducing the locations where construction activities may take place);
4. Discussions with NSR at locations where night-time projected noise levels will slightly exceed the recommended night-time noise limit (45 – 48 dBA). NSR should be informed about the potential issues associated with long-term exposure to high noise level. If acceptable to the NSR, the applicant could consider the acoustic treatment of the dwellings to ensure compliance with Table 1 of SANS 10103. Each dwelling must be treated on a case-to-case base, as this option is mainly available to housing structures of proper construction (concrete or brick, with a roof with a ceiling space);
5. Together with a combination of the mitigation measures raised in points 1, 2, 3 and 4; the applicant can add noise reducing additions (such as serrated trailing edges) to the blades of certain WTG. This could reduce noise levels between 1 and 2 dBA at NSR;
6. Together with a combination of the mitigation measures raised in points 1, 2, 3, 4 and 5; the applicant can design and implement a noise abatement plan that would reduce the noise emissions from the WTG during certain times or conditions. This can reduce noise emission levels significantly at NSR.

Residual impact	There will be a residual impact stemming from operational activities, with the residual noise impact stopping once the WEF cease to operate.

Table 10-7: Impact Assessment: Potential Cumulative Noise Impacts

Impact Phase: Operational							
Potential impact description: ***Numerous WTG operating simultaneously at Emvelo and Emvelo WEF*** The projected cumulative noise levels, the potential change in ambient sound levels as well as the potential noise impact is defined per NSR in **Appendix E, Table 8**. If the Emvelo WEF operate simultaneously with the Sheepmoor WEF, noise levels will increase with more than 3 dBA at NSR E082 and E066.							
	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	Very High	Regional	Long -term	Negative	Definite	High	High
With Mitigation	Moderate	Regional	Long -term	Negative	Possible	Low	Medium
Can the impact be reversed?			Impact is fully reversible once operational activities cease				
Will impact cause irreplaceable loss or resources?			Medium loss of resource (quiet environment away from busy roads).				
Can impact be avoided, managed or mitigated?			Potential operational impacts can be mitigated				
Mitigation measures to reduce residual risk or enhance opportunities: 1. Considering potential future night-time operational noise levels, the applicant can relocate certain NSR (such as NSR E050, E047, E051, E038, E043, E056, E039, E042, E057, E041, E040, E049, E046, E052, E044, E053 and/or E058) where operational noise levels will be high, and the addition of serrated training edges alone may not be sufficient to reduce noise levels to less than 45 dBA; 2. The applicant can reduce the number of WTG closer than 800m from the identified NSR; 3. The applicant can relocate WTG further from identified NSR where operational noise levels will be high (reducing the locations where construction activities may take place); 4. Discussions with NSR at locations where night-time projected noise levels will slightly exceed the recommended night-time noise limit (45 – 48 dBA). NSR should be informed about the potential issues associated with long-term exposure to high noise level. If acceptable to the NSR, the applicant could consider the acoustic treatment of the dwellings to ensure compliance with Table 1 of SANS 10103. Each dwelling must be treated on a case-to-case base, as this option is mainly available to housing structures of proper construction (concrete or brick, with a roof with a ceiling space); 5. Together with a combination of the mitigation measures raised in points 1, 2, 3 and 4; the applicant can add noise reducing additions to the blades of certain WTG (such as serrated trailing edges); 6. Together with a combination of the mitigation measures raised in points 1, 2, 3, 4 and 5; the applicant can design and implement a noise abatement plan that would reduce the noise emissions from the WTG during certain times or conditions.							
Residual impact	There will be a residual impact stemming from operational activities, with the residual noise impact stopping once the WEF cease to operate.						

Table 10-8: Impact Assessment: Decommissioning activities

Impact Phase: Decommissioning							
Potential impact description: ***Various decommissioning activities*** Based on the site measurements, daytime ambient sound levels ranged from 24.8 to more than 72 dBA, averaging at 43.3 dBA (for the six measurement locations). Daytime ambient sound levels are thus typical of a rural noise district. Construction traffic noises might be audible over large distances during quiet periods (during low wind conditions). Daytime decommissioning activities should not change the existing ambient sound levels, with this report recommending a daytime noise limit of 52 dBA (see also **section 6.4.1.3**). The projected noise levels, the change in ambient sound levels as well as the potential noise impact might be similar (or less) than typical daytime construction noises. Assuming that mitigation measures as recommended for the construction and operational phases will be implemented, decommissioning activities would likely have a much lower noise impact than the construction and operational phase.							
	Severity (Table 6-3)	***Extent (Table 6-5)***	***Duration (Table 6-4)***	**Status**	***Probability (Table 6-6)***	***Significance (Table 6-7)***	**Confidence**
Without Mitigation	Moderate	Local	Short-term	Negative	Possible	Low	Medium
With Mitigation	Moderate	Local	Short-term	Negative	Possible	Low	Medium

Can the impact be reversed?	Impact is fully reversible once decommissioning activities cease
Will impact cause irreplaceable loss or resources?	Low loss of resource (quiet environment away from busy roads).
Can impact be avoided, managed or mitigated?	Potential construction impacts can be mitigated
Mitigation measures to reduce residual risk or enhance opportunities: Mitigation measures are not required or recommended for the decommissioning phase.	
Residual impact	There will be no residual noise impact after the decommissioning phase.

11 MITIGATION OPTIONS

This study considers the potential noise impact on the surrounding environment due to the construction, operational and future decommissioning activities associated with the WEF project. It was determined that the potential noise impacts, without mitigation, would be:

- of a **medium significance** for the daytime construction of the access roads. Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **medium significance** for the daytime construction traffic passing NSR (one NSR). Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **low significance** for the daytime construction activities (hard standing areas, excavation and concreting of foundations and the erecting of the WTG and other infrastructure);
- of a **medium significance** for the night-time construction activities (such as the pouring of concrete, erecting the WTG, etc.). While night-time construction is not likely, it may be required that such activities take place at night, and mitigation measures were included that would reduce the significance of the noise impact to **low**;
- of a **low significance** for the daytime operational activities;
- of a **high significance** for night-time operational activities (noises from wind turbines) at the Emvelo WEF when considering the worst-case PWL. Mitigation is available to reduce the significance of the noise impact to **low**; and
- of a **low significance** for the potential decommissioning activities.

There is a potential for a cumulative noise impact at two receptors (NSR E082 and E066).

The project developer must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon, as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. At all stages, surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities will be inaudible due to existing high ambient sound levels, nor to state that complaints or concerns are unwarranted (or to refer to the "nocebo" effect.

Even when noise levels may be elevated, the magnitude of the sound levels will depend on a multitude of variables which will vary from day to day and from place to place with

environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities, the spectral character and that of the surrounding soundscape (both level and spectral character).

The developer must implement a line of communication (i.e., a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers. The proposed WEFs should maintain a commitment to the local community (people staying within 2,000 m from construction or operational activities) and respond to noise concerns in an expedient fashion. Sporadic and legitimate noise complaints could be raised and it is the responsibility of the developer to investigate. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or perforations or slits in the blades. Problems of this nature can be corrected quickly and it is in the developer's interest to do so. In cases where valid noise complaints are verified, the developer must consider appropriate mitigation measures to address the issues or concerns.

Concentrating on the night-time period (when a quieter environment is more desired), continuing management objectives would be:

- Ensure that total daytime noise levels are less than 52 dBA at all potential NSRs (dwellings used for residential purposes);
- Ensure that total night-time noise levels are less than 45 dBA at all potential NSRs (dwellings used for residential purposes);
- Prevent the generation of nuisance noises.

11.1 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING THE CONSTRUCTION PHASE

The significance of the noise impact associated with access road construction activities, road traffic noises and night-time construction activities could be of a **medium** significance. The **medium** significance noise impact may relate to the worst-case scenario being investigated as well as the use of strict EIA criteria.

Potential mitigation measures that could reduce the significance of construction noise impacts could include:

8. The applicant should discuss the potential noise levels associated with road construction activities with NSR staying within 60m from access roads;
9. The applicant can locate access roads further than 60 m from NSR;

10. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people;
11. Where possible, night-time construction activities closer than 1,000m from NSR should not be permitted without prior warning the NSR about the proposed activities as well as the duration;
12. Plan construction schedule that such simultaneous activities are only required at one WTG location (WTG located within 1,000m from an NSR). Other simultaneous construction activities can continue, but should take place further than 1,000m from NSR;
13. Minimise active construction equipment at night, planning the completion of noisiest activities (such a pile driving, rock breaking and excavation) during the daytime period; and
14. The applicant should add a component covering noise in the health and safety induction process. Employees and contractors should understand that noises could impact on the quality of living of people.

The following measures are also recommended for the applicant to discuss with the project contractor to implement in their environmental management programme:

- If practical, road construction or upgrading activities (when working closer than 120 m from NSR) should ideally be planned for when NSR are not at home (children at school, adults at work or busy). Ideally work near NSR should be planned to take place between 08:00 and 14:00;
- Construction vehicles should reduce speeds to the minimum when passing NSR staying closer than 60 m from the road;
- NSR should be provided with the contact details of the environmental representative (Environmental Control Officer "ECO") to register potential complaints about noise;
- Access roads passing within 120 m from NSR should ideally not be used at night by construction vehicles (trucks and heavy construction equipment).

11.2 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING OPERATION

Worst-case noise levels could exceed 45 dBA (the night-time upper recommended noise limit) at a number of NSR considering the layout and a WTG with a maximum PWL of 111.2 dBA (re 1 pW). For this layout, mitigation will be required for any WTG with a PWL exceeding 107 dBA (re 1 pW).

The significance of the daytime noise impact during the operation phase is projected to be **low**, with the night-time operational noise impact projected to be **high**. Additional mitigation measures are required and recommended for the operational phase (focusing on the night-time period). Potential measures that will ensure acceptable night-time noise levels are discussed in the following subsections.

11.2.1 Planning Phase

Potential future construction and operational noise impacts must be addressed during the planning stage, as the costs implications will make the implementation of viable mitigation measures prohibitive. Measures that should be addressed during the planning stage include:

1. Considering potential future night-time operational noise levels, the applicant can relocate certain NSR (such as NSR E048, E050, E051, E038, E056, E039, E041 and/or E040) where operational noise levels will be high (for the evaluated cumulative scenario, this could be E050, E047, E051, E038, E043, E056, E039, E042, E057, E041, E040, E049, E046, E052, E044, E053 and/or E058);
2. The applicant can reduce the number of WTG closer than 800m from certain NSR;
3. The applicant can relocate WTG further from identified NSR where operational noise levels will be high (reducing the locations where construction activities may take place);
4. Discussions with NSR at locations where night-time projected noise levels will slightly exceed the recommended night-time noise limit (45 – 48 dBA). NSR should be informed about the potential issues associated with long-term exposure to high noise level. If acceptable to the NSR, the applicant could consider the acoustic treatment of the dwellings to ensure compliance with Table 1 of SANS 10103. Each dwelling must be treated on a case-to-case base, as this option is mainly available to housing structures of proper construction (concrete or brick, with a roof with a ceiling space);
5. Together with a combination of the mitigation measures raised in points 1, 2, 3 and 4; the applicant can add noise reducing additions (such as serrated trailing edges) to the blades of certain WTG. This could reduce noise levels between 1 and 2 dBA at NSR;
6. Together with a combination of the mitigation measures raised in points 1, 2, 3, 4 and 5; the applicant can design and implement a noise abatement plan that would reduce the noise emissions from the WTG during certain times or conditions. This can reduce noise emission levels significantly at NSR.
7. The potential mitigation measures should be modelled to ensure that the potential future operational noise levels will comply with the recommended and agreed noise limits. Noise modelling must consider the cumulative scenario; and

8. Once the mitigation measures above are selected and modelled, the applicant must design a noise monitoring program at representative NSR locations where the modelled worst-case noise rating levels exceed 42 dBA. This should include the measurement of ambient sound levels prior to the development of the WEF, followed by noise measurements once the WEF is operational to confirm that noise levels are less than 45 dBA.

11.2.2 Operational Phase

It is the intention to manage noise levels during the Planning Phase, however, it may still be necessary to implement a noise abatement plan. If noise monitoring indicates that the measures designed during the planning stage do not adequately mitigate noise levels to be within acceptable levels, the applicant should design and implement a noise abatement programme that will further reduce the noise emission levels during certain wind speeds, wind directions, time periods or meteorological conditions.

11.3 MITIGATION OPTIONS AVAILABLE TO REDUCE NOISE IMPACT DURING DECOMMISSIONING

The potential significance of the noise impact would be similar as the daytime construction phase (**low** significance) and no further mitigation is recommended or required for the decommissioning phase.

11.4 MITIGATION AND MANAGEMENT CONDITIONS TO BE INCLUDED IN THE EMPR AND ENVIRONMENTAL AUTHORIZATION

It is recommended that the project applicant:

1. The applicant should remodel the potential noise rating levels once the WTG and specifications are finalised;
2. If noise modelling of the final selected WTG (and final layout) indicates noise levels higher than 45 dBA at any NSR, the applicant must select appropriate mitigation measures to ensure outside night-time noise levels of 45 dBA, or noise levels inside residential structures should comply with Table 1 of SANS 10103 (in agreement with the different NSR);
3. re-evaluate the noise impact should the layout be revised (as part of amendment process post EA) where:
    a. any WTG, located within 2,500 m from a confirmed NSR, are moved closer to the NSR;
    b. any new WTG are introduced within 2,500m from an NSR;
    c. the number of WTG within 2,500m from an NSR are increased;

4. re-evaluate the noise impact should the applicant make use of a WTG with a maximum PWL exceeding 111.2 dBA re 1 pW;
5. ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised;
6. include a component covering environmental noise in the Health and Safety Induction to sensitize all employees and contractors about the potential impact from noise, especially those employees and contractors that have to travel past receptors at night, or might be required to do work close (within 1,200m) to NSRs at night. This should include issues such as minimising the use of vehicle horns;
7. investigates any reasonable and valid noise complaint if registered by a receptor staying within 2,500 m from the location where construction activities are taking place, or where an operational WTG are located. A complaint register, keeping a full record of the complaint, must be kept by the applicant; and
8. The applicant must plan and design a noise monitoring program at representative NSR locations where the modelled worst-case noise rating levels exceed 42 dBA. This should include the measurement of ambient sound levels prior to the development of the WEF, followed by noise measurements once the WEF is operational to confirm that noise levels are less than 45 dBA, or that noise levels within the dwelling complies with Table 1 of SANS 10103;
9. Where practicable, mobile equipment should be fitted with broadband (white-noise generators/alarms [33] [34]), rather than tonal reverse alarms.

[33]White Noise Reverse Alarms: http://www.brigade-electronics.com/products.
[34] https://www.constructionnews.co.uk/home/white-noise-sounds-the-reversing-alarm/885410.article - White noise sounds the reversing alarm

12 ENVIRONMENTAL MONITORING PLAN

Environmental Noise Monitoring can be divided into two distinct categories, namely:

- Passive monitoring – the registering of any complaints (reasonable and valid from NSR living within 2,500m from any WTG of the Emvelo WEF) regarding noise; and
- Active monitoring – the measurement of noise levels at identified locations.

After the implementation of mitigation measures, noise levels could be higher than 42 dBA (more than 7 dBA of the night-time rating level of a rural noise district) and active noise monitoring is recommended and required.

In addition, passive monitoring also applies in the instance where a reasonable and valid noise complaint be registered, and the applicant/developer should investigate the noise complaint as per the guidelines in **sub-section 12.1** and **12.2**. These guidelines should be used as a rough guideline as site-specific conditions may require that the monitoring locations, frequency or procedure be adapted.

12.1 MEASUREMENT LOCALITIES AND FREQUENCY

Ambient sound levels could be measured at 4 – 5 representative locations before the development of the WEF (at the minimum), with the measurements repeated after the first year of operation. In addition, should there be a valid and reasonable noise complaint, once-off noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. These measurement locations can be reduced accordingly if the NSRs are relocated or the dwellings are no longer used for residential purposes.

12.2 MEASUREMENT PROCEDURES

For active monitoring, it is recommended that ambient sound levels be measured at representative NSR where the worst-case noise levels could exceed 42 dBA (4 – 5 measurement locations should provide sufficient information about the compliance of the project to the noise limits) before the development of the WF, with the measurements repeated after the first year of operation. The procedures are described in the sub-section below.

In addition, should there be a valid and reasonable noise complaint, once-off noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading.

12.3 MEASUREMENT PROCEDURES

Noise level measurements should be collected considering the requirements of SANS 10103:2008 (or an internationally recognised method such as ISO 1996, IEC 61400-11 or ETSU R97, considering the limitations of measuring the noise from WTG). It should be noted that the correct protocol should be selected to ensure quality data, with:

- SANS 10103 or ISO 1996 are recommended for use to measure noise levels due to construction activities (low wind conditions); and
- IEC 61400-11 or ETSU-R97 are recommended for use to measure operational noise levels (where increased winds may influence the measurements). Measurements done in terms of SANS 10103 or ISO 1996 would report elevated noise levels due to wind-induced noises impacting on the measurement, with the elevated noise levels already being higher than 45 dBA due to wind-induced noises, and not noises from the operating infrastructure.

When a noise complaint is being investigated, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event.

13 ENVIRONMENTAL MANAGEMENT

Environmental Management Objectives are difficult to be defined for noise because ambient sound levels would slowly increase as developmental pressures increase in the area. This is due to increased traffic associated with increased development, human habitation, agriculture and even eco-tourism. While these increases in ambient sound levels may be low (and insignificant) it has the effect of cumulatively increasing the ambient sound levels over time.

The moment the WEF facility stops operation, ambient sound levels will drop to levels similar to the pre-WEF levels, or to new levels (typical of other areas with a similar developmental character) if other developments have occurred in the interim.

For the purpose of this report potential environmental management objectives would be:

- That the development (construction and operational phase) of the WEF project not result in noise levels exceeding 52 dBA (when measured over a period of at least 1 hour) during the day; and
- That the development (construction and operational phase) of the WEF project should not result in noise levels exceeding 45 dBA (when measured over a period of at least 1 hour) at night. If the existing night-time ambient sound levels are already higher than 45 dBA, the development of the Emvelo WEF should not change the existing ambient sound levels with more than 3 dBA (IFC requirements, see **section 3.5.6**).

Environmental Management is mainly focusing on the night-time period as summarized in:

- **Table 13-1** for the planning phase (to ensure that noise levels are with the acceptable limits during the future operational phase:
- **Table 13-2** for night-time activities during the construction phase; and
- **Table 13-3** for the operational of the WTG.

Table 13-1: Environmental Management for planning phase

Objective: Future construction and operational noise levels should not change the existing ambient sound levels with more than 7 dBA from the existing levels, if the ambient sound levels are less than the IFC noise limits for residential use. If ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.	
Project Components:	Future construction and operational activities of WTG of the Emvelo WEF
Potential Impact:	Noise levels impacting on the quality of living of NSR
Activity/Risk source	Future construction and operational activities

Mitigation: Target	Daytime noise levels less than 52 dBA, night-time noise levels less than 45 dBA at locations used for residential purposes. If existing ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.		
Mitigation: Action / Control		**Responsibility**	**Timeframe**
Applicant to re-evaluate the noise impact once the WTG specifications and layout are finalised		Applicant	Planning phase, before development of WEF
If noise levels, after the evaluation of the selected WTG are higher than 45 dBA, the applicant must design a noise abatement programme (or define appropriate mitigation measures) that will ensure that operational noise levels are less than 45 dBA at all verified NSR;		Applicant	Planning phase, before development of WEF
Applicant to re-evaluate the noise impact should the layout be revised (as part of an amendment process post EA) where any WTG, located within 2,500 m from a confirmed NSR, are moved closer to the NSR.		Applicant	Planning phase, before development of WEF
Applicant to re-evaluate the noise impact should the layout be revised (as part of an amendment process post EA) where any new WTG are introduced within 2,500 m from an NSR		Applicant	Planning phase, before development of WEF
Applicant to re-evaluate the noise impact should the layout be revised (as part of an amendment process post EA) where the number of WTG within 2,500 m from an NSR are increased		Applicant	Planning phase, before development of WEF
Applicant to re-evaluate the noise impact should the applicant make use of a wind turbine with a maximum PWL exceeding 111.2 dBA re 1 pW		Applicant	Planning phase, before development of WEF
Applicant to plan and design a noise monitoring program at representative NSR locations where the worst-case noise rating levels exceed 42 dBA. This should include the measurement of ambient sound levels prior to the development of the WEF, followed by noise measurements once the WF is operational.		Applicant	Planning phase, before development of WEF
Performance Indicator	Calculated daytime noise levels should be less than 52 dBA, with night-time noise levels being less than 45 dBA at structures used residential purposes. If existing ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.		
Monitoring	Potential measurements of ambient sound levels at representative NSR.		

Table 13-2: Environmental Management for night-time construction activities

Objective: Construction activities should not result in daytime noise levels exceeding 52 dBA, nor night-time noise levels 45 dBA (at locations used for residential purposes). If existing ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.			
Project Components:	Day- and night-time noise levels impacting on the quality of living of NSR		
Potential Impact:	Construction activities		
Activity/Risk source	Daytime noise levels less than 52 dBA at locations used for residential purposes Night-time noise levels less than 45 dBA at locations used for residential purposes If existing ambient sound levels already exceed the IFC noise limits, introduced noises should not change the ambient sound levels with more than 3 dBA (IFC requirement)		
Mitigation: Target	Day- and night-time noise levels impacting on the quality of living of NSR		
Mitigation: Action / Control		**Responsibility**	**Timeframe**
ECO to ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures;		ECO	Ongoing during construction phase
ECO to include a component covering environmental noise in the Health and Safety Induction to sensitize all employees and contractors about the potential impact from noise;		ECO	Ongoing during construction phase
Complaints register kept on site, to register any noise complaints.		Contractor	Ongoing during construction phase
ECO to notify NSR (and/or land owner(s)) before night-time construction activities are to take place within 1,000 m from an NSR (if the structures are used for residential activities during the proposed construction period).		ECO	Construction activities within 1,000 m from NSR

Performance Indicator	Daytime noise levels less than 52 dBA, night-time noise levels less than 45 dBA at locations used for residential purposes. If existing ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.
Monitoring	Inspection of equipment by ECO. Measurement of noise levels at dwellings of NSR after noise complaints.

Table 13-3: Environmental Management for night-time operational period

Objective: Operational activities should not result in daytime noise levels exceeding 52 dBA, nor night-time noise levels 45 dBA (at locations used for residential purposes). If existing ambient sound levels exceed the IFC noise limits, the change in ambient sound levels should be less than 3 dBA.		
Project Components:	Operation of WTG within 2,500 m from structure used for residential purposes	
Potential Impact:	Noises from WTG impacting on the quality of living of NSR	
Activity/Risk source	Operation of WTG	
Mitigation: Target	Daytime noise levels from operational activities less than 52 dBA at NSR Night-time noise levels from operational activities less than 45 dBA at NSR	
Mitigation: Action / Control	**Responsibility**	**Timeframe**
Applicant to conduct noise monitoring when a reasonable and valid noise complaint are received from an NSR living within 2,500m from a WTG of the project.	EO / Applicant	Within 2 months after a noise complaint is registered
Noise monitoring to confirm that noise levels associated with operating WTG are less than 45 dBA at all NSR.	EO	During the first year once the project is operational. Noise specialist to confirm need for future measurements.
Performance Indicator	Daytime noise levels from operating WTG less than 52 dBA, with night-time noise levels due to operating WTG being less than 45 dBA	

14 CONCLUSIONS AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the noise impacts due to the proposed development, operation and decommissioning of the Emvelo WEF (and associated infrastructure) south-east of Ermelo in Mpumalanga. It is based on a predictive model to estimate potential noise levels due to the various activities and to assist in the identification of potential issues of concern.

It was determined that the potential noise impacts, without mitigation, would be:

- of a **medium significance** for the daytime construction of the access roads. Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **medium significance** for the daytime construction traffic passing NSR (one NSR). Mitigation is recommended and measures are available that could reduce this significance to **low**;
- of a **low significance** for the daytime construction activities (hard standing areas, excavation and concreting of foundations and the erecting of the WTG and other infrastructure);
- of a **medium significance** for the night-time construction activities (such as the pouring of concrete, erecting the WTG, etc.). While night-time construction is not likely, it may be required that such activities take place at night, and mitigation measures were included that would reduce the significance of the noise impact to **low**;
- of a **low significance** for the daytime operational activities;
- of a **high significance** for night-time operational activities (noises from wind turbines) at the Emvelo WEF when considering the worst-case PWL. Mitigation is available to reduce the significance of the noise impact to **low**; and
- of a **low significance** for the potential decommissioning activities.

There is a potential for a cumulative noise impact at two receptors (NSR E082 and E066).

The proposed layout (turbine placement) is considered acceptable, as reasonable mitigation measures exists to manage the medium and high significance rating (pre-mitigation). Mitigation measures could include a combination of:

- Relocating a number of NSR where noise levels could exceed the recommended noise limits (such as NSR E048, E050, E051, E038, E056, E039, E041 and/or E040; where simple mitigation measures such as serrated trailing edges may not be sufficient); and

- Reducing the noise emission levels (selecting a WTG with a lower sound PWL, using blade additions to reduce noise emission levels and potentially implementing a noise abatement plan during certain periods of time, wind speeds or meteorological conditions. Acoustic treatment of residential dwellings should only be considered after other mitigation measures were considered.

The applicant could also change the layout (locating WTG further from NSR, or reducing the number of WTG within 1,000m from NSR) to mitigate the noise impact, though the applicant should re-evaluate the noise impact should:

- the layout be revised (as part of amendment process post EA) where any WTG, located within 2,500 m from a confirmed NSR, are moved closer to the NSR;
- the layout be revised (as part of amendment process post EA) where any new WTG are introduced within 2,500m from an NSR;
- the layout be revised (as part of amendment process post EA) where the number of WTG within 2,500m from an NSR are increased; and
- the applicant selects to use a WTG with a SPL higher than 111.2 dBA (re 1 pW).

The applicant should also develop and implement an environmental noise monitoring programme at selected NSR living within the 42 dBA noise contour.

It is proposed that the applicant recommend to landowners that:

- no new residential dwellings 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 permanent residential purposed.

Therefore, considering the potential noise levels and viability of available mitigation measures, it is recommended that the Emvelo WEF be authorized (in terms of noise).

15 REFERENCES

In this report reference was made to the following documentation:

1. Ambrose, SE and Rand, RW, 2011. *The Bruce McPherson Infrasound and Low Frequency Noise Study: Adverse health effects produced by large industrial wind turbines confirmed*. Rand Acoustics, December 14, 2011.
2. Autumn, Lyn Radle, 2007: *The effect of noise on Wildlife: A literature review*
3. Atkinson-Palombo, C and Hoen, B. 2014: *Relationship between Wind Turbines and Residential Property Values in Massachusetts – A Joint Report of University of Connecticut and Lawrence Berkley National Laboratory.* Boston, Massachusetts
4. Bakker, R.H., Pedersen, E., van den Berg, G.P., Stewart, R.E., Lok,W., Bouma, J. 2012: *Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress*. Sci. Total Environ. **15** (425), 42–51
5. Barber, J.R., K.R. Crooks, and K. Fristrup. 2010. *The costs of chronic noise exposure for terrestrial organisms*. Trends Ecology and Evolution 25(3): 180–189
6. Bass JH *et al*, 1996: *Development of a wind farm noise propagation prediction model.* JH Bass, AJ Bullmore, E Sloth. Contract JOR3-CT95-0051. Renewable Energy Systems Limits, Hoare Lea & Partners Acoustics, Acoustica A/S
7. Bastasch, M; van Dam, J; Søndergaard, B; Rogers, A. 2006: *Wind Turbine Noise - An Overview*. Canadian Acoustics Vol. 34(2). pp. 7-15
8. Bayne EM *et al*, 2008: *Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest*. Conservation Biology 22(5) 1186-1193
9. Bernstein, M.H. Blease, C. Locher, C. Brown, W.A. (2024). The Nocebo Effect. Mayo Clinic Press, ISBN 9798887700243
10. Blickley, J.L. and Patricelli, G.L. 2010. *Impacts of Anthropogenic Noise on Wildlife: Research Priorities for the Development of Standards and Mitigation*. Journal of International Wildlife Law & Policy, 13:274–292.
11. Bolin et al, 2011: *Infrasound and low frequency noise from wind turbines: exposure and health effects.* Environ. Res. Lett. 6 (2011) 035103
12. Bowdler, D. 2005: *ETSU-R-97 Why it is Wrong,* Internet White Paper, New Acoustics, Dunbartonshire, Scotland, July 2005
13. Bowdler, Dick, 2008: *Amplitude modulation of wind turbine noise: a review of the evidence*
14. Bowdler, D. Bullmore, A. Davis, B. Hayes, M. Jiggens, M. Leventhall, G. McKenzie, A. 2009: *Prediction and Assessment of Wind Turbine Noise – Agreement about relevant factors for noise assessment from wind energy projects*. Acoustics, Vol 34, No 2. March/April 2009

15. Bray, W and James, R. 2011. *Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception*. Noise-Con 2011.
16. Broucek, J. 2014. *Effect of Noise on Performance, Stress and Behaviour of Animals.* Slovak J. Anim. Sci., 47, 2014 (2): 111-123
17. BWEA, 2005*: Low Frequency Noise and Wind Turbines – Technical Annex*
18. CanWEA, 2007: *Wind Turbines and Sound: Review and Best Practice Guidelines*. Canadian Wind Energy Association.
19. Chapman *et al*. 2013: *Spatio-temporal differences in the history of health and noise complaints about Australian wind farms: evidence for the psychogenic, "communicated disease" hypothesis*. Sydney School of Public Health, University of Sydney
20. Chief Medical Officer of Health, 2010: *The Potential Health Impact of Wind Turbines*, Canada
21. Conrady, K; Bolin, K; Sjöblom, A; Rutgersson, A. 2019: *Amplitude modulation of wind turbine sound in cold climates*. Applied Acoustics, Vol 158, 15 January 2020.
22. Cooper, 2012: *Are Wind Farms too close to communities*, The Acoustic Group (date posted on Wind-watch.org: Referenced on various anti-wind energy websites)
23. Cooper, S. Chan, C. 2020: *Determination of Acoustic Compliance of Wind Farms*. Acoustics **2020**, 2, 416–450; doi:10.3390/acoustics2020024
24. Council of Canadian Academies, 2015: Understanding the Evidence: Wind Turbine Noise. Ottawa (ON): The Expert Panel on Wind Turbine Noise and Human Health. Council of Canadian Academies
25. Crichton *et al*. 2014: *Can expectations produce symptoms from infrasound associated with wind turbines?. Health Psychology, Vol 33(4), Apr 2014, 360-364*
26. Crichton, F., Dodd, G., Schmid, G., Gamble, G., Cundy, T., & Petrie, K. J. (2014). The power of positive and negative expectations to influence reported symptoms and mood during exposure to wind farm sound. Health psychology : official journal of the Division of Health Psychology, American Psychological Association, 33(12), 1588–1592. https://doi.org/10.1037/hea0000037
27. CSES, 2016: *Evaluation of Directive 2002/49/EC relating to the assessment and management of environmental noise*. The Centre for Strategy & Evaluation Services, European Commission, Brussels.
28. CSIR, 2002: *Integrated Environmental Management Information Series: Information Series 5: Impact Assessment*. Issued by the Department of Environmental Affairs and Tourism, Pretoria

29. CSIR, 2015: *The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa.* Issued by the Department of Environmental Affairs and Tourism, Pretoria
30. Cummings, J. 2012: *Wind Farm Noise and Health: Lay summary of new research released in 2011*. Acoustic Ecology Institute, April 2012 (online resource: http://www.acousticecology.org/wind/winddocs/AEI_WindFarmsHealthResearch2011.pdf)
31. Cummings, J. 2009: *AEI Special Report: Wind Energy Noise Impacts*. Acoustic Ecology Institute, (online resource: http://acousticecology.org/srwind.html)
32. DEFRA, 2003: *A Review of Published Research on Low Frequency Noise and its Effects*, Report for Defra by Dr Geoff Leventhall Assisted by Dr Peter Pelmear and Dr Stephen Benton
33. DEFRA, 2007: *Research into Aerodynamic Modulation of Wind Turbine Noise: Final Report*
34. DELTA, 2008: *EFP-06 project: Low Frequency Noise from Large Wind Turbines, a procedure for evaluation of the audibility for low frequency sound and a literature study*. Danish Energy Authority
35. Derryberry EP *et al*, 2016: *Patterns of song across Natural and Anthropogenic Soundscapes suggest that White-Crowned Sparrows minimize acoustic masking and maximize signal content*. PLOS ONE| DOI: 10.1371/journal.pone.0154456, April 29, 2016
36. Dooling, R. 2002. *Avian Hearing and the Avoidance of Wind Turbines*. National Renewable Energy Laboratory, NREL/TP-500-30844
37. Dooling R. J., and A. N. Popper. 2007. *The effects of highway noise on birds*. Report to the California Department of Transportation, contract 43AO139. California Department of Transportation, Division of Environmental Analysis, Sacramento, California, USA
38. Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise
39. Duncan, E. and Kaliski, K. 2008: *Propagation Modelling Parameters for Wind Power Projects*
40. Ellenbogen, J.M., Grace, S., Heiger-Bernays,W.J., Manwell, J.F., Mills, D.A., Sullivan, K.A., Santos, S.L. 2012: *Wind Turbine Health Impact Study. Report of Independent Expert Panel*. Prepared for: Massachusetts Department of Environmental Protection. Massachusetts Department of Health
41. Enertrag, 2008: *Noise and Vibration*. Hempnall Wind Farm (http://www.enertraguk.com/technical/noise-and-vibration.html)

42. Envision, 2024: *Sound power level of the Envision Energy EN-182-8.0 Wind Turbine Generator*. Envision Energy.
43. EPA, 2009: *Wind Farms Environmental Noise Guidelines*. Environmental Protection Authority, Adelaide, South Australia (Updated November 2021)
44. EPA, 2011: *Guidance Note on Noise Assessment of Wind Turbine Operations at EPA Licences Sites (NG3).* Environmental Protection Agency, Office of Environmental Enforcement,
45. ETSU R97: 1996. '*The Assessment and Rating of Noise from Wind Farms: Working Group on Noise from Wind Turbines*'
46. Evans Tom, Cooper Jonathan, 2012: *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*. Acoustics Australia, Vol. 40, No. 1, April 2012.
47. Evans, T. Cooper, J. Lenchine, V. 2012: *Infrasound Levels near Windfarms and in other Environments. Resonate Acoustics in conjunction with Environment Protection Authority, South Australia*
48. Fégeant, O. 2002: *Masking of Wind Turbine Noise: Influence of Wind Turbulence on Ambient Noise Fluctuations*.
49. Francis, C.D. et al, 2011: Different behavioural responses to anthropogenic noise by two closely related passerine birds. Biol. Lett. (2011) 7, 850-852 doi:10.1098 / rsbl.2011.0359
50. Francis, C.D. et al, 2012: Noise pollution alters ecological services: enhanced pollination and disrupted seed dispersal. Proc. R Soc. B doi: 10.1098 / rsbl.2012.0230
51. Garrad Hassan, 2013: *Summary of results of the noise emission measurement, in accordance with IEC 61400-11, of a WTGS of the type N117/3000. Doc.* GLGH-4286 12 10220 258-S-0002-A (extract from GLGH-4286 12 10220 258-A-0002-A)
52. Gibbons, S. 2014: *Gone with the Wind: Valuing the Visual Impacts of Wind turbines through House Prices*, Spatial Economics Research Centre
53. Goldwind. 2021: *Goldwind GW165-6.0 V42R01C100 Wind Turbine Noise Manual*. Document No. GW17XW.0145. Goldwind Technology Co., Ltd (document in Chinese)
54. Goldwind. 2022: *Description of GW165-6.0 Acoustic Performance*. Document No. GSC-17AP.a0006. Beijing Goldwind Science & Creation Wind Power Equipment Co., Ltd
55. Guillaume Dutilleux. *Anthropogenic outdoor sound and wildlife: it's not just bioacoustics!*. Soci´et´e Fran¸caise d'Acoustique. Acoustics 2012, Apr 2012, Nantes, France
56. Halfwerk, W. *et al*. 2011: *Low-frequency songs lose their potency in noisy urban conditions*. PNAS, August 30, 2011, vol. 108, no. 35, 14549-14554.

57. Hanning, 2010: *Wind Turbine Noise, Sleep and Health*. (referenced on a few websites, especially anti-wind energy. No evidence that the study has been published formally.)
58. Hartley, J.C., 1991: *Can Bush Crickets Discriminate Frequency?* University of Nottingham.
59. Havas, M and Colling, D. 2011: *Wind Turbines Make Waves: Why Some Residents Near Wind Turbines Become Ill*. *Bulletin of Science Technology & Society published online 30 September 2011*
60. Helldin, J.O., Jung, J., Neumann, W., Olsson, M., Skarin, A. and Widemo, F. 2012. *The impacts of wind power on terrestrial mammals: a synthesis*. Report 6510. Swedish Environmental Protection Agency.
61. Hessler, D. 2011: *Best Practices Guidelines for Assessing Sound Emissions From Proposed Wind Farms and Measuring the Performance of Completed Projects*. Prepared for the Minnesota Public Utilities Commission, under the auspices of the National Association of Regulatory Utility Commissioners (NARUC)
62. HGC Engineering, 2006: *Wind Turbines and Infrasound*, report to the Canadian Wind Energy Association
63. HGC Engineering, 2007: *Wind Turbines and Sound*, report to the Canadian Wind Energy Association
64. HGC Engineering, 2011: *Low frequency noise and infrasound associated with wind turbine generator systems: A literature review*. Ontario Ministry of the Environment RFP No. OSS-078696.
65. IFC, 2007: '*Environmental, Health, and Safety General Guidelines*'. International Finance Corporation, Washington
66. IFC, 2015: '*Environmental, Health, and Safety Guidelines for Wind Energy*'. International Finance Corporation, Washington
67. IOA, 2013: *A good practice guide to the application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*. Institute of Acoustics.
68. ISO 9613-2: 1996. '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*'
69. Janssen, S.A., Vos, H., Eisses, A.R., Pedersen, E. 2011: *A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources*. J. Acoust. Soc. Am. **130**(6), 3746–53 (2011)
70. Jeffery *et al*, 2013: *Adverse health effects of industrial wind turbines*, Can Fam Physician, 2013 May. 59(5): 473-475
71. Journal of Acoustical Society of America, 2009: *Response to noise from modern wind farms in the Netherlands*
72. Kaliski K & Duncan E, 2008: *Propagation modelling Parameters for Wind Power Projects.*

73. Kaliski K & Wilson DK. 2011: *Improving predictions of wind turbine noise using PE modelling*. Noise-con 2011.
74. Kamperman GW & James RR, 2008: *The "How to" guide to siting wind turbines to prevent health risks from sound*
75. Karwowska, M. *et al*. 2015: *The effect of varying distances from the wind turbine on meat quality of growing-finishing pigs*. Ann. Anim. Sci., Vol. 15, No. 4 (2015) 1043–1054 DOI: 10.1515/aoas-2015-0051
76. Knopper, L.D., Ollson, C.A.,McCallum, L.C.,Whitfield Aslund, M.L., Berger, R.G., Souweine, K., McDaniel, M. 2014: *Wind turbines and human health*. Front. Public Health **19**(2), 63
77. Kroesen & Schreckenberg, 2011. *A measurement model for general noise reaction in response to aircraft noise*. J. Acoust. Soc. Am. 129 (1), January 2011, 200-210
78. Lohr, B. Wright, TF. Dooling, RJ. 2003: *Detection and discrimination of natural calls in masking noise by birds: estimating the active space of a signal*. Animal Behavior 65:763-777
79. Łopucki, R. Klich, D. Gielarek, S. 2016: *Do terrestrial animals avoid areas close to turbines in functioning wind farms in agricultural landscapes?* Environ Monit Assess (2016) 188:122
80. McCunney, R.J., Mundt, K.A., Colby, W.D., Dobie, R., Kaliski, K.,Blais, M. 2014: *Wind turbines and health: a critical review of the scientific literature*. J. Occup. Environ. Med. **56**(11), e108–30
81. McMurtry RY, 2011: *Toward a Case Definition of Adverse Health Effects in the Environs of Industrial Wind Turbines: Facilitating a Clinical Diagnosis*. Bulletin of Science Technology Society. August 2011 vol. 31 no. 4 316-320
82. MDEP: Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health. Wind Turbine Health Impact Study: Report of Independent Expert Panel
83. Merlin, T., Newton, S., Ellery, B., Milverton, J., Farah, C. 2013: Systematic review of the human health effects of wind farms. National Health & Medical Research Council, Canberra
84. Miedema, H.M., Vos, H. 2003: *Noise sensitivity and reactions to noise and other environmental conditions*. J. Acoust. Soc. Am. **113**(3), 1492–504
85. Michaud, D.S., Keith, S.E., Feder, K., Voicescu, S.A., Marro, L., Than, J., Guay,M., Bower, T., Denning, A., Lavigne, E., Whelan, C. 2016: *Personal and situational variables associated with wind turbine noise annoyance*. J. Acoust. Soc. Am. **139**(3), 1455–66

86. Mikolajczak, J. *et al*. 2013: *Preliminary studies on the reaction of growing geese (Anser anser f. domestica) to the proximity of wind turbines*. Pol J Vet Sci. 2013;16(4):679-86. doi: 10.2478/pjvs-2013-0096.
87. Minnesota Department of Health, 2009: *Public Health Impacts of Wind Farms*
88. Ministry of the Environment, 2008: *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*
89. Møller H, 2010: *Low-frequency noise from large wind turbines*. J. Acoust. Soc. Am, 129(6), June 2011, 3727 - 3744
90. NARUC, 2011: *Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects*. National Association of Regulatory Utility Commissioners. US Department of Energy
91. Nissenbaum A, 2012: *Effects of industrial wind turbine noise on sleep and health*. Noise and Health, Vol. 14, Issue 60, p 237 – 243.
92. Noise-con, 2008: *Simple guidelines for siting wind turbines to prevent health risks*
93. Noise quest, Aviation Noise Information &Resources, 2010: https://www.noisequest.psu.edu/noiseeffects-animals.html
94. Nordex, 2021: Octave Sound Power Levels, Nordex N163 6/X. Nordex Energy SE & Co, Hamburg. Report F008_277_A19_IN, Revision 02, 2021-11-08
95. Norton, M.P. and Karczub, D.G.: *Fundamentals of Noise and Vibration Analysis for Engineers*, Second Edition, 2003
96. O'Neal, *et al*. 2011: *Low frequency noise and infrasound from wind turbines*. Noise Control Eng. J. 59 (2), March-April 2011
97. Ortega, CP. 2012. *Ornithological Monographs. Chapter 2: Effects of noise pollution on birds: A brief review of our knowledge*. 74(1), pp.6-22.
98. Oud, M. 2012: *Low-frequency noise: a biophysical phenomenon* (http://www.leefmilieu.nl/sites/www3.leefmilieu.nl/files/imported/pdf_s/2012_OudM_Low-frequency%20noise_0.pdf) (unpublished webresource)
99. Parnell, J. 2015: "*The Generation and propagation of noise from large coal mines, and how it is managed in NSW*". NSW Department of Planning and Environment, Sydney NSW, Australia
100. Parris, M. Schneider, A. 2009: *Impacts of traffic noise and traffic volume on birds of roadside habitats*. Ecology and Society 14(1): 29
101. Parry, G. 2008: *A review of the use of different noise prediction models for wind farms and the effects of meteorology*. The Journal of the Acoustical Society of America **123**, 3535 (2008); https://doi.org/10.1121/1.2934501
102. Pedersen, T. H. 2007: *The "Genlyd" Noise Annoyance Model*. DELTA report AV 1102/07

103. Pedersen, E., Hallberg, L.M., Persson, W.K. 2007: *Living in the vicinity of wind turbines—a grounded theory study*. Qual. Res. Psychol. **4**(1–2), 49–63
104. Pedersen, Eja; Halmstad, Högskolan I, 2003: '*Noise annoyance from wind turbines: a review'*. Naturvårdsverket, Swedish Environmental Protection Agency, Stockholm
105. Pedersen, E. 2011: "*Health aspects associated with wind turbine noise—Results from three field studies",* Noise Control Eng. J. 59 (1), Jan-Feb 2011
106. Phillips, CV, 2011: *"Properly Interpreting the Epidemiologic Evidence About the Health Effects of Industrial Wind Turbines on Nearby Residents"*. Bulletin of Science Technology & Society 2011 31: 303 DOI: 10.1177/0270467611412554
107. Pierpont, N. 2009: *"Wind Turbine Syndrome: A Report on a Natural Experiment",* K Select Books, 2009
108. Punch, *et al*. 2010: *Wind Turbine Noise. What Audiologists should know.* Audiology Today. JulAug2010
109. Quinn, J.L., M.J. Whittingham, S.J. Butler, and W. Cresswell. 2006*. Noise, predation risk compensation and vigilance in the chaffinch Fringilla coelebs*. Journal of Avian Biology 37: 601-608
110. Rabin, L.A., R.G. Coss, D.H. Owings. 2006. *The effects of wind turbines on antipredator behavior in California ground squirrels (Spermophilus beecheyi)*. Biological Conservation 131: 410-420
111. Renewable Energy Research Laboratory, 2006: *Wind Turbine Acoustic Noise*
112. RenewableUK, 2013: *Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect.*
113. SANS 10103:2008. '*The measurement and rating of environmental noise with respect to annoyance and to speech communication*'.
114. SANS 10210:2004. '*Calculating and predicting road traffic noise*'.
115. SANS 10328:2008. '*Methods for environmental noise impact assessments*'.
116. SANS 10357:2004. *The calculation of sound propagation by the Concave method*'.
117. Saurenman, H. Chambers, J. Sutherland, LC. Bronsdon, RL. Forschner, H. 2005: "*Atmospheric effects associated with highway noise propagation*". Final Report 555. Arizona Department of Transportation, US Dept of Transport. Federal Highway Administration
118. Schaub, A, J. Ostwald and B.M. Siemers. 2008. "*Foraging bats avoid noise*". The Journal of Experimental Biology 211: 3174-3180
119. Schmidt, J.H., Klokker,M. 2014: Health effects related to wind turbine noise exposure: a systematic review. PLoS ONE **9**(12), e114183
120. Šottník, J. 2011: Influence of noise and object noisiness on animal breeding.. Šiška, B. – Hauptvogl, M. – Eliašová, M. (eds.). Bioclimate: Source and Limit of Social

Development International Scientific Conference, 6th – 9th September 2011, Topoľčianky, Slovakia

121. Shannon, G., McKenna, M.F., Angeloni, L.M., Crooks, K.R., Fristrup, K.M., Brown, E., Warner, K.A., Nelson, M.D., White, C., Briggs, J., McFarland, S. and Wittemyer, G. 2015. *A synthesis of two decades of research documenting the effects of noise on wildlife*. Biological Reviews.
122. Sheperd, D and Billington, R. 2011: *Mitigating the Acoustic Impacts of Modern Technologies: Acoustic, Health, and Psychosocial Factors Informing Wind Farm Placement*. *Bulletin of Science Technology & Society* published online 22 August 2011, DOI: 10.1177/0270467611417841
123. Shepherd. D *et al*. 2011: *Evaluating the impact of wind turbine noise on health related quality of life*. Noise & Health, September-October 2011, 13:54,333-9.
124. Smith. M (*et al*) (2012): "*Mechanisms of amplitude modulation in wind turbine noise*"; Proceedings of the Acoustics 2012 Nantes Conference
125. Stigwood, M. Large, S. Stigwood, D. 2013: "*Audible amplitude modulation – results of field measurements and investigations compared to psycho-acoustical assessments and theoretical research*"; Paper presented at the 5th International Conference on Wind Turbine Noise, Denver 28 – 30 August 2013
126. Superior Health Council, 2013: *Public health effects of siting and operating onshore wind turbines*. Publication of the Superior Health Council No. 8738
127. Szymański, P. *et al*. 2017: *The song of Skylarks Alauda arvensis indicates the deterioration of an acoustic environment resulting from wind farm start-up*. https://doi.org/10.1111/ibi.12514
128. Tachibana, H (*et al*) (2013): "*Assessment of wind turbine noise in immission areas*"; Paper presented at the 5th International Conference on Wind Turbine Noise, Denver 28 – 30 August 2013
129. The Scottish Government, 2011. Planning Advice Note PAN 1/2011: Planning and Noise. https://www.gov.scot/publications/planning-advice-note-1-2011-planning-noise/pages/5/
130. Thorne et al, 2010: *Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1*
131. Thorne, 2010: *The Problems with "Noise Numbers" for Wind Farm Noise Assessment*. Bulletin of Science Technology and Society, 2011 31: 262
132. UK Department for Communities and Local Government, 2013: Planning practice guidance for renewable and low carbon energy. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/225689/Planning_Practice_Guidance_for_Renewable_and_Low_Carbon_Energy.pdf

133. USEPA, 1971: *Effects of Noise on Wildlife and other animals*.
134. Van den Berg, G.P., 2003. '*Effects of the wind profile at night on wind turbine sound'.* Journal of Sound and Vibration
135. Van den Berg, G.P., 2004. *'Do wind turbines produce significant low frequency sound levels?'*. 11th International Meeting on Low Frequency Noise and Vibration and its Control
136. Van den Berg, F., Pedersen, E., Bouma, J., Bakker, R. 2008: *Visual and acoustic impact of wind turbine farms on residents*. Final Rep.
137. Van den Berg, F., Verhagen, C., Uitenbroek, D. 2014: The relation between scores on noise annoyance and noise disturbed sleep in a public health survey. Int. J. Environ. Res. Public Health **11**(2), 2314–27
138. Van Kamp, I., Davies, H. 2013: Noise and health in vulnerable groups: a review. Noise Health **15**(64), 153
139. Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis. 1998. *Environmental potential atlas for South Africa*. J.L. van Schaik, Pretoria
140. Vestas, 2017: '*V150-4.0 MW Third Octave Noise Emissions*'. DMS no.: 0067-4767_00, Vestas Wind Systems A/S, Denmark
141. Vestas, 2022: 'Performance Specification - *V162-7.2 MW 50/60 Hz*'. DMS no.: 0114-3777 V04, Vestas Wind Systems A/S, Denmark
142. Wang, Z. 2011: *Evaluation of Wind Farm Noise Policies in South Australia: A Case Study of Waterloo Wind Farm*. Masters Degree Research Thesis, Adelaide University 2011
143. Whitford, Jacques, 2008: *Model Wind Turbine By-laws and Best Practices for Nova Scotia Municipalities*
144. World Health Organization, 1999: *Protection of the Human Environment; Guidelines for Community Noise*
145. World Health Organization, 2009: *Night Noise Guidelines for Europe*
146. World Health Organization, 2018: *Environmental Noise Guidelines for the European Region*
147. WSP, 2016: *Wind Turbine AM Review – Phase 2 Report*. WSP Parsons Brinckerhoff for the Department of Energy and Climate Change
148. Zwart, M.C *et al.* 2014: *Wind farm noise suppresses territorial defense behavior in a songbird*. Behavioral Ecology arv128(1), July 2014

APPENDIX A

Curriculum Vitae

Details for the Author are:

Author:	Morné de Jager
Company:	Enviro-Acoustic Research cc
Website:	http://www.eares.co.za
Email:	morne@eares.co.za
Office number:	012 004 0362
Mobile number:	082 565 4059
Qualifications:	B. Ing (Chemical Engineering) [Pretoria University]
Membership(s):	SACNASP (South African Council for Natural Scientific Professions) - 117253 SAIOSH (SA Institute of Occupation Safety & Health) - 72765282 NACA (National Association for Clean Air) ASA (Acoustical Society of America)

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc.] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Use License Applications and EIA's), auditing of license conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 20 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental

Noise Measurement, Prediction and Control as well as blasting impacts. Since 2007 he has completed more than 500 Environmental Noise Impact Assessments and Noise Monitoring Reports as well as various acoustic consulting services, including amongst others:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for - Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Isivunguvungu (Aurecon), De Aar (Aurecon), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Kokerboom 3 (Aurecon), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee (ARCUS), Kolkies (ARCUS), San Kraal (ARCUS), Phezukomoya (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Scarlet Ibis (CESNET), Albany (CESNET), Sutherland (CSIR), Kap Vley (CSIR), Kuruman (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Perdekraal (ERM), Teekloof (Mainstream), Eskom Aberdene (SE), Dorper (SE), Spreeukloof (SE), Loperberg (SE), Penhoek Pass (SE), Amakhala Emoyeni (SE), Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), Namas (SE), Zonnequa (SE), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Iziduli (SE), Msenge (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Boulders (SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab), Wobben (IWP), Trakas (SiVest), Beaufort West (SiVest)*
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo), Royal Sheba Project (Cabanga Environmental), Rietkol Silica (Jacana), Gruisfontein Colliery (Jacana), Lehlabile Colliery (Jaco-K Consulting), Bloemendal Colliery (Enviro-Insight), Rondevly Colliery (REC), Welgedacht Colliery (REC), Kalabasfontein Extension (EIMS), Waltloo Power Generation Project (EScience), Buffalo Colliery (Marang), Balgarthen Colliery (Rayten), Kusipongo Block C (Rayten), Zandheuvel (Exigo), NamPower Walvis Bay (GPT), Eloff Phase 3 (EIMS), Dunbar (Enviro-Insight), Smokey Hills (Prescali), Bierspruit (Aurecon)*

Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental), Riverfarm Development (Terramanzi), Conakry to Kindia Toll Road (Rayten)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm (Globeleq), Sephaku Aganang (Exigo), Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Bank of Botswana measurements (Linnspace), Skukuza Noise Measurements (Concor), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream), Twisdraai Colliery (Lefatshe Minerals), SASOL Prospecting (Lefatshe Minerals), South32 Klipspruit (Rayten), Sibanye Stillwater Kroondal (Rayten), Rooiberg Asphalt (Rooiberg Asphalt), SASOL Shondoni (Lefatshe), SASOL Twisdraai (Lefatshe), Anglo Mototolo (Exigo), Heineken Inyaniga (AECOM), Glencore Izimbiwa (Cleanstream) Glencore Impunzi (Cleanstream), Black Chrome Mine (Prescali) Sibanye Stillwater Ezulwini (Aurecon), Sibanye Stillwater Beatrix (Aurecon), Bank of Botshwana (Linspace), Lakeside (Linspace), Skukuza (SiVest), Rietvlei Colliery (Jaco-K Consulting)*
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering), Tiegerpoort Wedding Venue (Henwood Environmental), Monavoni Development (Marindzini), Rezoning of Portion 1 (Primo Properties), Tswaing Mega City (Makole), Mabopane Church (EP Architects), ERGO Soweto Cluster (Kongiwe), Fabio Chains (Marang), GIDZ JMP (Marang), Temple Complex (KWP Create), Germiston Metals (Dorean), Sebenza Metals (Dorean)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma Community Wind Farm Noise Simulation project (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (SE), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy), De Aar WEF (Holland), Quarterly Measurement Reports – Dangote Delmas (Exigo), Quarterly Measurement Reports – Dangote Lichtenburg (Exigo), Quarterly Measurement Reports – Mamba Cement (Exigo), Quarterly Measurement Reports – Dangote Delmas*



(Exigo) Quarterly Measurement Reports – Nokeng Fluorspar (Exigo), Proton Energy Limited Nigeria (ERM), Hartebeest WEF Update (Moorreesburg) (Savannah Environmental), Modderfontein WEF Opinion (Terramanzi), IPD Vredenburg WEF (IPD Power Vredenburg), Paul Puts WEF (ARCUS), Juno WEF (ARCUS), etc.

APPENDIX B

Glossary of Terms

GLOSSARY OF ACOUSTIC TERMS, DEFINITIONS AND GENERAL INFORMATION

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or

	(ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.

F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} and L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.

Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e., A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.

Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micro pascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX C

Site Sensitivity Verification

SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Site sensitivity verification is required for All environmental themes as identified by the online screening tool (whether a protocol has been published or not).

Section 2 of the Noise Protocol in terms of this GNR320 requires that:

2. Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool must be confirmed by undertaking a site sensitivity verification.

2.1. The site sensitivity verification must be undertaken by an environmental assessment practitioner (EAP) or a noise specialist, where noise specialist means someone with relevant academic qualifications and with expertise in the domain of acoustic assessments and noise management.

2.2. The site sensitivity verification must be undertaken through the use of:

(a) a desktop analysis, using satellite imagery;

(b) a preliminary on-site inspection; and

(c) any other available and relevant information.

2.3. The outcome of the site sensitivity verification must be recorded in the form of a report that:

(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool, such as new developments or infrastructure etc.;

(b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and

(c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations

The details of the specialist that visited the site are noted below:

Date of Site Visit	7 and 9 June 2023 (Francois de Vries) 11, 12 and 19 September 2023
Specialist Name	Morné de Jager (Noise)
Professional Registration Number (if applicable)	SACNASP (South African Council for Natural Scientific Professions) - 117253 SAIOSH (SA Institute of Occupation Safety & Health) - 72765282
Specialist Affiliation / Company	Enviro-Acoustic Research CC

Output from National Environmental Screening Tool

The site was initially assessed using the National Environmental Screening tool, available at, https://screening.environment.gov.za. The output from the National Online Screening tool indicates a number of areas within, and up to 2,000 m from the project boundary is considered to be of a "very high" sensitivity to noise. These potentially "very high" sensitive areas (in terms of noise) are indicated on **Figures C.1** together with the potential noise-sensitive receptors as identified after the site visit.

Description on how the site sensitivity verification was undertaken

The site sensitivity was verified using:

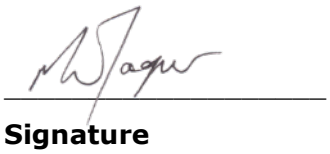
a) *available aerial images (Google Earth®) (See **Figure C.1** for identified potential noise-sensitive receptors);*
b) *the statuses of these structures were verified during the site visit done in June 2023 and September 2023.*

Outcome of the Site Sensitivity Verification

Based on the site sensitivity verification there are a number of residential structures associated with the areas identified to have a "very high" sensitivity to noise located within the project focus area. The site sensitivity verification agrees with the findings of the online screening tool for the areas marked with green dots in **Figure C.1**.

There are a number of areas identified to have a "very high" sensitivity to noise, though there are no noise-sensitive activities associated with these areas. This site sensitivity verification therefore disputes the finding of the online screening tool for these areas.

Because of the number of receptors staying near, or in the vicinity of the Emvelo WEF project area, the potential impact from noise from the project is assessed in this Noise Specialist Study.



Signature
Morné de Jager
2025 – 05 – 20

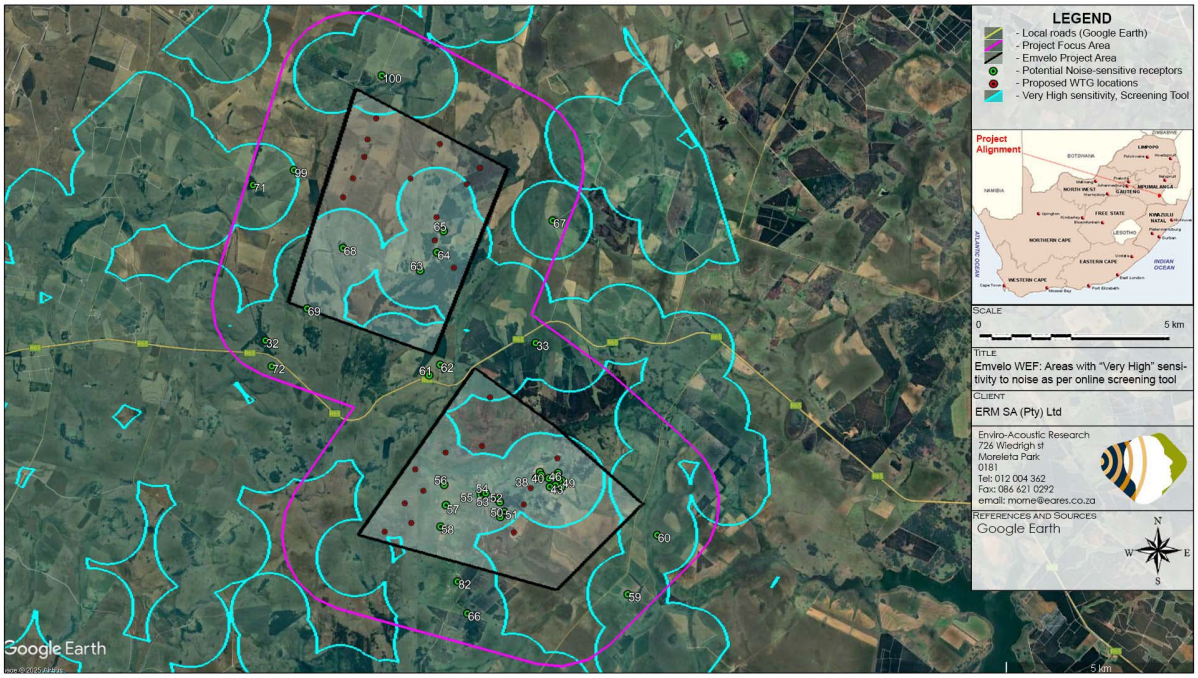


Figure C.1: Areas defined to be of "Very High" sensitivity in terms of noise by the online screening tool

APPENDIX D

Photos of Measurement Location





Photo D.1: Measurement location at EMAWCLTSL01





Photo D.2: Measurement location at EMAWCLTSL02



Photo D.3: Measurement location at EMAWCLTSL03





Photo D.4: Measurement location at EMAWCLTSL04





Photo D.5: Measurement location at EMAWCLTSL05





Photo D.6: Measurement location at EMAWCLTSL06

APPENDIX E

Calculated conceptual noise levels

Appendix E, Table 1: Noise-sensitive receptors and their statuses

NSR	WGS-84		UTM-36S		Distance from closest WTG (m)	Comment
	Longitude	Latitude	X	Y		
E032	30.28435	-26.5653	229476.9	7058837	4220	No access, not visited
E033	30.35553	-26.566	236572.3	7058918	1767	Assumed residential
E038	30.35565	-26.5977	236657	7055397	629	Assumed residential
E039	30.35666	-26.5964	236754	7055550	673	Assumed residential
E040	30.35702	-26.597	236792	7055475	708	Assumed residential
E041	30.35716	-26.5976	236807	7055411	699	Assumed residential
E042	30.35901	-26.5978	236992	7055393	694	Assumed residential
E043	30.35927	-26.5998	237022	7055174	661	Assumed residential
E044	30.36078	-26.5995	237172	7055216	809	Assumed residential
E045	30.36226	-26.5999	237320	7055172	892	Assumed residential
E046	30.36163	-26.5985	237254	7055329	729	Assumed residential
E047	30.36103	-26.5972	237192	7055464	592	Assumed residential
E048	30.36145	-26.5966	237232	7055538	519	Assumed residential
E049	30.36238	-26.5983	237329	7055344	724	Assumed residential
E050	30.34623	-26.6069	235739	7054359	541	Assumed residential
E051	30.34729	-26.6057	235842.3	7054494	595	Assumed residential
E052	30.34611	-26.6034	235719	7054746	765	Assumed residential
E053	30.34533	-26.6027	235640	7054827	843	Assumed residential
E054	30.34236	-26.6013	235341	7054973	1156	Assumed residential
E055	30.3411	-26.6017	235216	7054927	1268	Assumed residential
E056	30.33145	-26.5993	234249	7055168	669	Assumed residential
E057	30.3319	-26.6041	234305	7054639	695	Assumed residential
E058	30.33045	-26.6092	234173	7054073	927	Assumed residential
E059	30.37979	-26.6251	239124	7052410	3395	Assumed residential
E060	30.38755	-26.6112	239865	7053972	3385	Assumed residential
E061	30.32749	-26.5735	233795	7058018	1777	Assumed residential
E062	30.33041	-26.5711	234080	7058298	1621	Assumed residential
E066	30.33751	-26.6297	233503	7060748	2441	Assumed residential
E067	30.36001	-26.5371	233932	7061231	2322	Assumed residential
E068	30.30483	-26.5436	234097	7061788	1305	Assumed residential
E069	30.29534	-26.5578	234923.3	7051821	3020	Assumed residential
E071	30.28108	-26.5287	236953	7062123	2353	Assumed residential
E072	30.28601	-26.5714	231467	7061290	4757	Assumed residential
E082	30.33498	-26.6221	230555	7059694	1954	Assumed residential
E099	30.29188	-26.5252	229065	7062888	1451	Assumed residential
E100	30.31502	-26.503	229657	7058167	959	Assumed residential

Appendix E, Table 2: Projected noise rating levels and daytime significance – Construction of Access Roads at the Emvelo WEF

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case access road construction scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E42	45	43.3	61.2	18.0	Very High	Temporary	Local	Likely	**Medium**
E41	45	43.3	54.7	11.7	Very High	Temporary	Local	Likely	**Medium**
E71	45	43.3	51.9	9.2	High	Temporary	Local	Likely	**Medium**
E61	45	43.3	51.8	9.1	High	Temporary	Local	Likely	**Medium**
E48	45	43.3	51.6	8.9	High	Temporary	Local	Likely	**Medium**
E40	45	43.3	51.2	8.6	High	Temporary	Local	Likely	**Medium**
E47	45	43.3	50.7	8.2	High	Temporary	Local	Likely	**Medium**
E51	45	43.3	49.4	7.1	High	Temporary	Local	Possible	**Low**
E72	45	43.3	48.8	6.6	Moderate	Temporary	Local	Possible	**Low**
E43	45	43.3	48.4	6.3	Moderate	Temporary	Local	Possible	**Low**
E38	45	43.3	48.3	6.2	Moderate	Temporary	Local	Possible	**Low**
E39	45	43.3	47.7	5.8	Moderate	Temporary	Local	Possible	**Low**
E50	45	43.3	47.1	5.4	Moderate	Temporary	Local	Possible	**Low**
E82	45	43.3	45.9	4.6	Low	Temporary	Local	Possible	**Low**
E46	45	43.3	45.6	4.3	Low	Temporary	Local	Possible	**Low**
E33	45	43.3	45.5	4.3	Low	Temporary	Local	Possible	**Low**
E44	45	43.3	45.4	4.2	Low	Temporary	Local	Possible	**Low**
E49	45	43.3	44.3	3.6	Low	Temporary	Local	Improbable	**Low**
E32	45	43.3	43.9	3.4	Low	Temporary	Local	Improbable	**Low**
E59	45	43.3	43.3	3.0	Low	Temporary	Local	Improbable	**Low**
E66	45	43.3	42.4	2.6	Minor	Temporary	Local	Improbable	**Low**
E45	45	43.3	42.0	2.4	Minor	Temporary	Local	Improbable	**Low**
E52	45	43.3	41.9	2.4	Minor	Temporary	Local	Improbable	**Low**
E62	45	43.3	41.1	2.1	Minor	Temporary	Local	Improbable	**Low**
0	45	43.3	0.0	0.0	Minor	Temporary	Local	Improbable	**Low**
0	45	43.3	0.0	0.0	Minor	Temporary	Local	Improbable	**Low**
0	45	43.3	0.0	0.0	Minor	Temporary	Local	Improbable	**Low**

Appendix E, Table 3: Projected noise rating levels and daytime significance – Construction traffic for Emvelo WEF

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted, low wind)	Projected Noise Level, Worst-case construction traffic scenario	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E42	45	43.3	51.1	8.5	High	Short-term	Local	Likely	**Medium**
E41	45	43.3	47.8	5.9	Moderate	Short-term	Local	Possible	**Low**
E71	45	43.3	41.4	2.2	Minor	Short-term	Local	Improbable	**Low**
E61	45	43.3	41.4	2.2	Minor	Short-term	Local	Improbable	**Low**
E48	45	43.3	41.3	2.1	Minor	Short-term	Local	Improbable	**Low**
E40	45	43.3	41.1	2.1	Minor	Short-term	Local	Improbable	**Low**
E47	45	43.3	40.9	2.0	Minor	Short-term	Local	Improbable	**Low**
E51	45	43.3	40.2	1.7	Minor	Short-term	Local	Improbable	**Low**
E72	45	43.3	39.9	1.6	Minor	Short-term	Local	Improbable	**Low**
E43	45	43.3	39.7	1.6	Minor	Short-term	Local	Improbable	**Low**
E38	45	43.3	39.7	1.6	Minor	Short-term	Local	Improbable	**Low**
E39	45	43.3	39.3	1.5	Minor	Short-term	Local	Improbable	**Low**
E50	45	43.3	39.1	1.4	Minor	Short-term	Local	Improbable	**Low**
E82	45	43.3	38.5	1.2	Minor	Short-term	Local	Improbable	**Low**
E46	45	43.3	38.3	1.2	Minor	Short-term	Local	Improbable	**Low**
E33	45	43.3	38.3	1.2	Minor	Short-term	Local	Improbable	**Low**
E44	45	43.3	38.2	1.2	Minor	Short-term	Local	Improbable	**Low**
E49	45	43.3	37.6	1.1	Minor	Short-term	Local	Improbable	**Low**
E32	45	43.3	37.4	1.0	Minor	Short-term	Local	Improbable	**Low**
E59	45	43.3	37.1	1.0	Minor	Short-term	Local	Improbable	**Low**
E66	45	43.3	36.7	0.9	Minor	Short-term	Local	Improbable	**Low**
E45	45	43.3	36.5	0.8	Minor	Short-term	Local	Improbable	**Low**
E52	45	43.3	36.4	0.8	Minor	Short-term	Local	Improbable	**Low**
E62	45	43.3	36.1	0.8	Minor	Short-term	Local	Improbable	**Low**

Appendix E, Table 4: Projected construction noise rating levels and daytime significance - Emvelo WEF

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - daytime rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E048	45	43.3	38.8	1.3	Minor	Short-term	Local	Improbable	Low
E050	45	43.3	43.5	3.1	Low	Short-term	Local	Improbable	Low
E047	45	43.3	39.7	1.6	Minor	Short-term	Local	Improbable	Low
E051	45	43.3	44.2	3.5	Low	Short-term	Local	Improbable	Low
E038	45	43.3	43.5	3.1	Low	Short-term	Local	Improbable	Low
E043	45	43.3	45.6	4.3	Low	Short-term	Local	Possible	Low
E056	45	43.3	41.1	2.1	Minor	Short-term	Local	Improbable	Low
E039	45	43.3	44.0	3.4	Low	Short-term	Local	Improbable	Low
E042	45	43.3	44.6	3.7	Low	Short-term	Local	Improbable	Low
E057	45	43.3	38.3	1.2	Minor	Short-term	Local	Improbable	Low
E041	45	43.3	45.4	4.2	Low	Short-term	Local	Possible	Low
E040	45	43.3	44.5	3.7	Low	Short-term	Local	Improbable	Low
E049	45	43.3	37.3	1.0	Minor	Short-term	Local	Improbable	Low
E046	45	43.3	39.4	1.5	Minor	Short-term	Local	Improbable	Low
E052	45	43.3	42.6	2.7	Minor	Short-term	Local	Improbable	Low
E044	45	43.3	39.8	1.6	Minor	Short-term	Local	Improbable	Low
E053	45	43.3	42.0	2.4	Minor	Short-term	Local	Improbable	Low
E045	45	43.3	38.4	1.2	Minor	Short-term	Local	Improbable	Low
E058	45	43.3	37.9	1.1	Minor	Short-term	Local	Improbable	Low
E100	45	43.3	39.4	1.5	Minor	Short-term	Local	Improbable	Low
E054	45	43.3	40.3	1.8	Minor	Short-term	Local	Improbable	Low
E055	45	43.3	38.8	1.3	Minor	Short-term	Local	Improbable	Low
E068	45	43.3	36.5	0.8	Minor	Short-term	Local	Improbable	Low
E099	45	43.3	36.8	0.9	Minor	Short-term	Local	Improbable	Low

Appendix E, Table 5: Projected construction noise rating levels and night-time significance - Emvelo WEF

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, Rural)	Potential Existing Ambient Sound Levels (long-term average - Fast-weighted)	Projected Noise Level	Change in rating level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E048	35	37.3	38.8	3.8	Low	Short-term	Regional	Possible	Low
E050	35	37.3	43.5	7.2	High	Short-term	Regional	Possible	Low
E047	35	37.3	39.7	4.4	Low	Short-term	Regional	Possible	Low
E051	35	37.3	44.2	7.7	High	Short-term	Regional	Possible	Low
E038	35	37.3	43.5	7.2	High	Short-term	Regional	Possible	Low
E043	35	37.3	45.6	8.9	High	Short-term	Regional	Likely	Medium
E056	35	37.3	41.1	5.3	Moderate	Short-term	Regional	Possible	Low
E039	35	37.3	44.0	7.6	High	Short-term	Regional	Possible	Low
E042	35	37.3	44.6	8.1	High	Short-term	Regional	Possible	Low
E057	35	37.3	38.3	3.6	Low	Short-term	Regional	Improbable	Low
E041	35	37.3	45.4	8.8	High	Short-term	Regional	Likely	Medium
E040	35	37.3	44.5	8.0	High	Short-term	Regional	Possible	Low
E049	35	37.3	37.3	3.0	Low	Short-term	Regional	Improbable	Low
E046	35	37.3	39.4	4.2	Low	Short-term	Regional	Possible	Low
E052	35	37.3	42.6	6.5	Moderate	Short-term	Regional	Possible	Low
E044	35	37.3	39.8	4.5	Low	Short-term	Regional	Possible	Low
E053	35	37.3	42.0	6.0	Moderate	Short-term	Regional	Possible	Low
E045	35	37.3	38.4	3.6	Low	Short-term	Regional	Improbable	Low
E058	35	37.3	37.9	3.3	Low	Short-term	Regional	Improbable	Low
E100	35	37.3	39.4	4.2	Low	Short-term	Regional	Possible	Low
E054	35	37.3	40.3	4.8	Low	Short-term	Regional	Possible	Low
E055	35	37.3	38.8	3.8	Low	Short-term	Regional	Possible	Low
E068	35	37.3	36.5	2.6	Minor	Short-term	Regional	Improbable	Low
E099	35	37.3	36.8	2.8	Minor	Short-term	Regional	Improbable	Low

Appendix E, Table 6: Projected operational noise rating levels and daytime significance - Emvelo WEF (PWL of 111.2 dBA re 1 pW)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, IFC/WHO)	Potential Existing Ambient Sound Levels (Estimated considering an 8m/s wind speed)	Projected Noise Level (average expected) - dBA	Projected Noise Level (worst-case, few times per year at most) - dBA	Change in rating level (considering the worst-case noise rating levels)	Potential Low-frequency Noise Level - dBG	Potential Low-frequency Noise Level issues - dBC - dBA	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E048	55	41.5	45.7	47.7	7.1	65.3	10.8	High	Long-term	Local	Possible	Low
E050	55	41.5	46.3	48.2	7.5	66	10.9	High	Long-term	Local	Possible	Low
E047	55	41.5	44.9	47.0	6.6	64.8	10.9	Moderate	Long-term	Local	Possible	Low
E051	55	41.5	46.3	48.3	7.6	66.1	10.9	High	Long-term	Local	Possible	Low
E038	55	41.5	45.5	47.5	7.0	65.4	11	High	Long-term	Local	Possible	Low
E043	55	41.5	44.8	46.8	6.4	64.8	11	Moderate	Long-term	Local	Possible	Low
E056	55	41.5	45.2	47.1	6.7	64.9	10.9	Moderate	Long-term	Local	Possible	Low
E039	55	41.5	45.2	47.2	6.7	65.2	11.1	Moderate	Long-term	Local	Possible	Low
E042	55	41.5	45.0	47.0	6.6	64.9	11	Moderate	Long-term	Local	Possible	Low
E057	55	41.5	44.8	46.8	6.4	65	11.2	Moderate	Long-term	Local	Possible	Low
E041	55	41.5	45.3	47.3	6.8	65.2	11	Moderate	Long-term	Local	Possible	Low
E040	55	41.5	45.2	47.2	6.7	65.2	11	Moderate	Long-term	Local	Possible	Low
E049	55	41.5	43.6	45.7	5.6	63.9	11.1	Moderate	Long-term	Local	Possible	Low
E046	55	41.5	43.8	45.9	5.7	64.1	11.2	Moderate	Long-term	Local	Possible	Low
E052	55	41.5	44.7	46.8	6.4	65	11.2	Moderate	Long-term	Local	Possible	Low
E044	55	41.5	43.9	45.9	5.7	64.1	11.2	Moderate	Long-term	Local	Possible	Low
E053	55	41.5	44.2	46.3	6.0	64.6	11.3	Moderate	Long-term	Local	Possible	Low
E045	55	41.5	42.9	45.0	5.1	63.4	11.3	Moderate	Long-term	Local	Possible	Low
E058	55	41.5	43.4	45.5	5.5	64	11.4	Moderate	Long-term	Local	Possible	Low
E100	55	41.5	41.1	43.2	3.9	62.1	11.7	Low	Long-term	Local	Improbable	Low
E054	55	41.5	42.9	45.0	5.1	63.7	11.6	Moderate	Long-term	Local	Possible	Low
E055	55	41.5	42.8	45.0	5.1	63.7	11.6	Moderate	Long-term	Local	Possible	Low
E068	55	41.5	39.3	41.4	3.0	61.1	12.3	Minor	Long-term	Local	Improbable	Low
E099	55	41.5	39.7	41.9	3.2	61.3	12.1	Low	Long-term	Local	Improbable	Low
E062	55	41.5	36.5	38.8	1.9	59.3	12.9	Minor	Long-term	Local	Improbable	Low
E033	55	41.5	35.1	37.3	1.4	58.3	13.3	Minor	Long-term	Local	Improbable	Low
E061	55	41.5	36.9	39.2	2.0	59.6	12.8	Minor	Long-term	Local	Improbable	Low
E082	55	41.5	37.7	39.8	2.2	60.1	12.8	Minor	Long-term	Local	Improbable	Low
E067	55	41.5	36.0	36.7	1.2	57.5	13.1	Minor	Long-term	Local	Improbable	Low
E071	55	41.5	36.0	38.2	1.7	59.1	13.2	Minor	Long-term	Local	Improbable	Low
E066	55	41.5	34.7	37.0	1.3	58.5	13.7	Minor	Long-term	Local	Improbable	Low
E069	55	41.5	30.7	33.1	0.6	55.1	14.1	Minor	Long-term	Local	Improbable	Low
E060	55	41.5	28.7	31.1	0.4	52.8	13.8	Minor	Long-term	Local	Improbable	Low
E059	55	41.5	26.9	29.3	0.3	51.2	14	Minor	Long-term	Local	Improbable	Low
E032	55	41.5	25.7	28.1	0.2	51.2	14.9	Minor	Long-term	Local	Improbable	Low
E072	55	41.5	21.7	24.2	0.1	47.7	15.3	Minor	Long-term	Local	Improbable	Low

Appendix E, Table 7: Projected operational noise rating levels and night-time significance - Emvelo WEF (PWL of 111.2 dBA re 1 pW)

Potential Noise-sensitive development / Receptor(s)	Recommended Rating Levels (noise limit - night-time rating level, IEC/WHO)	Potential Existing Ambient Sound Levels (Estimated considering an 8m/s wind speed)	Projected Noise Level (average expected) - dBA	Projected Noise Level (worst-case, few times per year at most) - dBA	Change in rating level (considering the worst-case noise rating levels)	Potential Low-frequency Noise Level - dBG	Potential Low-frequency Noise Level issues - dBA - dBC	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E048	45	41.5	**45.7**	**47.7**	7.1	65.3	10.8	High	Long-term	Regional	Highly Likely	**High**
E050	45	41.5	**46.3**	**48.2**	7.5	66	10.9	High	Long-term	Regional	Highly Likely	**High**
E047	45	41.5	44.9	**47.0**	6.6	64.8	10.9	Moderate	Long-term	Regional	Likely	**Medium**
E051	45	41.5	**46.3**	**48.3**	7.6	66.1	10.9	High	Long-term	Regional	Highly Likely	**High**
E038	45	41.5	**45.5**	**47.5**	7.0	65.4	11	High	Long-term	Regional	Highly Likely	**High**
E043	45	41.5	44.8	**46.8**	6.4	64.8	11	Moderate	Long-term	Regional	Likely	**Medium**
E056	45	41.5	**45.2**	**47.1**	6.7	64.9	10.9	Moderate	Long-term	Regional	Likely	**Medium**
E039	45	41.5	**45.2**	**47.2**	6.7	65.2	11.1	Moderate	Long-term	Regional	Likely	**Medium**
E042	45	41.5	45.0	**47.0**	6.6	64.9	11	Moderate	Long-term	Regional	Likely	**Medium**
E057	45	41.5	44.8	**46.8**	6.4	65	11.2	Moderate	Long-term	Regional	Likely	**Medium**
E041	45	41.5	**45.3**	**47.3**	6.8	65.2	11	Moderate	Long-term	Regional	Likely	**Medium**
E040	45	41.5	**45.2**	**47.2**	6.7	65.2	11	Moderate	Long-term	Regional	Likely	**Medium**
E049	45	41.5	43.6	**45.7**	5.6	63.9	11.1	Moderate	Long-term	Regional	Likely	**Medium**
E046	45	41.5	43.8	**45.9**	5.7	64.1	11.2	Moderate	Long-term	Regional	Likely	**Medium**
E052	45	41.5	44.7	**46.8**	6.4	65	11.2	Moderate	Long-term	Regional	Likely	**Medium**
E044	45	41.5	43.9	**45.9**	5.7	64.1	11.2	Moderate	Long-term	Regional	Likely	**Medium**
E053	45	41.5	44.2	**46.3**	6.0	64.6	11.3	Moderate	Long-term	Regional	Likely	**Medium**
E045	45	41.5	42.9	45.0	5.1	63.4	11.3	Moderate	Long-term	Regional	Likely	**Medium**
E058	45	41.5	43.4	**45.5**	5.5	64	11.4	Moderate	Long-term	Regional	Likely	**Medium**
E100	45	41.5	41.1	43.2	3.9	62.1	11.7	Low	Long-term	Regional	Possible	**Low**
E054	45	41.5	42.9	45.0	5.1	63.7	11.6	Moderate	Long-term	Regional	Likely	**Medium**
E055	45	41.5	42.8	45.0	5.1	63.7	11.6	Moderate	Long-term	Regional	Likely	**Medium**
E068	45	41.5	39.3	41.4	3.0	61.1	12.3	Minor	Long-term	Regional	Possible	**Low**
E099	45	41.5	39.7	41.9	3.2	61.3	12.1	Low	Long-term	Regional	Possible	**Low**
E062	45	41.5	36.5	38.8	1.9	59.3	12.9	Minor	Long-term	Regional	Possible	**Low**
E033	45	41.5	35.1	37.3	1.4	58.3	13.3	Minor	Long-term	Regional	Improbable	**Low**
E061	45	41.5	36.9	39.2	2.0	59.6	12.8	Minor	Long-term	Regional	Possible	**Low**
E082	45	41.5	37.7	39.8	2.2	60.1	12.8	Minor	Long-term	Regional	Possible	**Low**
E067	45	41.5	36.0	36.7	1.2	57.5	13.1	Minor	Long-term	Regional	Improbable	**Low**
E071	45	41.5	36.0	38.2	1.7	59.1	13.2	Minor	Long-term	Regional	Improbable	**Low**
E066	45	41.5	34.7	37.0	1.3	58.5	13.7	Minor	Long-term	Regional	Improbable	**Low**
E069	45	41.5	30.7	33.1	0.6	55.1	14.1	Minor	Long-term	Regional	Improbable	**Low**
E060	45	41.5	28.7	31.1	0.4	52.8	13.8	Minor	Long-term	Regional	Improbable	**Low**
E059	45	41.5	26.9	29.3	0.3	51.2	14	Minor	Long-term	Regional	Improbable	**Low**
E032	45	41.5	25.7	28.1	0.2	51.2	14.9	Minor	Long-term	Regional	Improbable	**Low**
E072	45	41.5	21.7	24.2	0.1	47.7	15.3	Minor	Long-term	Regional	Improbable	**Low**

Appendix E, Table 8: Projected cumulative noise rating levels and night-time significance - Emvelo WEF (PWL of 111.2 dBA re 1 pW)

Potential Noise-sensitive development / Receptor(s)	Potential Existing Ambient Sound Levels (Estimated considering an 8m/s wind speed)	Projected Noise Level for the Emvelo WEF operating in isolation (dBA)	Projected Cumulative Noise Level (For the Emvelo and Sheepmoor WEFs) (dBA)	Potential change in noise levels due to cumulative effects from both the Emvelo and Sheepmoor WEFs	Potential contribution from Hugo WTG when considering Cumulative Noise Level	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
E048	41.5	47.7	47.8	7.2	Insig.	High	Long-term	Regional	Highly Likely	High
E050	41.5	48.2	48.7	8.0	Insig.	High	Long-term	Regional	Highly Likely	High
E047	41.5	47.0	47.2	6.7	Insig.	Moderate	Long-term	Regional	Likely	Medium
E051	41.5	48.3	48.7	8.0	Insig.	High	Long-term	Regional	Highly Likely	High
E038	41.5	47.5	47.7	7.1	Insig.	High	Long-term	Regional	Highly Likely	High
E043	41.5	46.8	47.0	6.6	Insig.	Moderate	Long-term	Regional	Likely	Medium
E056	41.5	47.1	47.5	7.0	Insig.	High	Long-term	Regional	Highly Likely	High
E039	41.5	47.2	47.4	6.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E042	41.5	47.0	47.1	6.7	Insig.	Moderate	Long-term	Regional	Likely	Medium
E057	41.5	46.8	47.5	7.0	Insig.	High	Long-term	Regional	Highly Likely	High
E041	41.5	47.3	47.4	6.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E040	41.5	47.2	47.4	6.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E049	41.5	45.7	45.8	5.7	Insig.	Moderate	Long-term	Regional	Likely	Medium
E046	41.5	45.9	46.1	5.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E052	41.5	46.8	47.2	6.7	Insig.	Moderate	Long-term	Regional	Likely	Medium
E044	41.5	45.9	46.1	5.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E053	41.5	46.3	46.8	6.4	Insig.	Moderate	Long-term	Regional	Likely	Medium
E045	41.5	45.0	45.2	5.2	Insig.	Moderate	Long-term	Regional	Likely	Medium
E058	41.5	45.5	47.4	6.9	Insig.	Moderate	Long-term	Regional	Likely	Medium
E100	41.5	43.2	43.2	3.9	Insig.	Low	Long-term	Regional	Possible	Low
E054	41.5	45.0	45.7	5.6	Insig.	Moderate	Long-term	Regional	Likely	Medium
E055	41.5	45.0	45.6	5.5	Insig.	Moderate	Long-term	Regional	Likely	Medium
E068	41.5	41.4	41.4	3.0	Insig.	Minor	Long-term	Regional	Possible	Low
E099	41.5	41.9	41.9	3.2	Insig.	Low	Long-term	Regional	Possible	Low
E062	41.5	38.8	38.9	1.9	Insig.	Minor	Long-term	Regional	Possible	Low
E033	41.5	37.3	37.3	1.4	Insig.	Minor	Long-term	Regional	Improbable	Low
E061	41.5	39.2	39.2	2.0	Insig.	Minor	Long-term	Regional	Possible	Low
E082	41.5	39.8	46.6	6.3	Signif.	Moderate	Long-term	Regional	Likely	Medium
E067	41.5	36.7	36.7	1.2	Insig.	Minor	Long-term	Regional	Improbable	Low
E071	41.5	38.2	38.2	1.7	Insig.	Minor	Long-term	Regional	Improbable	Low
E066	41.5	37.0	47.1	6.7	Signif.	Moderate	Long-term	Regional	Likely	Medium
E069	41.5	33.1	33.1	0.6	Insig.	Minor	Long-term	Regional	Improbable	Low
E060	41.5	31.1	32.1	0.5	Insig.	Minor	Long-term	Regional	Improbable	Low
E059	41.5	29.3	32.2	0.5	Insig.	Minor	Long-term	Regional	Improbable	Low
E032	41.5	28.1	28.1	0.2	Insig.	Minor	Long-term	Regional	Improbable	Low
E072	41.5	24.2	24.2	0.1	Insig.	Minor	Long-term	Regional	Improbable	Low

End of Report

EIA PHASE FOR THE PROPOSED MULILO CLUSTER WEF, NEAR ERMELO, MPUMALANGA PROVINCE

Emvelo Wind Energy Facility

AQUATIC IMPACT ASSESSMENT

FOR

ERM Southern Africa (Pty) Ltd

BY

EnviroSci (Pty) Ltd

Dr Brian Colloty

1 Rossini Rd
Pari Park
Gqeberha
6070

DATE

15 May 2025

REVISION 1

Executive Summary

ERM Southern Africa (Pty) Ltd appointed EnviroSci (Pty) Ltd to conduct an aquatic assessment of the proposed Mulilo Amsterdam Wind Energy Facility cluster between Ermelo and Amsterdam in the Mpumalanga Province. This report is focused on assessing the Emvelo Wind Energy Facility and its associated Overhead Line alignment

This assessment includes delineating any natural waterbodies, as well as assessing the potential consequences of the proposed project – The study area) on the surrounding wetlands and or watercourses. This was based on information collected during various site visits conducted within the region from March 2022 and a site-specific assessment in April & September 2023. Substantiated by the National Wetland Inventory v5.2 spatial data (NWI). Additional site visits were conducted in February 2025, while working in the region to confirm any changes since the initial surveys.

These surveys adhered to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the National Wetland Classification System. This report will inform the Environmental Authorisation process, as well as the required Water Use License Application that will be initiated, once the final project layout is available, i.e. once all the constraints, if any from this and other specialists have been considered in the design process.

The PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to as results of the DFFE Screening tool indicated that portions of the study area are located within a VERY HIGH SENSITIVITY area, requiring this assessment. This is due to following being highlighted by the DFFE Screening Tool Results:

- Very High CBA: Aquatic rivers
- Very High CBA: Wetlands
- Very High ESA: Important sub catchments
- Very High ESA: Strategic Water Source Area (SWSA)
- Very High ESA: Wetland clusters
- Very High ESA: Wetlands
- Very High FEPA Subcatchment
- Very High Rivers_AB
- Very High Rivers_B
- Very High Rivers_C
- Very High SWSA (Surface Water) _Upper Usutu
- Very High SWSA (Surface Water) _Upper Vaal
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Seep)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Valley-bottom)
- Very High Wetlands_Mesic (Riverine)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Depression)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Floodplain)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Seep)

The proposed Wind Energy Facility (WEF) is located in the Inkomati-Usuthu Water Management Area, within the upper catchment of the Usuthu River (SQ W54A) and Mpama River (SQ W53B), while the proposed grid connection options are located in the Upper Vaal River (SQ C11B) in the Vaal Water Management Area. Thus, several permanent rivers and a variety of wetland hydrogeomorphic types are anticipated both associated with the riverine valleys and bench or plateaux areas located between river valleys on higher lying areas.

The study region is further characterised by several National Biodiversity Assessment (2018) Wetland Clusters, National Freshwater Ecosystem Area (NFEPAs), Threatened Ecosystems and Strategic Water Resources Areas.

The geology is mostly shales or sandstone of the Vryhied Group, with several intrusions associated with dolerite sills and dykes in areas associated with the Karoo Supergroup. This typically allows for the development of riverine areas, some with floodplains, interspersed by the rocky inselbergs and small ridges and or bench / plateaus observed.

Overall, these catchment and subsequent rivers / watercourses and wetlands range from a Largely Natural to transformed states. Current impacts occur in localised areas and included the following:

- Mining
- Large scale farming
- Forestry
- Erosion due small road crossings and tracks;
- Grazing; and
- Small to large river impoundments, and off channel farm dams.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the watercourses within the site have been assigned a condition score of C (Nel et al. 2011), indicating that they are Moderately Modified, but still have biological significance, while the NBA (2018) data indicated that most mainstem system near the WEF, had a River Conservation Score of B (Usuthu) and B on the Vaal River. These scores were substantiated by observations made in the field within the study area, and due to the impacts or disturbance observed these scores would be upheld.

Any ratings will the also be substantiated with an assessment of the study area catchments linked to Critical Biodiversity Areas (CBA) and Ecological Support Areas, as shown in the Mpumalanga CBA spatial data.

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al*., 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs). The study area falls within several FEPA and Upstream FEPA catchments associated with the Usuthu & Vaal river systems. This is large due to the presence of several important fish and aquatic invertebrate habitats that as well as the provision and maintenance of flows within the lower catchments.

This report also indicates the significant watercourses and wetlands delineated within the study area, inclusive of the respective buffers. Any activities within these areas and or the 100m (riverine) 500m (wetland) regulated zones will require a Water Use license under Section 21 c & i of the National Water Act (Act 36 of 1998). The respective Water Use Licenses must be finalised once the preferred layout has been determined especially if any access roads will need to cross these areas, but it is advised that any new crossing over watercourses and wetlands areas are avoided.

Using the baseline description, aquatic features were identified, then categorised into one of number pre-determined sensitivity categories to provide protection and/or guide the layout planning processes. The sensitivity ratings of High (No-Go) to Low were determined through an assessment of the habitat sensitivity and related constraints. However, these No-Go areas (with buffers) relate in general terms to the project and there are areas where encroachment on these areas would occur (i.e. existing road crossings within systems) and this is considered acceptable since these areas are already disturbed.

These proposed constraints / buffers do not include bird buffers / constraints as theirs buffers along aquatic features are at times far larger around aquatic features, than those required for the known aquatic species within this region.

Development Component	Habitat type	Sensitivity rating of the respective habitat type against the development type	Buffer distance (m)	Development acceptability	Sensitivity rating override if an impact such as a road or other disturbance already occurs within the proposed footprint and confirmed by the specialist
WTG towers	Channelled Valley Bottom Wetlands	No-Go	105m	No WTGs should be placed in any of these areas, regardless of the state, type and functionality of the respective aquatic ecosystem	None
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		
Hardstands, Buildings / Substations & BESS	Channelled Valley Bottom Wetlands	No-Go	105m	None of these types of infrastructure should be placed in any of these areas	None
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		
Roads & Underground cables alignment roads	Channelled Valley Bottom Wetlands	High	105m	New roads and underground cables would not be deem appropriate within any of these areas, unless some form of disturbance already occurs, such as an existing track or bridge	Only existing tracks or disturbed areas may be used
	Pans and Depressions		95m		
	Rivers and Floodplains				
	Seeps		65m		
	Minor watercourses		35m		

Development Component	Habitat type	Sensitivity rating of the respective habitat type against the development type	Buffer distance (m)	Development acceptability	Sensitivity rating override if an impact such as a road or other disturbance already occurs within the proposed footprint and confirmed by the specialist
OHL	Channelled Valley Bottom Wetlands	High	105m	OHL towers must be placed outside of these area so that only the cables span these systems. The exception being that Pans & Depression inclusive of buffers must be avoided completely	
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		

In summary, any structures such as turbines/towers, crane pads, hardstands, buildings, substations and BESS, have been placed outside of the observed Very High Sensitivity watercourses, while any remaining structures (Roads and transmission lines) could cross or span the other sensitivity areas. Noting Low Sensitivity = Moderate areas but with existing impacts e.g., current roads, farm tracks of previously disturbed areas

The following direct impacts were assessed with regard the aquatic systems in this impact assessment phase based on the assumptions that any of the delineated Very High no-Go sensitivity areas shown in this assessment will either be avoided by the WEF components or spanned by the grid connections, noting that some access roads must cross some of these areas, but should preferably be within previously disturbed areas:

- Impact 1: Loss of habitat containing protected species or Species of Special Concern
- Impact 2: Loss of any critical corridors, important catchment areas and connected habitats that are linked to any Critical Biodiversity Areas or Ecological Support Areas
- Impact 3: The potential spread of alien vegetation
- Impact 4: Loss of riparian and or wetland habitat
- Impact 5: Changes to the hydrological regime and increased potential for erosion
- Impact 6: Changes to water quality
- Impact 7: Cumulative Impacts

During this assessment, several sensitive aquatic habitats were observed and are shown in the maps provided in this report. Noteworthy areas, were then avoided by the required infrastructure, and include the main riverine and wetland systems, while the access roads could will make use of existing roads thus previously disturbed areas.

If this is carried out, then the specialist has no objection to the authorisation of the proposed activities assuming that all mitigations and buffer zones are implemented.

Mitigation should focus on these areas and include measures to halt erosion and rehabilitate habitat in the sections affected by the construction. Without the implementation of mitigation measures, the project has potential to cause a Moderate cumulative impact upon aquatic biodiversity. However, with the adoption of mitigation, the proposed project will have a Low impact upon aquatic biodiversity.

As the proposed activities have the potential to create erosion the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment, and suitable dust and erosion control mitigation measures should be included in the generic EMPr, if not included already to mitigate.

- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel. It is therefore suggested that all construction camps, lay down areas, batching plants or areas and any stores should be located more than 50 m from any demarcated watercourses.

- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.

- All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.

- It is further recommended from the project onset that all watercourse areas (inclusive of buffers) are included into any existing EMPr as reference, this to ensure a net benefit to the aquatic environment. This should from part of the suggested walk down as part of the final EMP preparation.

TABLE OF CONTENTS

1. Introduction 1
2. Terms of Reference 3
3. Project Description 4
4. Methodology 4
5. Description of the affected environment 17
6. Present Ecological State and conservation importance 26
7. Permit requirements 28
8. Sensitivity Assessment 29
9. Impact assessment 31
10. Potential aquatic ecosystems impacts 31
11. Draft Specialists Recommendations for the inclusion in the EA 40
12. Monitoring and Management Actions 41
13. Conclusion and Recommendations 41
14. References 43
12. Appendix 1 - Specialist CV 44
15. Appendix 2 - Site Sensitivity Verification Report 46
16. Appendix 3: Compliance with the Aquatic Biodiversity Protocol (GN 320, 20 March 2020) 48

LIST OF TABLES

Table 1: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the NWA and ecosystems included in DWAF's (2005) delineation manual 9
Table 2: Description of A – F ecological categories based on Kleynhans *et al*., (2005) 13
Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al*., 2008 15
Table 4: Results of the sensitivity rating / constraints assessment 30
Table 5: Impact assessment summary for Impact 1 – Loss of habitat containing protected species or Species of Special Concern 32
Table 6: Impact assessment summary for Impact 2 – Loss of CBAs or potential areas with conservation potential or linked to any important catchments and strategic water resource areas 34
Table 7: Impact assessment summary for Impact 3 – Potential spread of alien vegetation 35
Table 8: Impact assessment summary for Impact 4 – Loss of riparian and or wetland habitat 36
Table 9: Impact assessment summary for Impact 5 – Changes to the hydrological regime and increase potential for erosion 37
Table 10: Impact assessment summary for Impact 6 –Changes to surface water quality characteristics 39
Table 11: Impact assessment summary for Impact 7 - Cumulative impact assessment for aquatic biodiversity 40

LIST OF FIGURES

Figure 1: The proposed Wind Energy Facility (WEF) site boundaries, possible infrastructure layout (excluding hardstand and crane pads) and the potential OHL alignment alternatives 3
Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al*., 2013)..... 11
Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al*., 2013)..... 12
Figure 4: Project locality map indicating the various quaternary catchment boundaries (white lines) in relation to the study area (Source DWS and NGI)..... 20
Figure 5: Various waterbodies identified in the National Wetland Inventory V5.2 (2020) 21
Figure 6: The respective Subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) and Strategic Water Resource Areas in relation to the study area..... 22
Figure 7: The confirmed watercourses and wetlands within the study area,..... 23
Figure 8: Critical Biodiversity Areas as per the Mpumalanga Biodiversity Spatial Plan, where the top map is for the project area and the bottom map is for the WEF 27

LIST OF PHOTO PLATES

Plate 1: A view of a mainstem watercourse (tributary of the Mpama River), with transformed floodplain 24
Plate 2: A view of channelled valley bottom wetland within a transformed catchment (crop production & grazing)..... 24
Plate 3: One of the smaller Endorheic Pans that is located near the OHL between the WEF and Ermelo 25
Plate 4: Seepage wetland in the headwater areas of the Vaal River / Usutu River catchment divide .. 25

ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographic Information System
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, *et al*. 2011).
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SQ	Subquaternary catchment
WUL	Water Use License
WULA	Water Use License Application

SPECIALIST REPORT DETAILS

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Member SAEIES.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), Ph. D Botany Conservation Importance rating (Estuaries) and interior wetland / riverine assessment consultant from 1996 to present.

I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs and or Department of Human Settlement, Water and Sanitation.



Signed: …… Date:15 May 2025……

Appendix 1 of this report contains a detailed CV

This document contains intellectual property and proprietary information that is protected by copyright in favour of EnviroSci (Pty) Ltd. The document may therefore not be reproduced, or used without the prior written consent of EnviroSci (Pty) Ltd. This document is prepared exclusively for ERM Southern Africa (Pty) Ltd, their client and is subject to all confidentiality, copyright, trade secrets, and intellectual property law and practices of SOUTH AFRICA.

1. Introduction

ERM Southern Africa (Pty) Ltd appointed EnviroSci (Pty) Ltd to conduct an aquatic assessment of the proposed Mulilo Amsterdam Wind Energy Facility cluster between Ermelo and Amsterdam in the Mpumalanga Province. This report is focused on assessing the Emvelo Wind Energy Facility and its associated Overhead Line alternative corridors (Figure 1).

This assessment includes delineating any natural waterbodies, as well as assessing the potential consequences of the proposed project – The study area) on the surrounding wetlands and or watercourses. This was based on information collected during various site visits conducted within the region from March 2022 and a site-specific assessment in April & September 2023. Substantiated by the National Wetland Inventory v5.2 spatial data (NWI). Additional site visits were conducted in February 2025, while working in the region to confirm any changes since the initial surveys.

These surveys adhered to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the National Wetland Classification System. This report will inform the Environmental Authorisation process, as well as the required Water Use License Application that will be initiated, once the final project layout is available, i.e. once all the constraints, if any from this and other specialists have been considered in the design process.

The PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to as results of the DFFE Screening tool indicated that portions of the study area are located within a VERY HIGH SENSITIVITY area, requiring this assessment. This is due to following being highlighted by the DFFE Screening Tool Results for the WEF study area and OHL assessment corridors:

- Very High CBA: Aquatic rivers
- Very High CBA: Wetlands
- Very High ESA: Important sub catchments
- Very High ESA: Strategic Water Source Area (SWSA)
- Very High ESA: Wetland clusters
- Very High ESA: Wetlands
- Very High FEPA Subcatchment
- Very High Rivers_AB
- Very High Rivers_B
- Very High Rivers_C
- Very High SWSA (Surface Water) _Upper Usutu
- Very High SWSA (Surface Water) _Upper Vaal
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Seep)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Valley-bottom)
- Very High Wetlands_Mesic (Riverine)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Depression)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Floodplain)
- Very High Wetlands_Mesic Highveld Grassland Bioregion (Seep)

Several important national, provincial and municipal scale conservation plans were also reviewed, with the results of those studies being included in this report. Most conservation plans are produced at a high level, so it is therefore important to verify the actual status of the study area during this initial phase, prior to the final layout plan being produced.

1.1 Aims and objectives

The aim of this report is to firstly provide a summary of the aquatic baseline and identify any No-Go areas. The report also makes recommendations with regard to further management and mitigation, to further reduce, avoid or mitigate the potential impacts and ultimately ensure the responsible and sustainable use of South

Africa's aquatic resources. The proposed layout was then assessed with regard the potential impacts and mitigations later in this report.

Certain aspects of the development could trigger the need for Section 21, Water Use License Applications (WULAs) (or general authorisation [GA] applications) such as river crossings or any activities within 500m of a wetland. Once the final layout receives Environmental Authorisation, these applications must then be submitted to the Department of Water and Sanitation (DWS).

Information regarding the state and function of the observed water bodies, including suitable no-go buffers areas is thus also provided. Information with regard to the state and function of the observed water bodies, suitable no-go buffers and assessment of the potential impacts are also provided, but it is the intent that where possible sensitive areas such as the wetlands will be avoided or spanned (OHL).

1.2 Assumptions and Limitation

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of the aquatic communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. No baseline long-term monitoring was undertaken as part of this assessment. However, a concerted effort was made to assess as much of the potential site, as well as make use of any available literature, species distribution data and aerial photography. Furthermore, based on the previous assessments undertaken between 2003 and 2023 in the area and this was not foreseen as a huge limiting factor. Detailed site visits conducted within the region from March 2022 and a site-specific assessment in April & September 2023 were also conducted. The level of investigation undertaken is sufficient to inform this assessment. Additional site visits were conducted in February 2025, while working in the region to confirm any changes since the initial surveys.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

For the purposes of this report, it is assumed that any existing roads and tracks will be used, while structures will be placed outside the wetlands and or watercourses. A further assumption is that water will be sourced from a licensed resource and not illegally abstracted from any surrounding watercourses, particularly if dust suppression is required for example at the laydown areas or along main / district roads.

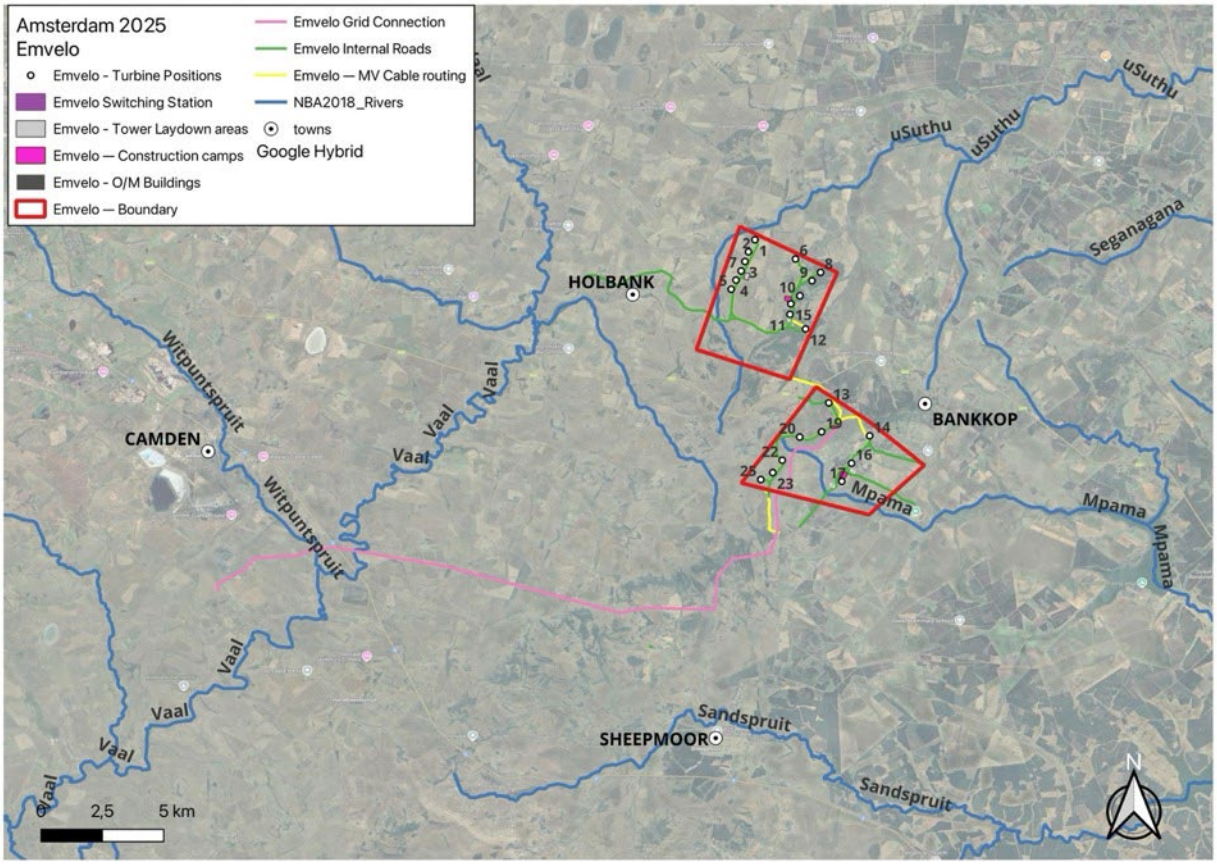


Figure 1: The proposed Wind Energy Facility (WEF) site boundaries, possible infrastructure layout (excluding hardstand and crane pads) and the potential OHL alignment

2. Terms of Reference

The proposed methods used in this assessment have been developed with the renewable industry in mind, coupled to the minimum requirements stipulated by DFFE and the Department of Water and Sanitation. These have been successful in assessing the direct, indirect and cumulative impacts of ca 200 renewable energy projects (2010 – 2023), of which 28 have been constructed:

- Desktop analysis
- Site investigation
- Compilation of one draft and one final site screening / sensitivity report for the project which adheres to the following (this list is not exhaustive):
    - The Initial Site Sensitivity Verification reporting requirements for environmental themes set out in Government Gazette No. 43110 which was promulgated on 20 March 2020 in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).
    - Identification and mapping of any discrepancies with the environmental sensitivity as identified on the national web based environmental screening tool.
    - Identification of sensitive areas to be avoided (including corresponding spatial data) and the determination of the respective buffers (if applicable) for each site.
    - Initial recommendations for the layout and allowable development footprint from a surface water and aquatic biodiversity perspective (including corresponding spatial data).
    - Recommendations regarding the areas to be utilised for solar technologies within the project site from a surface water and aquatic biodiversity perspective (including corresponding spatial data)
- Assess the potential impacts, based on a supplied methodology, including cumulative impacts and for pre-construction, construction, operations and decommissioning phases.

- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated wetland areas.
- Supply the client with geo-referenced GIS shape files of the wetland / riverine areas.
- Provide one draft report for comment, with a maximum of two rounds of comments addressed per project phase (max of 2).

3. Project Description

The following information was provided by the client:

Emvelo WEF is proposed to comprise up to 45 turbines with a maximum output capacity of up to 200 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 20 – 25 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design.

It is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the Eskom Uitkoms Substation.

Emvelo WEF			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
DC Geldenhuys Family Trust	Remainder of the Farm Schiedam No. 274	274	RE
Randell's Ranch Trust (Philip Randall)	Portion 2 of the Farm Schiedam No. 274	274	2
Antonette Swart	Remainder Portion 1 of the Farm Schiedam No. 274	274	1
Henry Goodwin Geldenhuys	Portion 6 of the Farm Schiedam No. 274	274	6
Loufried Testamentere Trust	Portion 5 of the Farm Schiedam No. 274	274	5
Josef & Merinda Loraine Benjamin van Tonder	Remaining Extent Ptn 1 of the Farm Vaalbank No. 285	285	1
Josef & Merinda Loraine Benjamin van Tonder	Portion 5 of the Farm Vaalbank No. 285	285	5
Johan Saaiman Trust	Portion 9 of the Farm Waaihoek No. 286	286	9
Johannes Stephanus Roberts	Remainder Portion 2 of the Farm Waaihoek No. 286	286	2
Johannes Stephanus Roberts	Remainder Portion 6 of the Farm Waaihoek No. 286	286	6
Johannes Stephanus Roberts	Remainder Portion 13 of the Farm Waaihoek No. 286	286	13
JMJ Trust	Portion 7 of the Farm Waaihoek No. 286	286	7
JMJ Trust	Portion 10 of the Farm Waaihoek No. 286	286	10
JMJ Trust	Portion 5 of the Farm Waaihoek No. 286	286	5
Josua Meyer Trust	Waaihoek	286	14
Josua Meyer Trust	Waaihoek	286	3

Emvelo WEF			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
Josua Meyer Trust	Waaihoek	286	12
NWJ Vorster Trust	Remaining Extent of the Farm Klipfontein No. 283	283	RE
Josua Meyer Trust	Bosjesspruit	291	7
Emvelo WEF Grid Connection			
Randell's Ranch Trust (Philip Randall)	Schiedam	274	2
National Government - of the Republic of South Africa	Onverwacht	273	1
Shammah Trust	Portion 7 of the Farm Onverwacht No. 273	273	7
Harrob Beleggings Pty Ltd (Jan Roberts)	Portion 8 of the Farm Onverwacht No. 273	273	8
Harrob Beleggings Pty Ltd (Jan Roberts)	Portion 3 of the Farm Onverwacht No. 287	287	3
Van Der Merwe Broers Trust	Portion 9 of the Farm Zwartwater No. 288	288	9
Merwe Johannes Jacobus Van Der	Portion 10 of the Farm Zwartwater No. 288	288	10
Kansvat Beleggings Pty Ltd	Zwartwater	288	2
National Government of SA	Zwartwater	288	1
Dream World Inv 450 Pty Ltd	Weltevreden	289	10
Dream World Inv 450 Pty Ltd	Weltevreden	289	11
Dream World Inv 450 Pty Ltd	Weltevreden	289	6
Van Der Merwe Broers Trust	Weltevreden	289	RE/3
National Government of SA	Witpunt	267	RE/7
National Government of SA	Mooiplaats	290	7
National Government of SA	Mooiplaats	290	8
Kayipheli Trust	Witpunt	267	29
Eskom Holdings Ltd	Camden Power Station	329	RE

4. Methodology

This study followed the approaches of several national guidelines with regards to wetland assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study systems, applicable to the specific environment and in a clear and objective manner, assess the potential impacts associated with the proposed development site based on information collected within the relevant farm portions of a number of years for this and other proposed projects.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System (NWCS) approach will be used in this study. It is also important to understand wetland definition, means of assessing wetland conservation and importance as well as understanding the pertinent legislation with regards to protecting wetlands. These aspects will be discussed in greater depth in this section of the report, as they form the basis of the study approach to assessing wetland impacts.

4.1 Waterbody classification systems

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects. **Coupled to this was the inclusion of other criteria within the classification systems to differentiate between river, riparian and wetland systems, as well as natural versus artificial waterbodies.**

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (NWCS) (Ollis *et al*., 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al*., 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in the wetland classifications as the HGM approach has been adopted throughout the water resources management realm with regards to the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Human Settlement, Water and Sanitation (DHSWS). The Ecological Reserve of a wetland or river is used by DHSWS to assess the water resource allocations when assessing WULAs.

The National Wetland Classification System process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are presented below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the **Reserve Template**

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

4.2 Wetland definition

Although the National Wetland Classification System (NWCS) (Ollis *et al*., 2013) is used to classify wetland types, it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard et al., 2005). An additional minor adaptation of the definition is the removal of the term

'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al*., 2013):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a watercourse (Ollis *et al*., 2013). Table 1 below provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al.*, 2013).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

- A high-water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines and rivers.

Table 1: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the NWA and ecosystems included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often described as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES[3]
Riparian [3] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act

[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods and would be considered riparian wetlands, as opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[3] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.

4.3 National Wetland Classification System method

During this study, due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al*., 2013) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (Ollis *et al.,* 2013).

The classification system used in this study is thus based on Ollis *et al*. (2013) and is summarised below:

The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 2). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland
- Hydrological characteristics – nature of water movement into, through and out of the wetland
- Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types based on biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

- Geology;
- Natural vs. Artificial;
- Vegetation cover type;
- Substratum;
- Salinity; and
- Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are thus nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

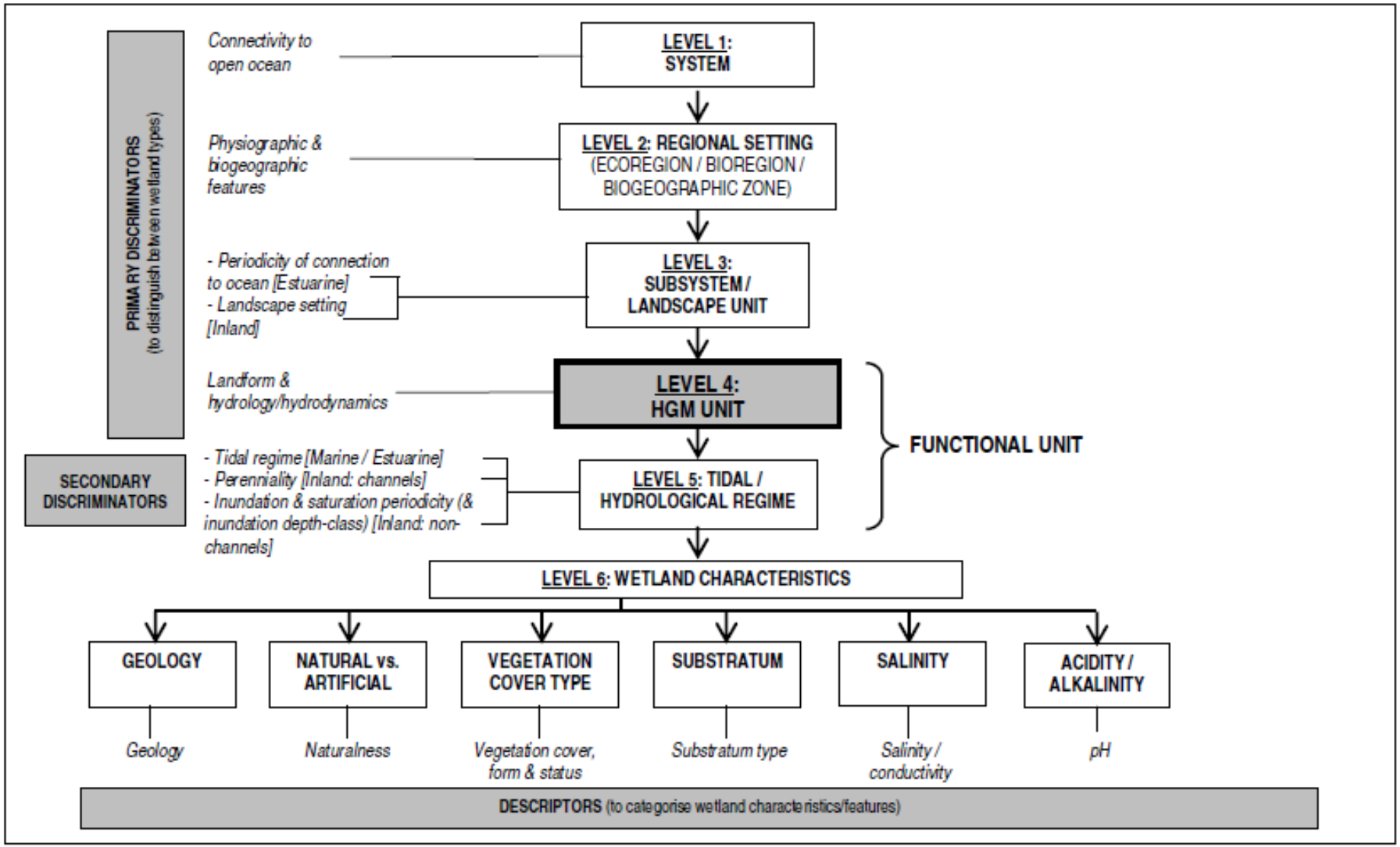


Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al.*, 2013).

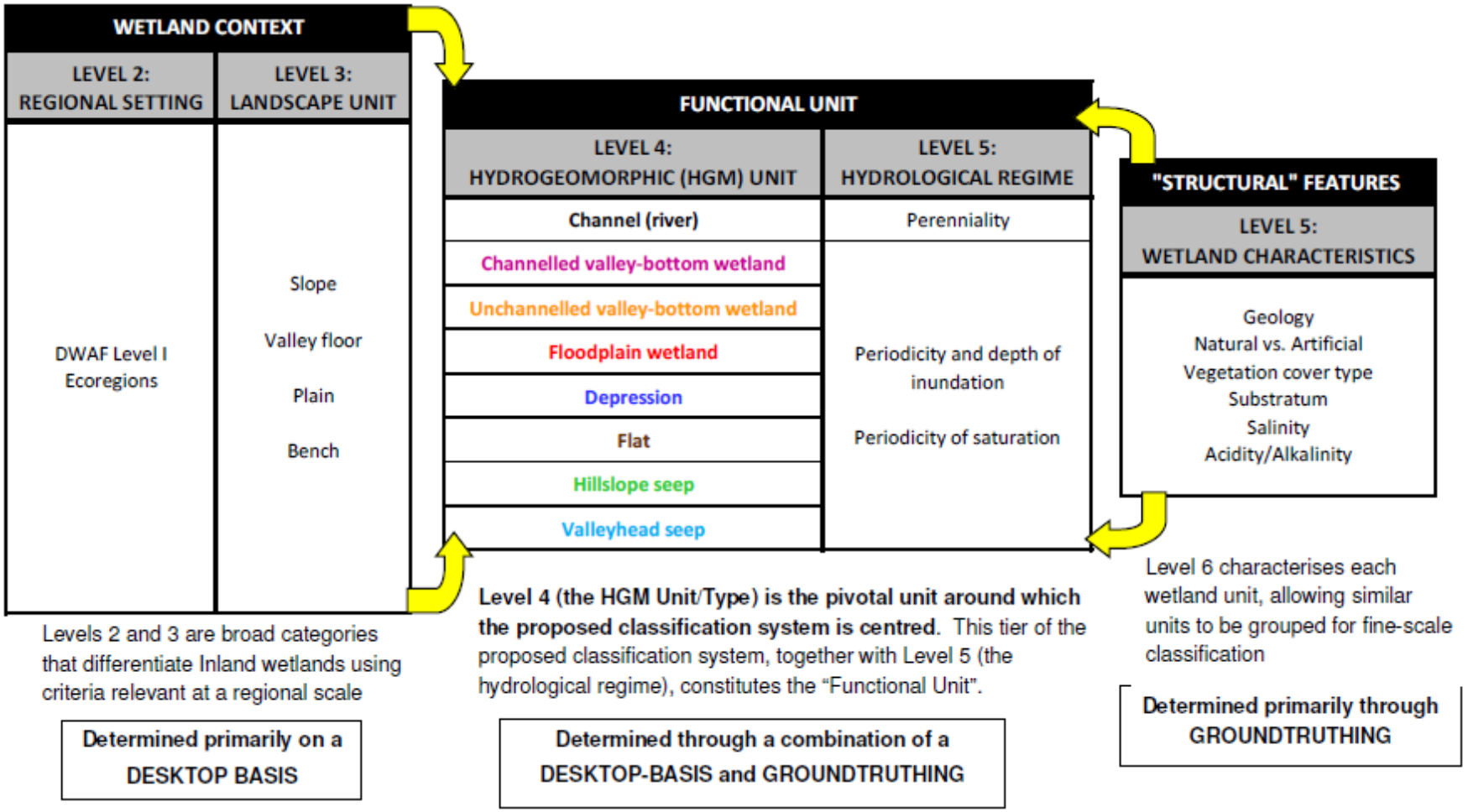


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013).

4.4 Waterbody condition

To assess the PES or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 2) and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 2: Description of A – F ecological categories based on Kleynhans *et al*., (2005)

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	**Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality**
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA’s River EcoStatus models which are currently used for the assessment of PES in riverine environments.

4.5 Aquatic ecosystem importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water-borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 3 below summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al*., 2008

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits		Flood attenuation
				Stream flow regulation
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
				Carbon storage
		Biodiversity maintenance		
	Direct benefits	*Provision of water for human use*		
		Provision of harvestable resources[2]		
		Provision of cultivated foods		
		Cultural significance		
		Tourism and recreation		
		Education and research		

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation or rather, continuity or intactness with regards to ecological corridors; and
- Ecosystem service (social and ecological).

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of Conservation Concern (SCC) was observed, in which case it would receive a HIGH rating. Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or Wetlands that resemble some form of the past landscape but receive a LOW conservation importance rating could be included into stormwater management features and should not be developed to retain the function of any ecological corridors.

4.6 Relevant wetland legislation and policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa, 1996;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983); and
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974)
- National Forest Act, 1998 (No. 84 of 1998)
- National Heritage Resources Act, 1999 (No. 25 of 1999)

NEMA and the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) would also apply to this project. These Acts have categorised many invasive plants together with associated obligations on the landowner.

4.7 Provincial legislation and policy

Currently riverine and wetland buffers distances are calculated using the model described by Macfarlane *&* Bredin (2017). Site specific information was collected during the visit and is used to determine site and development specific range of buffers. In short, the buffer distances are based on the current condition of the waterbody, the state of the remainder of the site, the potential impacts posed by the type and scale of the of development, as wells as the proposed alteration of hydrological flows. The model also takes cognisance of the level of mitigation possible, coupled to the reversibility of the impacts. Based then on the information known for the site the buffer model provided the following:

Channelled Valley Bottom Wetlands	65m
Pans and Depressions	105m
Rivers and Floodplains	95m
Seeps	65m
Minor watercourses	35m

Artificial dams were not buffered.

5. Description of the affected environment

This baseline description was a summer and winter survey of the study area that spanned a total of two weeks and conducted in February / March 2022 (late summer) and a site-specific assessment in April (Autumn) & September (Later winter) 2023. Additional site visits were conducted in February 2025, while working in the region to confirm any changes since the initial surveys.

The study area was dominated by a variety of aquatic features associated with catchments and rivers, characterised as follows:

- Mainstem Rivers: Floodplain dominated systems with floodplain wetlands (Plate 1). A few reaches did contain very narrow riparian zones, consisting mostly of a single row of willow trees associated with the Vaal River
- Valley Bottom Wetlands (Channelled and Unchanneled) (Plate 2)
- Endorheic pans (Plate 3)
- Seep wetlands (Plate 4)

The proposed Wind Energy Facility (WEF) is located in the Inkomati-Usuthu Water Management Area, within the upper catchment of the Usuthu River (SQ W54A) and Mpama Rivers (SQ W53B), while the proposed grid connection options are located in the Upper Vaal River (SQ C11B) in the Vaal Water Management Area (Figure 4). Thus, several permanent rivers and a variety of wetland hydrogeomorphic types are anticipated both associated with the riverine valleys and bench or plateaux areas located between river valleys on higher lying areas (Figure 5).

The study region is further characterised by several National Biodiversity Assessment (2018) Wetland Clusters, National Freshwater Ecosystem Area (NFEPAs) and Strategic Water Resources Areas (Figure 6)

The geology is mostly shales or sandstone of the Vryhied Group, with several intrusions associated with dolerite sills and dykes in areas associated with the Karoo Supergroup. This typically allows for the development of riverine areas, some with floodplains, interspersed by the rocky inselbergs and small ridges and or bench / plateaus observed.

Overall, these catchment and subsequent rivers / watercourses and wetlands range from a Largely Natural to transformed states. Current impacts occur in localised areas and included the following:

- Mining
- Large scale farming
- Forestry
- Erosion due small road crossings and tracks;
- Grazing; and
- Small to large river impoundments, and off channel farm dams.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the watercourses within the site have been assigned a condition score of C (Nel et al. 2011), indicating that they are Moderately Modified, but still have biological significance, while the NBA (2018) data indicated that most mainstem system near the WEF, had a River Conservation Score of B (Usuthu) and B on the Vaal River. These scores were substantiated by observations made in the field within the study area, and due to the impacts or disturbance observed these scores would be upheld.

Any ratings will the also be substantiated with an assessment of the study area catchments linked to Critical Biodiversity Areas (CBA) and Ecological Support Areas, as shown in the Mpumalanga CBA spatial data.

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al*., 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs).

The study area falls within several FEPA and Upstream FEPA catchments associated with the Usuthu & Vaal river systems. This is large due to the presence of several important fish and aquatic invertebrate habitats that as well as the provision and maintenance of flows within the lower catchments.

Notably the following fish are commonly found in the study areas systems (Freshwater Biodiversity Information System - FBIS):

Fish Taxon	Conservation status
Enteromius anoplus (Weber, 1897)	Least concern
Enteromius pallidus (Smith, 1841)	Least concern
Enteromius paludinosus (Peters, 1852)	Least concern
Pseudocrenilabrus philander (Weber, 1897)	Least concern

The FBIS site data from 44 sites (https://freshwaterbiodiversity.org/map/#search//taxon=&search=&siteId=&collector=&category=&yearFrom=&yearTo=&months=&boundary=&userBoundary=&) spanning the study area also indicated a total of 200 aquatic invertebrate species, none currently listed as conservation needy as well as the following aquatic plants that were confirmed in this assessment

Plant Taxon	Conservation Status
Agrostis continuata Stapf	Not evaluated
Andropogon eucomus Nees	Least concern
Andropogon lacunosus J.G.Anderson	Least concern
Arundinella nepalensis Trin.	Not evaluated
Berula thunbergii (DC.) H.Wolff	Least concern
Brachiaria bovonei (Chiov.) Robyns	Least concern
Carex rhodesiaca Nelmes	Least concern
Chironia purpurascens (E.Mey.) Benth. & Hook.fil.	Least concern
Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.	Least concern
Cyperus denudatus L.f.	Least concern
Cyperus macranthus Boeckeler	Not evaluated
Cyperus melanospermus (Nees) Valck.Sur.	Not evaluated
Cyperus nitidus Lam.	Not evaluated
Denekia capensis Thunb.	Not evaluated
Drosera collinsae N.E.Br. ex BurttDavy	Least concern
Echinochloa jubata Stapf	Least concern
Eleocharis dregeana Steud.	Least concern
Eleocharis limosa (Schrad.) Schult.	Least concern
Festuca caprina Nees	Not evaluated
Fimbristylis complanata (Retz.) Link	Least concern
Fuirena pubescens (Poir.) Kunth	Least concern
Geranium multisectum N.E.Br.	Least concern
Geranium wakkerstroomianum R.Knuth	Least concern
Gladiolus papilio Hook.f.	Not evaluated
Gunnera perpensa L.	Least concern
Hesperantha hygrophila Hilliard & B.L.Burtt	Least concern
Isolepis costata Hochst. ex A.Rich.	Not evaluated
Juncus effusus L.	Least concern
Juncus oxycarpus E.Mey. ex Kunth	Least concern
Lagarosiphon muscoides Harv.	Least concern

Leersia hexandra Sw.	Least concern
Limosella major Diels	Least concern
Miscanthus junceus (Stapf) Pilg.	Least concern
Nymphoides thunbergiana (Griseb.) Kuntze	Least concern
Odontelytrum abyssinicum Hack.	Least concern
Ornithogalum flexuosum (Thunb.) U.Müll.-Doblies & D.Müll.-Doblies	Not evaluated
Pennisetum macrourum Trin.	Least concern
Persicaria decipiens (R.Br.) K.L.Wilson	Least concern
Persicaria madagascariensis (Meisn.) S.Ortiz & Paiva	Not evaluated
Pterygodium nigrescens (Sond.) Schltr.	Least concern
Ranunculus multifidus Forssk.	Least concern
Rhynchospora brownii Roem. & Schult.	Least concern
Rorippa nudiuscula (E.Mey. ex Sond.) Thell.	Least concern
Sacciolepis typhura (Stapf) Stapf	Least concern
Schoenoplectus muriculatus (Kük.) Browning	Not evaluated
Schoenoplectus paludicola (Kunth) J.Raynal, 1976	Least concern
Typha capensis (Rohrb.) N.E.Br.	Not evaluated
Veronica anagallis-aquatica L.	Not evaluated
Xyris gerrardii N.E.Br.	Least concern

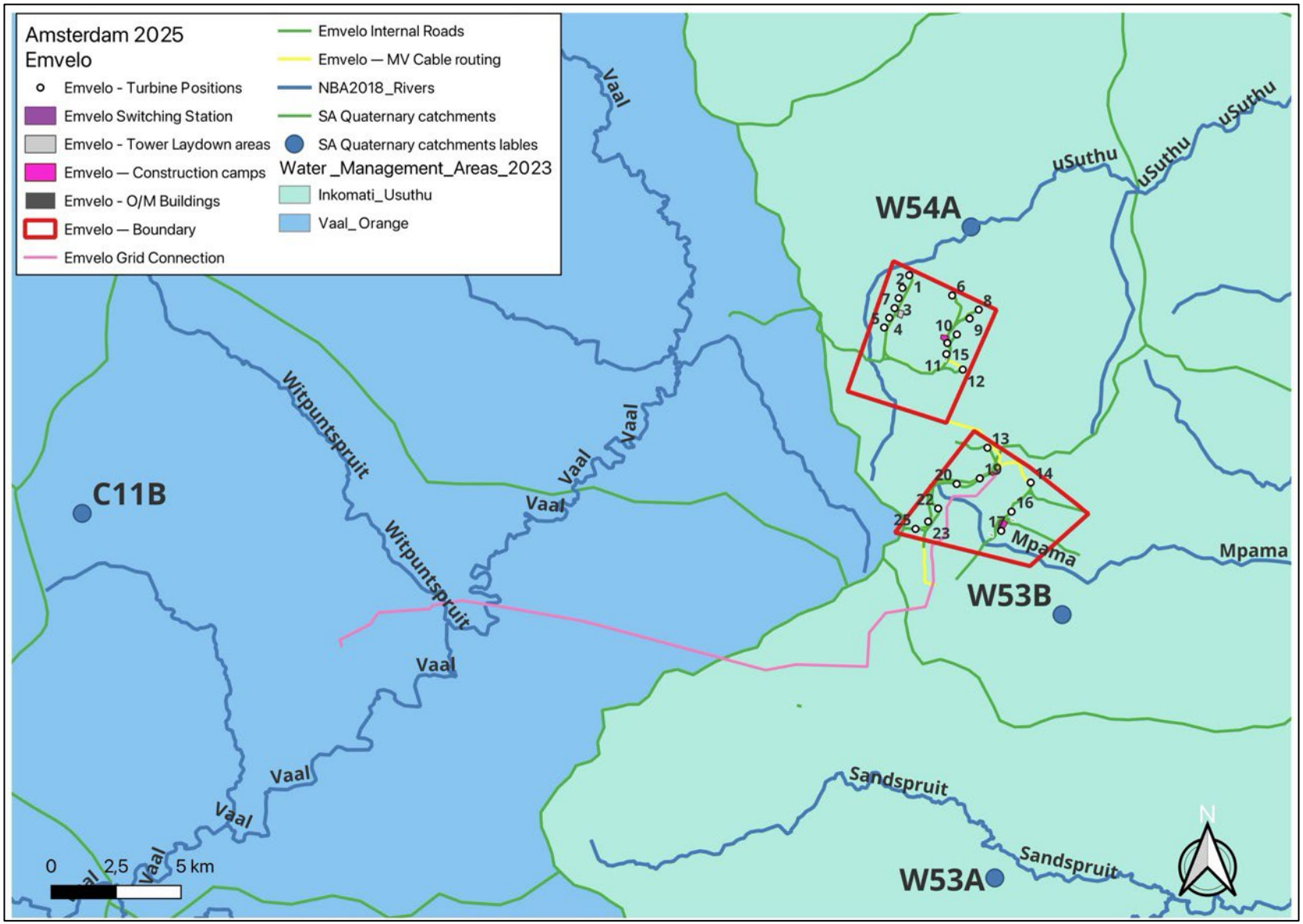


Figure 4: Project locality map indicating the various quaternary catchment boundaries (white lines) in relation to the study area (Source DWS and NGI).

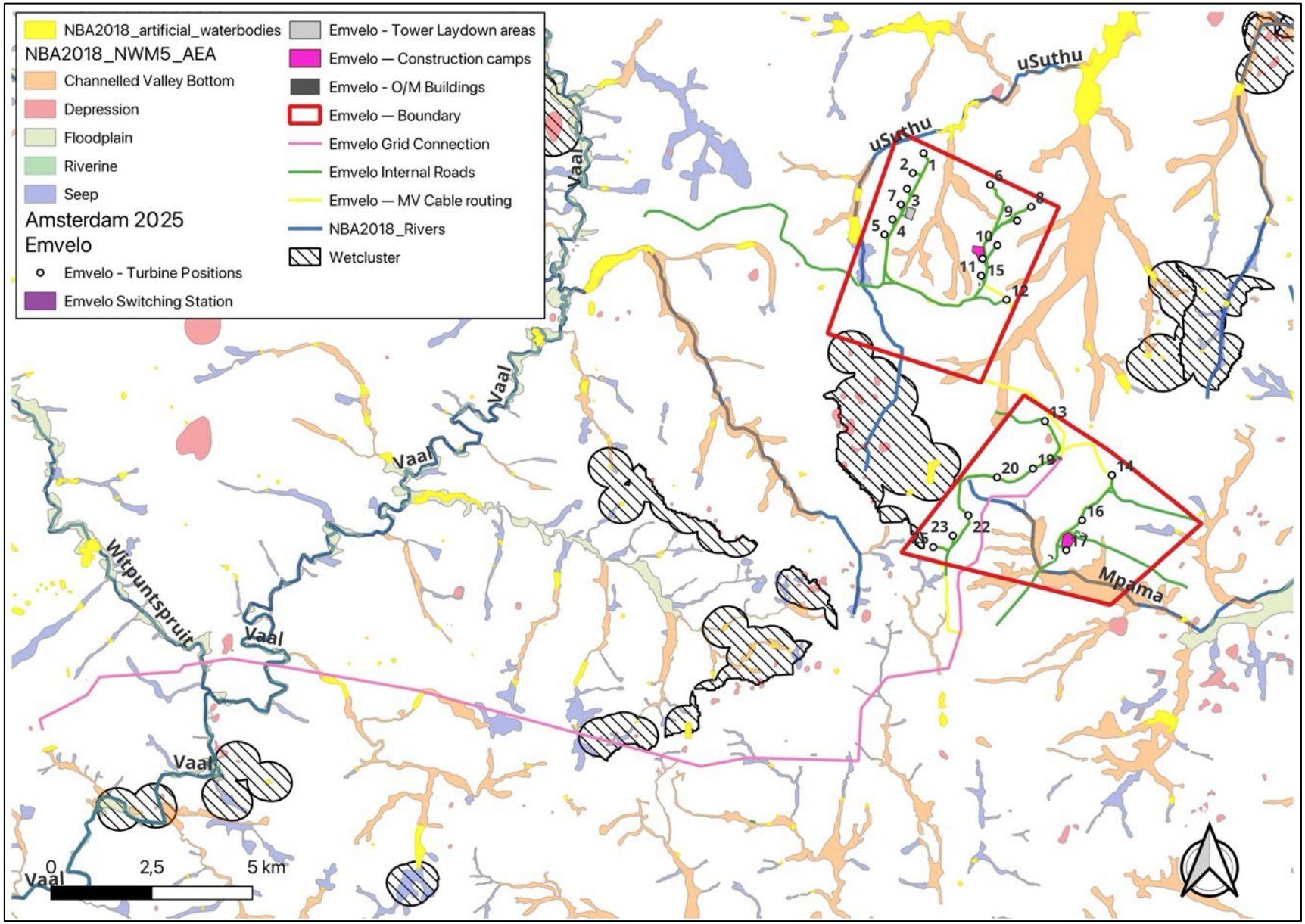


Figure 5: Various waterbodies identified in the National Wetland Inventory V5.2 (2020)

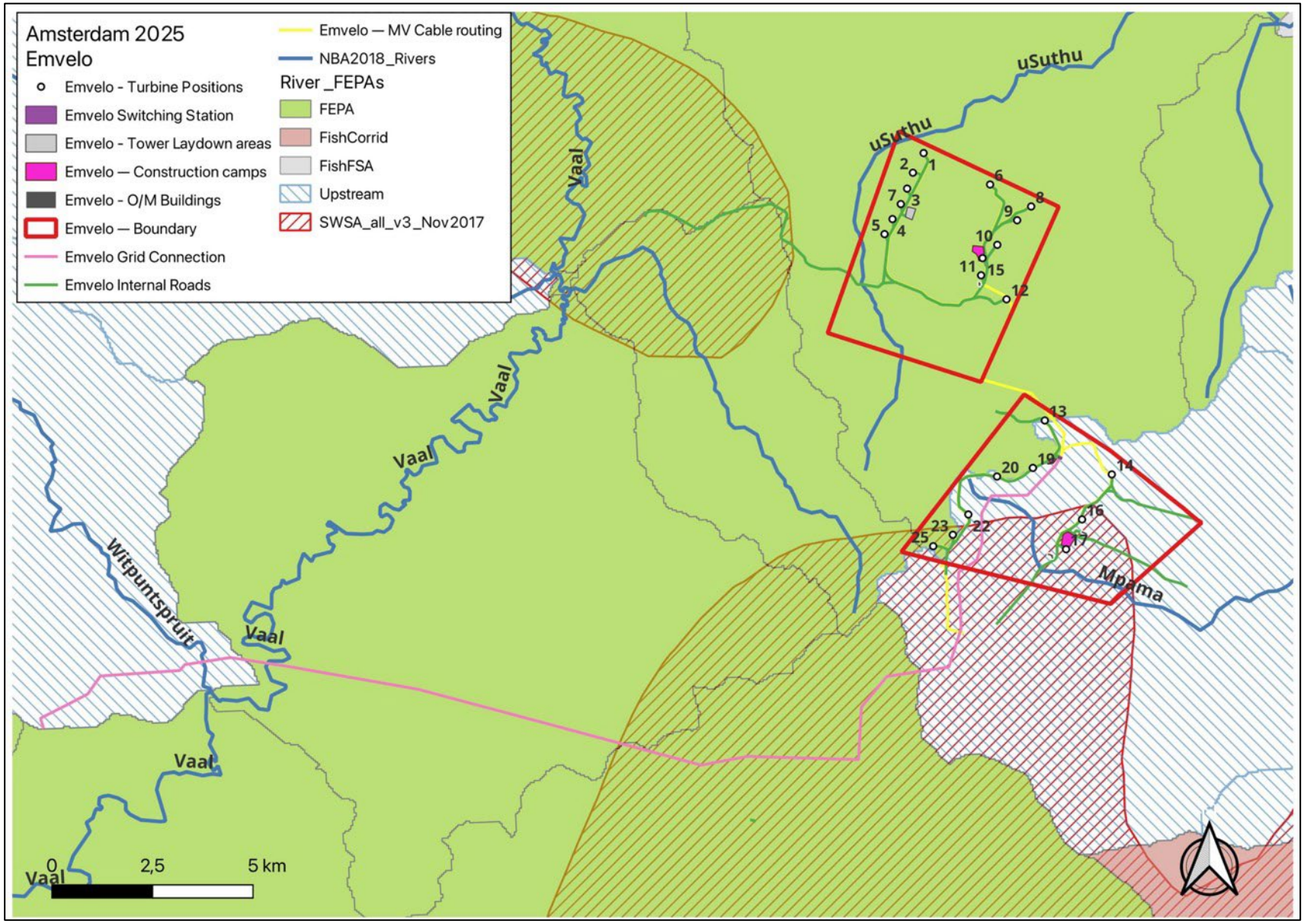


Figure 6: The respective Subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) and Strategic Water Resource Areas in relation to the study area

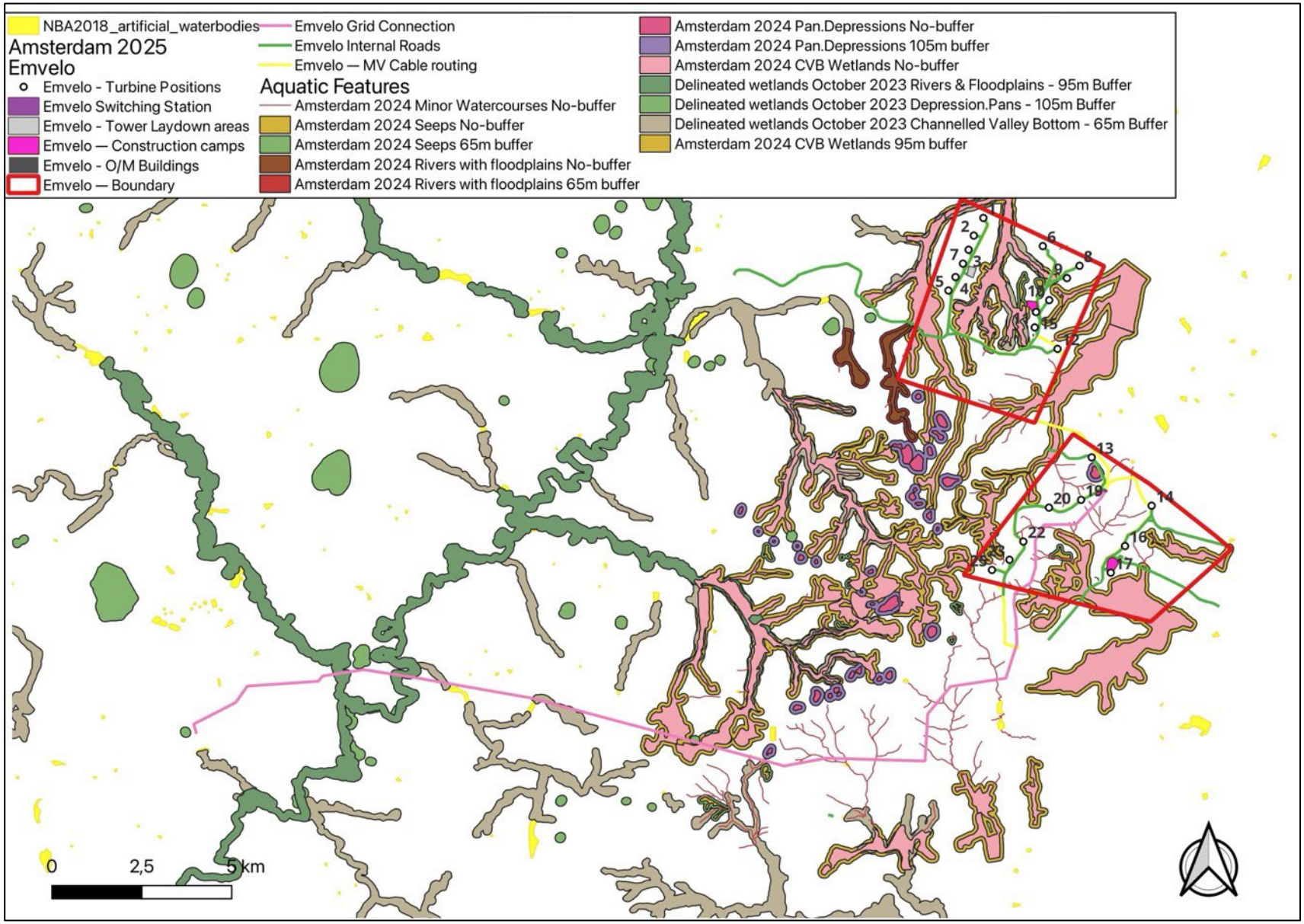


Figure 7: The confirmed watercourses and wetlands within the study area



Plate 1: A view of a mainstem watercourse (tributary of the Mpama River), with transformed floodplain



Plate 2: A view of channelled valley bottom wetland within a transformed catchment (crop production & grazing)



Plate 3: One of the smaller Endorheic Pans that is located near the OHL between the WEF and Ermelo



Plate 4: Seepage wetland in the headwater areas of the Vaal River / Usutu River catchment divide

6. Present Ecological State and conservation importance

The PES of a river 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 current models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014). The current PES system also 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 updated 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 Present Ecological State scores (PES) for the main watercourses in the study area were rated as follows (DWS, 2014 – where B = Largely Natural and C = Moderately Modified):

Subquaternary Catchment Number	Present Ecological State	Ecological Importance	Ecological Sensitivity
1630	B	Moderate	High
1710	B	Moderate	High
1678	C	High	Moderate
1693	C	High	High
1770	C	High	High

These scores were substantiated by observations made in the field within the study area, and due to the overall lack of impacts or disturbance these scores for each of the watercourses within the site should be upheld.

This was further substantiated by the inclusion of study area catchments into Critical Biodiversity Areas (Type 1 and 2), i.e. the wetland areas near the alignment crossing the Brak River in particular and Ecological Support Area as shown in the Mpumalanga CBA MAP spatial data and Wetland Clusters (Figure 8).

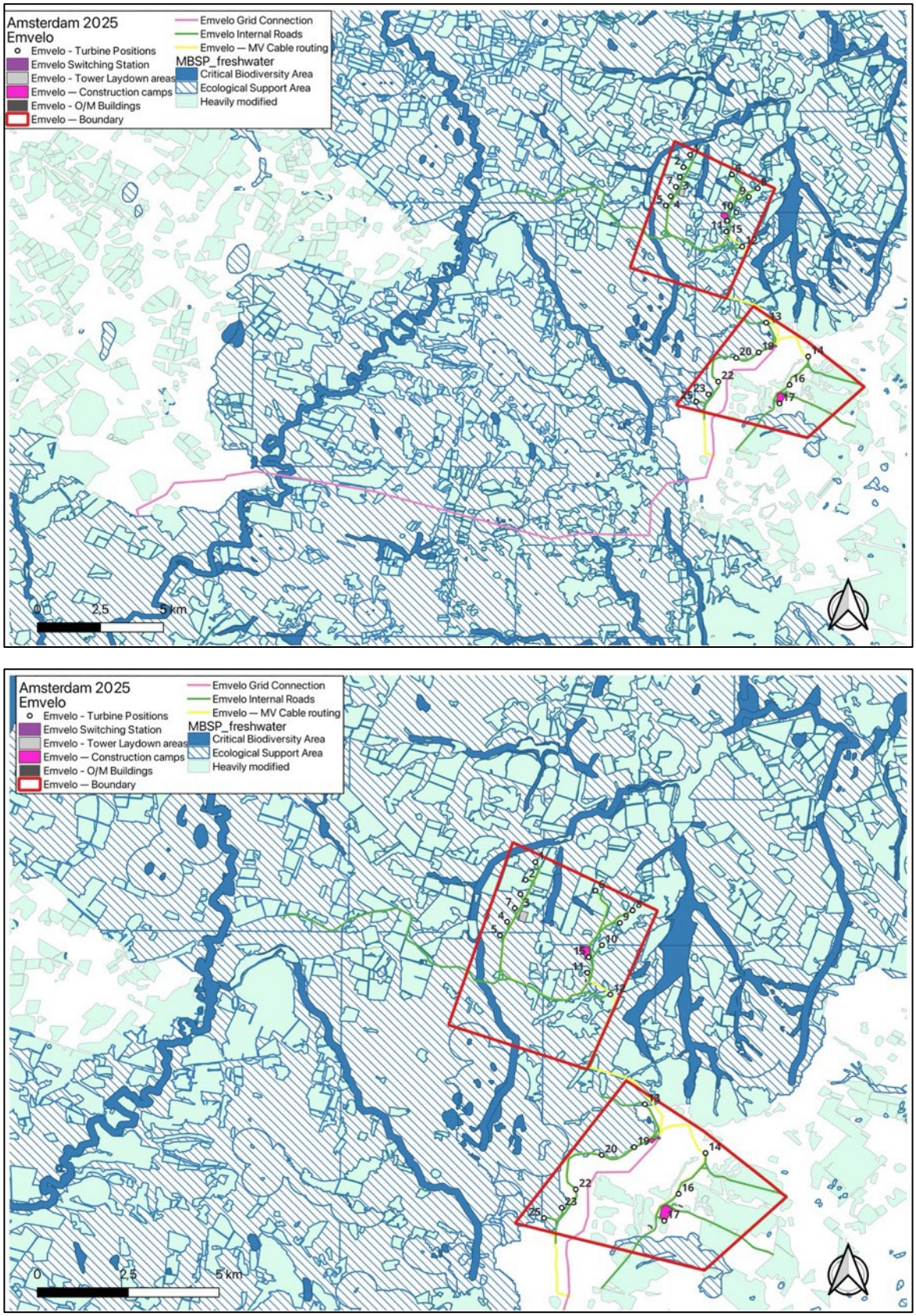


Figure 8: Critical Biodiversity Areas as per the Mpumalanga Biodiversity Spatial Plan, where the top map is for the project area and the bottom map is for the WEF

7. Permit requirements

Based on an assessment of the proposed activities and past engagement with DWS, the following WULs/ GA's could be required based on the following thresholds as listed in the following Government Notices, however ultimately the Department Water and Sanitation (DWS) will determine if a GA or full WULA will be required during the pre-application process (Phase 1):

	Water Use Activity	**Applicable to this development proposal**
S21(a)	Taking water from a water resource	Only water if water is abstracted from a local river or borehole
S21(b)	Storing water	If the total volume stored is greater than 40 000 m^3 then a full Water Use License will be required. This is however unlikely due to the scale of the project and the need for such large volumes.
S21(c)	Impeding or diverting the flow of water in a watercourse	Yes – several new crossings of watercourses (i.e. activities within 500m of a wetland or 100m of a watercourse will be required. A GA process can potentially be followed if Risk Assessment Matrix indicates all impacts are LOW.
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Not applicable – Only portable toilets will be required
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Not applicable
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Yes – several new crossings of watercourses (i.e. activities within 500m of a wetland or 100m of a watercourse will be required. A GA process can potentially be followed if Risk Assessment Matrix indicates all impacts are LOW.
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable
S21(k)	Using water for recreational purposes	Not applicable

8. Sensitivity Assessment

Using the baseline description and field data while considering the current disturbances and site characteristics, the following features were identified, then categorised into one of number pre-determined sensitivity categories to provide protect and/or guide the layout planning:

High = No Go	"No go" areas or setbacks and areas or features that are considered of such significance that impacting them may be regarded as fatal flaw or strongly influence the project impact significance profile Therefore areas or features that are considered to have a high sensitivity or where project infrastructure would be highly constrained and should be avoided as far as possible. Infrastructure located in these areas are likely to drive up impact significance ratings and mitigations
Medium	Buffer areas and or areas that are deemed to be of medium sensitivity but should still be avoid as this would minimise impacts and or the need for additional Water Use Authorisation
Low	Areas of low sensitivity or constraints, such as artificial systems with little to no biological value or would not result in any future licensing requirements e.g. dry earth wall farm dams
Neutral	Unconstrained areas (left blank in mapping)

Table 4 below provides an overview of the sensitivity of various aquatic features (with buffers distances included) as it relates to the main project component types for the project. The features are shown spatially in Figure 7 above.

The sensitivity ratings of High No-go and Low were determined through an assessment of the aquatic habitat sensitivity and related constraints. However, these No-Go areas (with buffers) relate in general terms to the project and there are areas where encroachment on these areas would occur (i.e. existing road crossings within systems, but this is considered acceptable since these areas have already been impacted.

These proposed constraints / buffers do not include bird and or bat specialist buffers / constraints as theirs buffers along aquatic features are at times far larger around aquatic features, than those required for the known aquatic species within this region.

Table 4: Results of the sensitivity rating / constraints assessment

Development Component	Habitat type	Sensitivity rating of the respective habitat type against the development type	Buffer distance (m)	Development acceptability	Sensitivity rating override if an impact such as a road or other disturbance already occurs within the proposed footprint and confirmed by the specialist
WTG towers	Channelled Valley Bottom Wetlands	No-Go	105m	No WTGs should be placed in any of these areas, regardless of the state, type and functionality of the respective aquatic ecosystem	None
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		
Hardstands, Buildings / Substations & BESS	Channelled Valley Bottom Wetlands	No-Go	105m	None of these types of infrastructure should be placed in any of these areas	None
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		
Roads & Underground cables alignment roads	Channelled Valley Bottom Wetlands	High	105m	New roads and underground cables would not be deem appropriate within any of these areas, unless some form of disturbance already occurs, such as an existing track or bridge	Only existing tracks or disturbed areas maybe used
	Pans and Depressions		95m		
	Rivers and Floodplains				
	Seeps		65m		
	Minor watercourses		35m		
OHL	Channelled Valley Bottom Wetlands	High	105m	OHL towers must be placed outside of these area so that only the cables span these systems. The exception being that Pans & Depression inclusive of buffers must be avoided completely	
	Pans and Depressions		95m		
	Rivers and Floodplains		65m		
	Seeps		65m		
	Minor watercourses		35m		

9. Impact assessment

During the impact assessment several potential key issues / impacts were identified and these were assessed based on the methodology supplied by ERM.

9.1 Alternatives Assessment

The 2014 EIA Regulations require that any feasible and reasonable activity, location and technology alternatives considered must be described and comparatively assessed.

9.2 No-Go Option

With regard the No-Go option it is assumed that the site would continue to degrade due to the prevalence of grazing and or erosion within the water courses. This would continue into the long-term with a Low intensity that would impact on the regional scale due to loss of important habitat. Little in the way of mitigation could be proposed due to the social needs of the surrounding residents and or landowners, coupled to the need for access.

10. Potential aquatic ecosystems impacts

- Impact 1: Loss of habitat containing protected species or Species of Special Concern
- Impact 2: Loss of any critical corridors, important catchment areas and connected habitats that are linked to any Critical Biodiversity Areas or Ecological Support Areas
- Impact 3: The potential spread of alien vegetation
- Impact 4: Loss of riparian and or wetland habitat
- Impact 5: Changes to the hydrological regime and increased potential for erosion
- Impact 6: Changes to water quality
- Impact 7: Cumulative Impacts

The Tables 5 – 11 below assesses the impact significance for each impact. It was determined that the impacts upon aquatic biodiversity associated with the project are of Low significance, after mitigation. This assumes that the mitigations listed below are considered coupled to the fact that the overall layouts have avoid any of the High / No-Go areas, unless making use of areas with impacts such as existing farm roads. However, it is assumed that the final layout will orientate the hardstands, crane pads, blade laydowns and construction camps outside of any of the No-Go areas.

The loss of irreplaceable aquatic habitat and/or important aquatic obligate biota is therefore highly unlikely. The impacts are easily mitigated (provided the mitigation measures and monitoring plan within the EMP and this report are implemented and adhered to during all phases of the project).

Table 5: Impact assessment summary for Impact 1 – Loss of habitat containing protected species or Species of Special Concern

Impact Phase: Construction and Decommissioning					
Nature of the impact: Loss of vegetation and in particular species / habitats that could contain listed as Critically Endangered and or Vulnerable species (direct)					
Description of Impact: Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones. Loss can also include a functional loss, through change in vegetation type via alien encroachment, reducing aquatic biodiversity. However no aquatic vegetation with conservation concern were observed during this assessment, coupled to the fact that any sensitive areas will be avoided.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					
Mitigation measures to reduce residual risk or enhance opportunities: • The development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to confirmation of the final layout prior to construction is made by the aquatic specialist. • Where large cut and fill areas are required, these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation. • Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc). To minimise the impact of the access roads: • Use existing roads or upgrade existing tracks rather than constructing entirely new roads wherever possible and has been included in the proposed layout.					

- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly before any construction commences.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Where required, all pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop because of the gradient change from the natural ground level to the invert level of the culvert.
- The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist, with a preference for low level drifts where possible.
- Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities.
- Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated.

It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.

Table 6: Impact assessment summary for Impact 2 – Loss of CBAs or potential areas with conservation potential or linked to any important catchments and strategic water resource areas

Impact Phase: Construction and Decommissioning					
Nature of the impact: Loss of any critical corridors and connect habitats that are linked to any future conservation plans (direct) is not expected as these can been avoided, coupled to the fact that hydrological connections will be retained through avoidance or the inclusion of ecological buffers.					
Description of Impact: Activities resulting in physical disturbance of aquatic systems which provide ecosystem services, especially where new crossings are made, or large hard engineered surfaces are placed within the buffer zones and have been included in any Critical Biodiversity Areas. it is assumed that the final layout will orientate the hardstands, crane pads, blade laydowns and construction camps outside of any of the No-Go areas.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					
Mitigation measures to reduce residual risk or enhance opportunities: • The aquatic systems have been mapped to a finer scale and have taken cognizance of any potential CBAs. As High / No-Go have been avoided by the major infrastructure such as turbines, the aquatic zones associated within the CBA / ESAs have also been avoided. Roads will need to traverse these areas, thus it is important to try and select existing areas with impacts / crossings where possible, coupled to the assumptions above • The development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to confirmation of the final layout prior to construction is made by the aquatic specialist. • Where large cut and fill areas are required, these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation. • Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc). To minimise the impact of the access roads: • Use existing roads or upgrade existing tracks rather than constructing entirely new roads wherever possible and has been included in the proposed layout. • Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.					

• Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils. • Where required, all pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert. • The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist, with a preference for low level drifts where possible. • Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities. • Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted. • All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated. It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.	
Residual impact	Very low and acceptable with adoption of mitigation measures

Table 7: Impact assessment summary for Impact 3 – Potential spread of alien vegetation

Impact Phase: Construction and Operation					
Nature of the impact: Any physical disturbance could result in the spread of alien vegetation (direct)					
Description of Impact: During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required. This disturbance then allows for the alien species to colonise the soils, if left unmanaged.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					

Mitigation measures to reduce residual risk or enhance opportunities: • Alien vegetation management must be initiated at the beginning of the construction period and must extend into any remaining areas into the operation phase on the facility • The revegetation of any temporary sites as well as any previously degraded areas must begin from the onset of the project, with the involvement of a botanist to assist with the revegetation specifications Regeneration of alien vegetation must be monitored once all areas have been cleared, forming part of a long-term alien vegetation management plan

Residual impact	Very low and acceptable, with adoption of mitigation measures and monitoring

Table 8: Impact assessment summary for Impact 4 – Loss of riparian and or wetland habitat

Impact Phase: Construction and Decommissioning					
Nature of the impact: It was recommended that all wetlands / riverine systems as well as the inclusive of buffers, be avoided. it is assumed that the final layout will orientate the hardstands, crane pads, blade laydowns and construction camps outside of any of the No-Go areas.					
Description of Impact: During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required, which may impact the aquatic function or any corridors or connections between aquatic systems. However, all Very High Sensitivity / No-Go areas have been avoided by the proposed layout by also making use of existing road crossings or considering any of the proposed buffers.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					
Mitigation measures to reduce residual risk or enhance opportunities: • The development of the stormwater management plan and Aquatic Rehabilitation and Monitoring plan, coupled to confirmation of the final layout prior to construction is made by the aquatic specialist. • Where large cut and fill areas are required these must be stabilised and rehabilitated during the construction process, to minimise erosion and sedimentation. • Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through whatever additional interventions maybe necessary (i.e., extension, energy dissipaters, spreaders, etc). To minimise the impact of the access roads: • Use existing roads or upgrade existing tracks rather than constructing entirely new roads wherever possible and has been included in the proposed layout.					

• Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences. • Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils. • Where required, all pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert. • The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist, with a preference for low level drifts where possible. • Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities. • Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted. • All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated. It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.	
Residual impact	Very low and acceptable with adoption of mitigation measures

Table 9: Impact assessment summary for Impact 5 – Changes to the hydrological regime and increase potential for erosion

Impact Phase: Construction and Decommissioning					
Nature of the impact: Increased hard surfaces can result in increases in runoff generated by the site, thereby resulting in changes to localised hydrological regimes.					
Description of Impact: During construction, complete clearing of the roads and turbine areas, as well any ancillary structures (offices and substations) will be required, which may impact the aquatic function or any corridors or connections between aquatic systems. However, these areas must be by the proposed layout by also making use of existing road crossings or by considering any of the proposed buffers.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability

Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					

Mitigation measures to reduce residual risk or enhance opportunities:

- No stormwater discharged may be directed to delineated aquatic zones or the associated buffers.
- A stormwater management plan finalised prior to construction, detailing the structures and actions that must be installed to prevent the increase of surface water flows directly into any natural systems.
- Effective stormwater management must include measures to slow, spread and deplete the energy of concentrated flows thorough effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed areas

To minimise the impact of the access roads:

- Use existing roads or upgrade existing tracks rather than constructing entirely new roads wherever possible and has been included in the proposed layout.
- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas.. Where intrusion is required, the working corridor must be kept to a minimum and demarcated clearly, before any construction commences.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Where required, all pipe culverts must be removed and replaced with suitable sized box culverts, where road levels are raised. Crossings that are installed below the natural ground level are to be constructed with an appropriate drop inlet structure on the upstream side to ensure that head cut erosion does not develop as a result of the gradient change from the natural ground level to the invert level of the culvert.
- The channel profile, regardless of the current state of the river / water course, will be reinstated thus preventing any impoundments from being formed. The related designs must be assessed by an aquatic specialist, with a preference for low level drifts where possible.
- Water diversions must be temporary in nature and no permanent walls, berms or dams may be installed within a watercourse. Sandbags used in any diversion or for any other activity within a watercourse must be in a good condition, so that they do not burst and empty sediment into the watercourse. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns. Under no circumstance shall a new channel or drainage canals be excavated to divert water away from construction activities.
- Any fauna (frogs, snakes, etc.) that are found within the construction area must be moved to the closest point of similar habitat type outside of the areas to be impacted.
- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated.

It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.

Residual impact	Very low and acceptable with adoption of mitigation measures

Table 10: Impact assessment summary for Impact 6 –Changes to surface water quality characteristics

Impact Phase: Construction and Decommissioning					
Nature of the impact: Potential impact on localised surface water quality (indirect)					
Description of Impact: During construction or decommissioning, earthworks will expose and mobilise earth materials, and a number of materials as well as chemicals will be imported and used on site and may end up in the surface water, including soaps, oils, grease and fuels, human wastes, cementitious wastes, paints and solvents, etc. Any spills during transport or while works area conducted in proximity to a watercourse has the potential to affect the surrounding biota. This can result in possible deterioration in aquatic ecosystem integrity and species diversity.					
Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Was public comment received? Not yet					
Has public comment been included in mitigation measures? Note still in the draft phase and that comment will be obtained during the NEMA comment periods					
Mitigation measures to reduce residual risk or enhance opportunities: • All liquid chemicals including fuels and oil, including for the BESS, must be stored in with secondary containment (bunds or containers or berms) that can contain a leak or spill. Such facilities must be inspected routinely and must have the suitable PPE and spill kits needed to contain likely worst-case scenario leak or spill in that facility, safely. • Washing and cleaning of equipment must be done in designated wash bays, where rinse water is contained in evaporation/sedimentation ponds (to capture oils, grease cement and sediment). • Mechanical plant and bowsers must not be refueled or serviced within 100m of a river channel or wetland. • All construction camps, lay down areas, wash bays, batching plants or areas and any stores should be beyond any demarcated water courses and their respective buffers. • Littering and contamination associated with construction activity must be avoided through effective construction camp management. • No stockpiling should take place within or near a water course. • All stockpiles must be protected and located in flat areas where run-off will be minimised and sediment recoverable.					

ECO monitors the site on a daily basis to ensure plant is in working order (minimise leaks), spills are prevented and if they do occur, are quickly rectified.	
Residual impact	Low risk and acceptable, with adoption of mitigation measures and monitoring

Table 11: Impact assessment summary for Impact 7 - Cumulative impact assessment for aquatic biodiversity

Cumulative Impact: Cumulative impacts on the aquatic resources of the area					
Description of Cumulative Impact: The cumulative impact assessment considers the combined impact of the remaining and other renewable projects within a 30km radius, that are also in the development phase and the associated grid lines on the aquatic resources. The rating below is based on the premise that important or sensitive features will be avoided by the various projects, while the mitigations proposed will ensure that the form and or function of downstream areas remain intact.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Long Term	Irreversible	Medium	Probable
Score	2	4	5	2	3
With Mitigation	Site	Short Term	Recoverable	Low	Low Probability
Score	1	2	3	1	2
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	Moderate Negative Impact (39)			Low Negative Impact (14)	
Can Impacts be Enhanced?	No				
Enhancement: The project should share roads and infrastructure where possible to reduce the overall footprint and reduce stormwater and erosion and sedimentation related impacts The projects should collaborate with provincial roads authority to upgrade the main access routes and improve the crossings and stormwater controls					
Residual impact	Low				

11. Draft Specialists Recommendations for the EA

The DFFE Screening Tool identified two sensitivity ratings within the development footprint, namely, Low and Very High. There is overlap with the findings on site and the Screening Tool's outcome, thus the development footprint must be developed with cognisance of these sensitivities.

Therefore, environmental sensitivity input received from the aquatic ecology specialist was taken forward and considered within the EIA process and the impact to these areas assessed. 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. However, it is assumed that the final layout will orientate the hardstands, crane pads, blade laydowns outside of any of the No-Go areas.

The specialist has no objection to the authorisation of the proposed activities assuming that all mitigations and buffer zones are implemented.

Mitigation should focus on these areas and include measures to halt erosion and rehabilitate habitat in the sections affected by the construction. Without the implementation of mitigation measures, the project has potential to cause a Low cumulative impact upon aquatic biodiversity. However, with the adoption of mitigation, the proposed project will have a Very Low impact upon aquatic biodiversity.

12. Monitoring and Management Actions

The following are key recommendations, which are also critical to the proposed mitigations:

- Any of the activities, should also be monitored by the appointed Environmental Officer /Environmental Control Officer (EO/ECO) on a daily basis, especially during periods of river flow during construction.
- Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems.
- The EMPr, must include a Construction Specific Monitoring and Rehabilitation Plan related to the water course and wetland crossings, and specifically to the prevention of erosion and sedimentation as these systems are prone to scour, with rehabilitation options being limited due to the sparse nature of the vegetation.
- Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then the WULA/GA must be amended to include these areas.

13.Conclusion and Recommendations

During this assessment, several sensitive aquatic habitats were observed and are shown in the maps provided in this report. Noteworthy areas, were then avoided by the required infrastructure, and include the main riverine and wetland systems, while the access roads could will make use of existing roads thus previously disturbed areas.

If this is carried out, then the specialist has no objection to the authorisation of the proposed activities assuming that all mitigations and buffer zones are implemented.

Mitigation should focus on these areas and include measures to halt erosion and rehabilitate habitat in the sections affected by the construction. Without the implementation of mitigation measures, the project has potential to cause a Moderate cumulative impact upon aquatic biodiversity. However, with the adoption of mitigation, the proposed project will have a Low impact upon aquatic biodiversity.

As the proposed activities have the potential to create erosion the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment, and suitable dust and erosion control mitigation measures should be included in the generic EMPr, if not included already to mitigate.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel. It is therefore suggested that all construction camps, lay down areas, batching plants or areas and any stores should be located more than 50 m from any demarcated watercourses.

- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.
- All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.

It is further recommended from the project onset that all watercourse areas (inclusive of buffers) are included into any existing EMPr as reference, this to ensure a net benefit to the aquatic environment. This should from part of the suggested walk down as part of the final EMP preparation.

14.References

Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998.

Agricultural Resources Act, 1983 (Act No. 43 of 1983).

Department of Water Affairs and Forestry - DWAF (2005). A practical field procedure for identification and delineation of wetland and riparian areas Edition 1. Department of Water Affairs and Forestry, Pretoria. Updated with amendments in 2007.

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: [W5 (for example)]. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx

Germishuizen, G. and Meyer, N.L. (eds) (2003). Plants of southern Africa: an annotated checklist. Strelitzia 14, South African National Biodiversity Institute, Pretoria.

Holness, S & Oosthuysen, E. 2016. Northern Cape Critical Biodiversity Area map, SANBI BGIS.

Kleynhans C.J., Thirion C. and Moolman J. (2005). A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Macfarlane, D.M. & Bredin, I.P. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. WRC Report No TT 715/1/17 Water Research Commission, Pretoria.

Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), as amended.

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

National Water Act, 1998 (Act No. 36 of 1998), as amended

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

12. Appendix 1 - Specialist CV

CURRICULUM VITAE
Dr Brian Michael Colloty
7212215031083

1 Rossini Rd
Pari Park
Port Elizabeth, 6070
b.colloty@gmail.com
083 498 3299

Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07)
Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of terrestrial habitats, wetlands, rivers & estuaries
Years experience: 25 years

SKILLS BASE AND CORE COMPETENCIES

- 25 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 15 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMU
- 1995: B Sc Hon (Zoology) - NMU
- 1996: M Sc (Botany - Rivers) - NMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela University – SAB institute for Coastal Research & Management. Funded by the WRC to develop estuarine importance rating methods for South African Estuaries
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – August 2018 Owner / Ecologist of Scherman Colloty & Associates cc
- August 2018 Owner / Ecologist - EnviroSci (Pty) Ltd

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Kenmare Mining Pilivilli, Mozambique - wetland (mangroves, peatlands and estuarine) assessment and biodiversity offset analysis - current
- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofeuls Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Plant and animal search and rescue for the Karusa, Soetwater, Nxuba, Oyster Bay and Garob Wind Farms on behalf of Enel Green Power, 2018 - 2019
- Plant and Animal Search and Rescue for the Port of Ngqura, Transnet Landside infrastructure Project, with development and management of on site nursery (Current).
- Plant and Animal Search and Rescue for the Port of Ngqura, OTGC Tank Farm Project (2019)
- Plant search and rescue, for NMBM (Driftsands sewer, Glen Hurd Drive), Department of Social Development (Military veterans housing, Despatch) and Nxuba Wind Farm, - current
- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.
- CDC IDZ Alien eradication plans for three renewable projects Coega Wind Farm, Sonop Wind Farm and Coega PV, on behalf of JG Afrika (2016 – 2017).
- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current
- Rangers Biomass Gasification Project (Uitenhage), biodiversity and wetland assessment and wetland rehabilitation / monitoring plans for CEM IEM Unit – current.
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - current
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Mogalakwena 33kv transmission line in the Limpopo Province, on behlaf of Aurecon, 2016
- Cape St Francis WWTW expansion wetland and passive treatment system for the Kouga Municipality, 2015
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Pola park bulk sewer line upgrade aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exarro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 101 renewable projects in the past 8 years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, Red Cap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. Particular aquatic sensitivity assessment and Water Use License Applications on behalf of Mainstream Renewable Energy (8 wind farms and 3 PV facilities.), Cennergi / Exxaro (2 Wind farms), WKN Wind current (2 wind farms & 2 PV facilities), ACED (6 wind farms) and Windlab (3 Wind farms) were also conducted. Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the PE to George, George to Graaf Reinet, PE to Colesburg, and East London to Bloemfontein on behalf of SRK (2013-2015).

15.Appendix 2 - Site Sensitivity Verification Report

Site verification report – Aquatic Ecology

Government Notice No. 645, dated 10 May 2019, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

(a) Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
(b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;
(c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Basic Assessment Report produced for the project.

Site sensitivity based on the aquatic biodiversity theme included in the Screening Tool and specialist assessment

Based on the DFFE Screening Tool, the WEF and Grid Connection falls within areas of very high sensitivity (Figure 1).

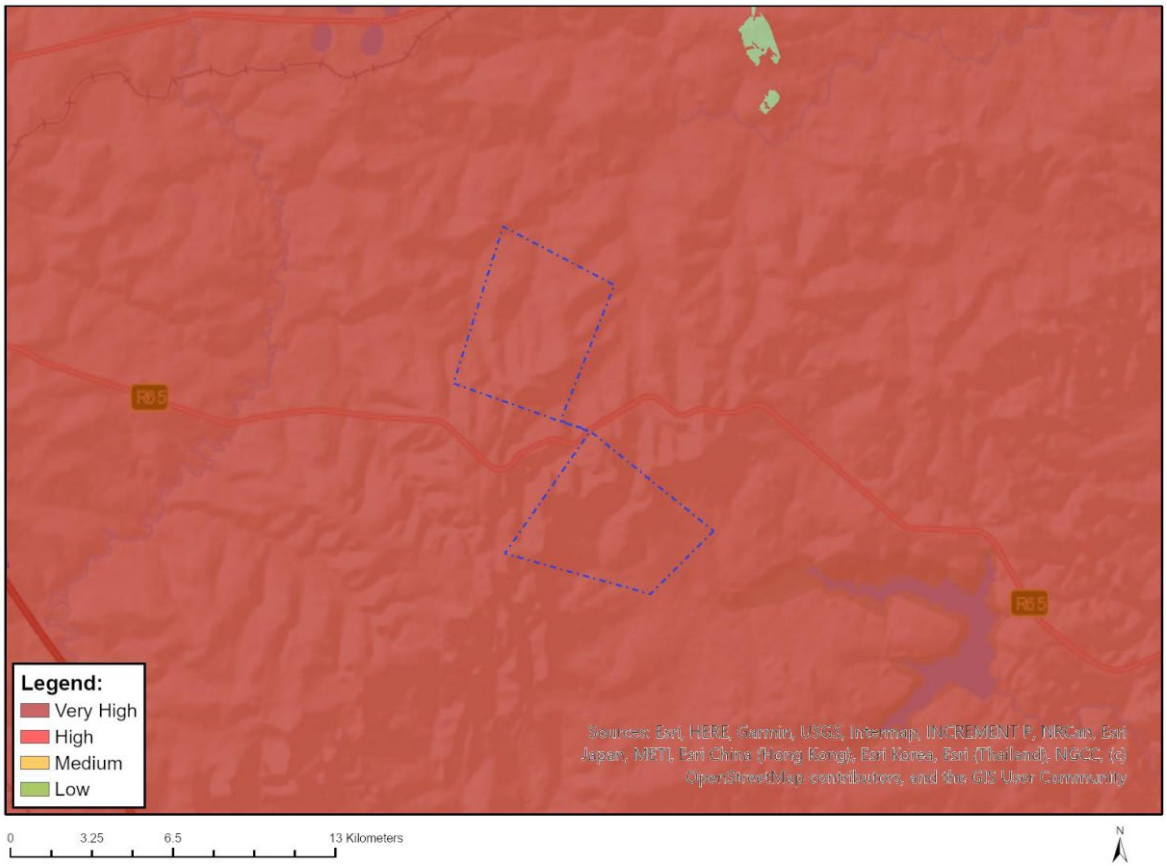


Figure 1a. DFFE Screening Tool outcome for the aquatic biodiversity theme for the WEF site

Figure 1b. DFFE Screening Tool outcome for the aquatic biodiversity theme for the Preferred Grid option

Based on the above outcomes, the specialist **agrees** the environmental sensitivities identified on site. However, disputes the exact extent of the systems, as the Screening Tool shows a catchment wide representation of the aquatic waterbodies that were rated as sensitive.

The specialist findings were informed by a site visits undertaken by Dr Brian Colloty over the course of several years. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping and the site. A baseline map was then developed which was refined, noting that due to the complex of the topography and geology, some of the river lines were digitised at a scale of 1:2000.

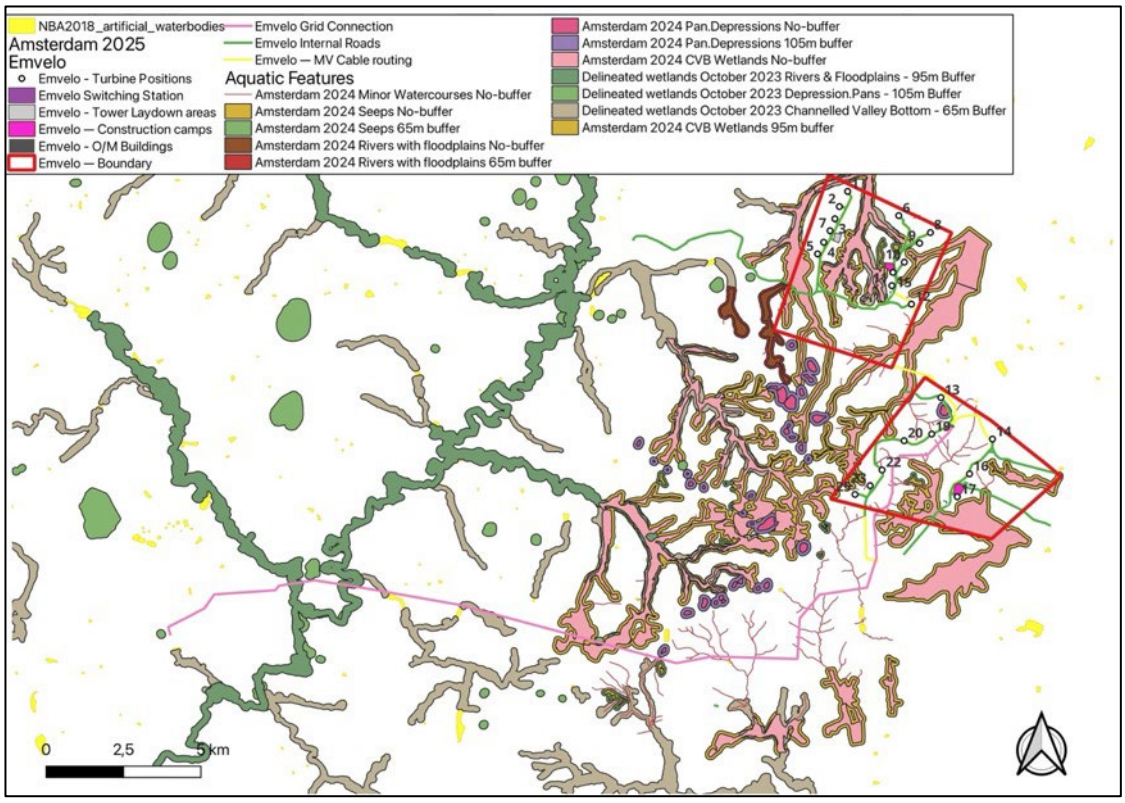


Figure 2. Environmental sensitivity map produced by the aquatic specialist

Motivation of the outcomes of the sensitivity map and key conclusions

In conclusion, the DFFE Screening Tool identified one sensitivity rating within the development footprint, namely, Very High.

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 several site visits and spatial input considerations.

The environmental sensitivity input received from the aquatic ecology specialist wase taken forward and considered within the formal EA process and the impact to these areas assessed. 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.

16. Appendix 3: Compliance with the Aquatic Biodiversity Protocol (GN 320, 20 March 2020)

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	***Section where this has been addressed in the Specialist Report***
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects: *2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including;* *a) aquatic ecosystem types; and* *b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution, and movement patterns;*	*Section 5 & 6 of this report*
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	*Section 5 & 6 of this report*
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e., if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free -flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	*Section 5 & 6 of this report*
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including: *a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g., movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and* *b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian, and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).*	*Section 5 & 6 of this report*
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	*Section 9 of this report*
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: *2.5.1. Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?* *2.5.2. Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?* *2.5.3. How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:* *a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g., suppression of floods, loss of flood attenuation*	*Section 9 of this report*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	*Section where this has been addressed in the Specialist Report*
capacity, unseasonal flooding or destruction of floodplain processes); *b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns);* *c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g., at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and* *d) to what extent will the risks associated with water uses and related activities change;*	
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include: *a) base flows (e.g., too little or too much water in terms of characteristics and requirements of the system);* *b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over - abstraction or instream or off stream impoundment of a wetland or river);* *c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchannelled valley-bottom wetland to a channelled valley -bottom wetland);* *d) quality of water (e.g., due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);* *e) fragmentation (e.g., road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and* *f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g., waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);*	*Section 9 of this report*
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially: *a) flood attenuation;* *b) streamflow regulation;* *c) sediment trapping;* *d) phosphate assimilation;* *e) nitrate assimilation;* *f) toxicant assimilation;* *g) erosion control; and* *h) carbon storage?*	*Section 9 of this report*
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	*Section 9 of this report*
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to:	*N/A*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	*Section where this has been addressed in the Specialist Report*
a) size of the estuary; *b) availability of sediment;* *c) wave action in the mouth;* *d) protection of the mouth;* *e) beach slope;* *f) volume of mean annual runoff; and* *g) extent of saline intrusion (especially relevant to permanently open systems).*	
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	*This report*
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	*Appendix 1*
2.7.2. a signed statement of independence by the specialist;	*Attached to EIA / BAR*
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	*Section 5 & 6 of this report*
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	*Section 4*
2.7.5. a description of the assumptions made any uncertainties or gaps in knowledge or data;	*Section 1*
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	*Section 8*
2.7.7. additional environmental impacts expected from the proposed development;	*Section 9*
2.7.8. any direct, indirect, and cumulative impacts of the proposed development on site;	*Section 9*
2.7.9. the degree to which impacts, and risks can be mitigated;	*Section 9*
2.7.10. the degree to which the impacts and risks can be reversed;	*Section 9*
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	*Section 9*
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	*Section 4*
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	*Section 10, 11 & 12*
2.7.14. a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	*Section 9*
2.7.15. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	*Section 13*
2.7.16. any conditions to which this statement is subjected.	*Section 11*
2.8. The findings of the Aquatic Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report including the mitigation	*Yes*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	*Section where this has been addressed in the Specialist Report*
and monitoring measures as identified, that are to be included in the EMPr.	
2.9. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	*Yes*

info@soilza.co.za
www.soilza.co.za
Postnet Suite #500
Private Bag X16
CONSTANTIA, 7848

SITE SENSITIVITY VERIFICATION
AND
AGRICULTURAL AGRO-ECOSYSTEM SPECIALIST ASSESSMENT
FOR
THE PROPOSED EMVELO WIND ENERGY FACILITY
NEAR ERMELO IN MPUMALANGA PROVINCE

Report by
Johann Lanz

16 May 2025

Table of Contents

Executive Summary 3
1 Introduction 5
2 Project description 6
3 Terms of reference 6
4 Methodology of study 9
5 Assumptions, uncertainties or gaps in knowledge or data 10
6 Applicable legislation and permit requirements 10
7 Baseline description of the agro-ecosystem 11
7.1 Assessment of the agricultural production potential 13
8 Site sensitivity verification 16
9 Assessment of agricultural impact 19
9.1 Impact identification and assessment 19
9.2 Cumulative impact assessment 21
9.3 Assessment of alternatives 23
10 Mitigation measures 24
11 Additional aspects required in an agricultural assessment 24
11.1 Micro siting 24
11.2 Confirmation of linear activity impact 24
11.3 Compliance with the allowable development limits 25
11.4 Long term benefits versus agricultural benefits 25
11.5 Additional environmental impacts 26
12 Conclusion 26
13 References 27
Appendix 1: Specialist Curriculum Vitae 29
Appendix 2: Specialist declaration form August 2023 30
Appendix 3: SACNASP Registration Certificate 33
Appendix 4: Projects included in cumulative impact assessment 34
Appendix 5: Soil data 35

EXECUTIVE SUMMARY

South Africa urgently needs electricity generation, and renewable energy offers good potential for that, but requires land. Inevitably agriculturally zoned land will need to be used for much of the renewable energy generation that the country requires. However, to ensure food security, energy facilities should not result in a loss of crop production.

The overall conclusion of this assessment is that the proposed development offers a valuable opportunity for integrating renewable energy with agricultural production in a way that provides benefits to agriculture but leads to insignificant loss of future agricultural production potential.

The site is classified as ranging from low to very high agricultural sensitivity by the screening tool. This site sensitivity verification verifies those parts of the site that are indicated as cropland in this assessment as being of high agricultural sensitivity, and the rest of the site as being of medium agricultural sensitivity.

In general, the soils across more than half of the site have insufficient capability for viable crop production and those on the remaining proportion are suitable for viable cropping. Soil limitations that prevent crop production are predominantly the result of limited depth due to underlying bedrock, clay, or hardpan, or the result of poor drainage. The crop-suitable versus unsuitable soils have been identified over time through trial and error. All the deep, well-drained, suitable soils are generally cropped and uncropped soils that are used for grazing can fairly reliably be considered to have various limitations that make them unsuitable for crop production.

In general, the agricultural production potential of the site is high, and it is within an area that makes a significant contribution to food production in the country. Due to the favourable climate, crop yields are high on the suitable soils with average maize yields of around 7 tons per hectare according to the farmers on site.

An agricultural impact is a change to the future agricultural production potential of land. This is primarily caused by the exclusion of agriculture from the footprint of a development. In the case of wind farms, the amount of land excluded from agriculture is so small that the total extent of the loss of future agricultural production potential is insignificantly small, regardless of how much production potential the land has, and regardless of the duration of the impact. Furthermore, wind farms have both positive and negative effects on the production potential of land, and it is the net sum of these positive and negative effects that determines the extent of the change in future production potential. The positive effects are:

1. increased financial security for farming
2. improved security against stock theft and other crime

3. an improved road network, with associated storm water handling system

Due to the facts that the proposed development will exclude agricultural production from only a very small area of land, and that its negative impact is offset by economic and other benefits to farming, the overall negative agricultural impact of the development (loss of future agricultural production potential) is assessed here as being of low significance and as acceptable.

Its acceptability is further substantiated by the following points:

1. The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.
2. 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.
3. 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. Furthermore, a reduction in coal power saves water resources and therefore potentially makes more water available for irrigated agriculture.

1 INTRODUCTION

Environmental and change of land use authorisation is being sought for the Emvelo Wind Energy Facility near Ermelo in Mpumalanga Province (see location in Figure 1). In terms of the National Environmental Management Act (Act No 107 of 1998 - NEMA), an application for environmental authorisation requires an agricultural assessment. In this case, because the assessed area includes high agricultural sensitivity land (see Section 8), the level of agricultural assessment required by the agricultural protocol is an Agricultural Agro-Ecosystem Specialist Assessment.

The purpose of an agricultural assessment is to answer the question:

> **Will the proposed development cause a significant reduction in agricultural production potential, and most importantly, will it result in a loss of arable land?**

Section 9 of this report unpacks this question, particularly with respect to what constitutes a significant reduction. To answer the above question, it is necessary to determine the existing agricultural production potential of the land that will be impacted, and specifically whether it is viable arable land or not. This is done in Section 7 of this report. Section 7, 9, and the conclusion of this report directly address the above question and therefore contain the essence of the agricultural impact assessment.

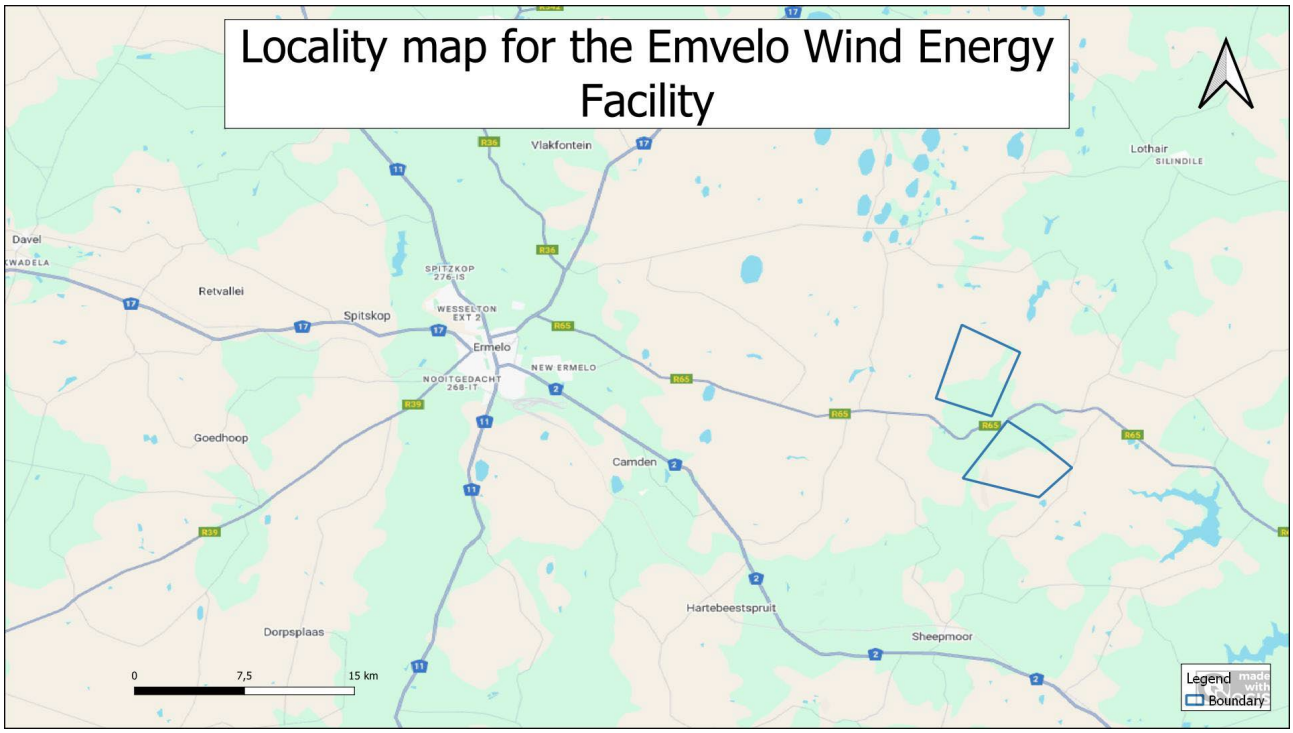


Figure 1. Locality map of the cadastral boundary of the proposed energy facility (blue outline) to the south-east of the town of Ermelo.

2 PROJECT DESCRIPTION

The proposed facility will consist of the standard infrastructure of a wind energy facility including, 29 turbines with foundations; crane pads per turbine; cabling; battery energy storage system (BESS); auxiliary buildings; access and internal roads; on-site IPP substation; 132kV grid connection, including an Eskom switching station and overhead power line; and temporary construction laydown areas.

What is relevant for agricultural impact in a wind energy facility layout is the extent of the total agricultural footprint – that is the very small and widely distributed footprint of land from which agriculture is actually excluded. The largest components of this footprint are the crane pads and the roads. The identification of individual components within this footprint is irrelevant to agricultural impact because all components have the same impact, namely occupation of agricultural land. Therefore, it is simply the location of the total footprint that matters.

This assessment includes the impact of the grid connection. However, a power line has negligible agricultural impact and is therefore not considered to be part of the agricultural footprint of a renewable energy facility in NEMA's agricultural protocol and the associated Eskom switching station has an insignificant footprint in the context of the entire development. The grid connection does not add in any way to the agricultural impact of the facility as assessed in this report.

3 TERMS OF REFERENCE

The terms of reference for this study are to fulfill the requirements of the *Protocol for the specialist assessment and minimum report content requirements of environmental impacts on agricultural resources by onshore wind and/or solar photovoltaic energy generation facilities where the electricity output is 20 megawatts or more*, gazetted on 20 March 2020 in GN 320 (in terms of Sections 24(5)(A) and (H) and 44 of NEMA, 1998).

The terms of reference for an Agricultural Agro-Ecosystem Specialist Assessment, as copied exactly from the protocol, are listed in the table below, and included, is the place in this report where each is addressed.

Table 1: *Reporting requirements as per NEMA's Agricultural Protocol.*

Number	Requirement	Where it is addressed
2.	Agricultural Agro-Ecosystem Specialist Assessment	
2.1.	The assessment must be undertaken by a soil scientist or agricultural specialist registered with the South African Council of Natural Scientific	Appendix 3

	Professionals (SACNASP).	
2.2.	The assessment must be undertaken on the preferred site and within the proposed development footprint.	Figure 2
2.3.	The assessment must be undertaken based on a site inspection as well as an investigation of the current production figures, where the land is under cultivation or has been within the past 5 years, and must identify:	Section 4
2.3.1.	the extent of the impact of the proposed development on the agricultural resources; and	Section 9.1
2.3.2.	whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such an impact is outweighed by the positive impact of the proposed development on agricultural resources.	Section 9.1
2.4.	The assessment must include a description of the status quo, including the following aspects which must be considered as a minimum in the baseline description of the agro-ecosystem:	Section 7
2.4.1.	the soil form/s, soil depth (effective and total soil depth), top and sub-soil clay percentage, terrain unit and slope;	Section 7 & Appendix 4
2.4.2.	the soil form, soil depth (effective and total soil depth), top and sub-soil clay percentage, terrain unit and slope;	Section 7 & Appendix 4
2.4.3.	where applicable, the vegetation composition, available water sources as well as agro-climatic information;	Section 7
2.4.4.	the current productivity of the land based on production figures for all agricultural activities undertaken on the land for the past 5 years, expressed as an annual figure and broken down into production units;	Section 7
2.4.5.	the current employment figures (both permanent and casual) for the land for the past 3 years, expressed as an annual figure; and	Section 7
2.4.6.	existing impacts on the site, located on a map (e.g. erosion, alien vegetation, non-agricultural infrastructure, waste, etc.).	Section 7
2.5.	The assessment must include an assessment of impacts, including the following aspects which must be considered as a minimum in the predicted impact of the proposed development on the agro-ecosystem:	Section 9.1
2.5.1.	change in productivity for all agricultural activities based on the figures of the past 5 years, expressed as an annual figure and broken down into production units;	Section 9.1
2.5.2.	change in employment figures (both permanent and casual) for the past 5 years expressed as an annual figure; and	Section 9.1
2.5.3.	any alternative development footprints within the preferred site which would be of “medium” or “low” sensitivity for agricultural resources as identified by the screening tool and verified through the site sensitivity	Section 9.3

	verification.	
2.6.	The findings of the Agricultural Agro-Ecosystem Specialist Assessment must be written up in an Agricultural Agro-Ecosystem Specialist Report that contains as a minimum the following information:	
2.6.1.	details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae;	Appendix 1
2.6.2.	a signed statement of independence by the specialist;	Appendix 2
2.6.3.	the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 4
2.6.4.	a description of the methodology used to undertake the on-site assessment inclusive of the equipment and models used, as relevant;	Section 4
2.6.5.	a map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool;	**Figure 8**
2.6.6.	an indication of the potential losses in production and employment from the change of the agricultural use of land as a result of the proposed development;	Section 9.1
2.6.7.	an indication of possible long term benefits that will be generated by the project in relation to the benefits of the agricultural activities on the affected land;	Section 10.4
2.6.8.	additional environmental impacts expected from the proposed development based on the current status quo of the land including erosion, alien vegetation, waste, etc.;	Section 10.5
2.6.9.	information on the current agricultural activities being undertaken on adjacent land parcels;	Section 7
2.6.10.	a motivation must be provided if there were development footprints identified as per paragraph 2.5.3 above that were identified as having a "low" or "medium" agriculture sensitivity and that were not considered appropriate;	Not applicable
2.6.11.	confirmation from the soil scientist or agricultural specialist that all reasonable measures have been considered in the micro-siting of the proposed development to minimise fragmentation and disturbance of agricultural activities;	Section 10.1
2.6.12.	a substantiated statement from the soil scientist or agricultural specialist with regards to agricultural resources on the acceptability or not of the proposed development and a recommendation on the approval or not of the proposed development;	Section 11
2.6.13.	any conditions to which this statement is subjected;	Section 11

2.6.14.	where identified, proposed impact management outcomes or any monitoring requirements and/or mitigation measures for inclusion in the Environmental Management Programme (EMPr);	Section 9.1
2.6.15.	a description of the assumptions made and any uncertainties or gaps in knowledge or data;	Section 5
2.6.16.	calculations of the physical development footprint area for each land parcel as well as the total physical development footprint area of the proposed development (including supporting infrastructure);	Section 2
2.6.17.	confirmation whether the development footprint is in line with the allowable development limits set in Table 1 above, including where applicable any deviation from the set development limits and motivation to support the deviation, including:	Section 10.3
2.6.17a.	where relevant, reasons why the proposed development footprint is required to exceed the limit;	Section 10.3
2.6.17b.	where relevant, reasons why this exceedance will be in the national interest; and	Section 10.3
2.6.17c.	where relevant, reasons why there are no alternative options available including evidence of alternatives considered; and	Not applicable
2.6.18.	a map showing the renewable energy facilities within a 50km radius of the proposed development.	Not applicable
2.7.	The findings of the Agricultural Agro-Ecosystem Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which are to be contained in the EMPr.	
2.8.	A signed copy of the full Agricultural Agro-Ecosystem Assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	

4 METHODOLOGY OF STUDY

The assessment was based on an on-site investigation of the soils and agricultural conditions conducted on 11 May 2023. It was also informed by existing climate, soil, and agricultural potential data for the site (see references). The aim of the on-site assessment was to:

1. ground-truth cropland status;
2. ground truth the land type soil data and achieve an understanding of the general range and distribution patterns of different soil conditions across the site;
3. gain an understanding of overall agricultural production potential across the site.

Soils were assessed based on the investigation of existing soil exposures in combination with indications of the surface conditions and topography. Soils were classified according to the South African soil classification system (Soil Classification Working Group, 2018). An interview was also conducted with farmers on the site for information on farming practices.

This level of soil assessment is considered entirely adequate for an understanding of on-site soil potential for the purposes of a wind farm assessment. For this purpose, only an understanding of the general range and distribution patterns of different soil conditions across the site is required. A more detailed soil survey would be extremely time consuming and impractical to conduct, given the very large assessment area, and would not provide any additional data that would add value to the assessment of the agricultural impact of the wind farm.

This is because a wind farm extends over a very large surface area. The layout design of a wind farm is complex and there are multiple interacting factors that determine the turbine locations that will ensure the viability of the wind farm. Each turbine influences the amount of wind that the other turbines receive. Therefore, the location of one turbine cannot simply be shifted without requiring other turbines to be shifted as well, to retain the viability of all the turbines. To shift turbines to account for variation in soil conditions would be extremely complex and would require a level of soil mapping detail across the whole wind farm area that would be practically impossible to achieve. Even with this level of detail, it is highly unlikely that it would have any influence on agricultural impact.

An assessment of soils and long-term agricultural potential is in no way affected by the season in which the assessment is made, and therefore the date on which this assessment was done has no bearing on its results.

5 ASSUMPTIONS, UNCERTAINTIES OR GAPS IN KNOWLEDGE OR DATA

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

6 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

This section identifies all applicable agricultural legislation and permit requirements over and above what is required in terms of NEMA.

The development requires approval from the National Department of Agriculture, Land Reform and Rural Development (DALRRD) because it is on agriculturally zoned land. This approval is separate to the Environmental Authorisation. There are two approvals that apply. The first is a No Objection

Letter for the change in land use. This letter is one of the requirements for receiving municipal rezoning. This application requires a motivation backed by good evidence that the development is acceptable in terms of its impact on the agricultural production potential of the development site. This agricultural assessment report will serve that purpose.

The second approval is a consent for long-term lease required in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). SALA approval is not required if the lease is over the entire farm portion. If DALRRD approval for the development has already been obtained in the form of the No Objection letter, then SALA approval is likely to be readily forthcoming. SALA approval can only be applied for once the Municipal Rezoning Certificate and Environmental Authorisation has been obtained.

Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983 - CARA). A consent in terms of CARA is required for the cultivation of virgin land. Cultivation is defined in CARA as “any act by means of which the topsoil is disturbed mechanically”. The purpose of this consent for the cultivation of virgin land is to ensure that only land that is suitable as arable land is cultivated. Therefore, despite the above definition of cultivation, disturbance to the topsoil that results from construction of infrastructure does not constitute cultivation as it is understood in CARA. This has been corroborated by Anneliza Collett (Acting Scientific Manager: Natural Resources Inventories and Assessments in the Directorate: Land and Soil Management of the Department of Agriculture, Land Reform and Rural Development (DALRRD)). The construction and operation of the facility will therefore not require consent from the Department of Agriculture, Land Reform and Rural Development in terms of this provision of CARA.

7 BASELINE DESCRIPTION OF THE AGRO-ECOSYSTEM

The purpose of this section of an agricultural assessment report is to present the baseline information that controls the agricultural production potential of the site so that an assessment of that potential can be made. Agricultural production potential, and particularly cropping potential, is one of three factors that determines the significance of an agricultural impact, together with size of footprint and duration of impact (see Section 9).

All the important parameters that control the agricultural production potential of the site are given in Table 1, and a satellite image map of the assessed area is shown in Figure 2.

The site falls within an area that is classified as a Protected Agricultural Area. A Protected Agricultural Area is a demarcated area in which the climate, terrain, and soil are generally conducive for agricultural production and which, historically, has made important contributions to the production of the various crops that are grown across South Africa. Within Protected Agricultural Areas, the protection, particularly of arable land, is considered a priority for the protection of food security in

South Africa. However, there may be much variation within a Protected Agricultural Area and all land within it is not necessarily of sufficient agricultural potential to be suitable for crop production, due to site-specific terrain, soil, and other constraints. All land within a Protected Agricultural Area is therefore not necessarily worthy of prioritised protection as agricultural production land.

There are no existing impacts on the site that are relevant to agricultural impact.

Table 1: Parameters that control and/or describe the agricultural production potential of the site.

	Parameter	**Value**
Climate	Köppen-Geiger climate description (Beck *et al*, 2018)	Temperate, dry winter, hot summer
	Mean Annual Rainfall (mm) (Schulze, 2009)	667
	Reference Crop Evaporation Annual Total (mm) (Schulze, 2009)	1207
	Climate capability classification (out of 9) (DAFF, 2017)	6 (moderate-high)
Terrain	Terrain type	Low hills
	Terrain morphological unit	Varied
	Slope gradients (%)	0-20
	Altitude (m)	1650
	Terrain capability classification (out of 9) (DAFF, 2017)	Between 3 (low) and 7 (high)
Soil	Geology (DAFF, 2002)	Shale and sandstone of the Vryheid Formation, Ecca Group, and dolerite; Granitic gneiss
	Land type (DAFF, 2002)	Bb35, Ac39, Fa169
	Description of the soils	There is much soil variation across the site, which includes deeper, well drained soils that are suitable for cropping and shallower and/or poorly drained soils that are not suitable for cropping.
	Dominant soil forms	Av, Cf, Lo, Wa, Ms, Hu, Gf, Gs, My, R
	Soil capability classification (out of 9) (DAFF, 2017)	Between 4 (low-medium) and 6 (medium-high)
	Soil limitations	Limited soil depth, drainage
Land use	Agricultural land use in the surrounding area	Irrigation, dry land crop production, grazing
	Agricultural land use on the site	Irrigation, dry land crop production, grazing
Gen eral	Long-term grazing capacity (ha/LSU) (DAFF, 2018)	4 (very high)

	Parameter	Value
	Land capability classification (out of 15) (DAFF, 2017))	Between 3 (low-very low) and 11 (high)
	Within Protected Agricultural Area (DALRRD, 2020)	Yes

The agricultural protocol requires the current productivity of the land based on detailed production figures and it requires the current employment figures. This detail is entirely irrelevant to the assessment of the agricultural impact, given that the expected losses in production and employment will be zero (see Section 9.1). It is therefore unnecessary to include this detail.

7.1 Assessment of the agricultural production potential

This assessment of the agricultural production potential of the site is based on an integration of the different parameters in Table 1 above and the on-site investigation.

In general, the soils across more than half of the site have insufficient capability for viable crop production and those on the remaining proportion are suitable for viable cropping. Soil limitations that prevent crop production are predominantly the result of limited depth due to underlying bedrock, clay, or hardpan, or the result of poor drainage. The crop-suitable versus unsuitable soils have been identified over time through trial and error. All the deep, well-drained, suitable soils are generally cropped and uncropped soils that are used for grazing can fairly reliably be considered to have various limitations that make them unsuitable for crop production.

In general, the agricultural production potential of the site is high, and it is within an area that makes a significant contribution to food production in the country. Due to the favourable climate, crop yields are high on the suitable soils with average maize yields of around 7 tons per hectare according to the farmers on site.

It should be noted that cropping potential changes with a changing agricultural economy over time. 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 increased input costs.

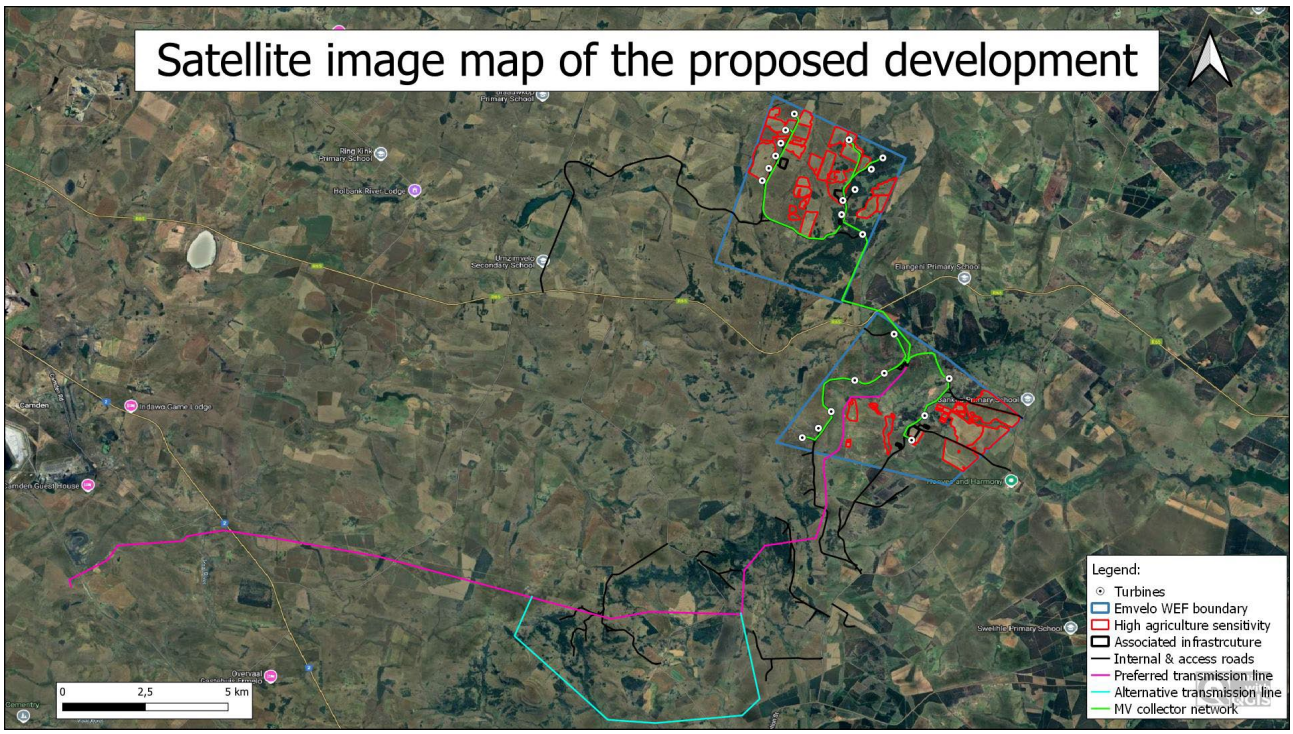


Figure 2. Satellite image map of the assessed area



Figure 3. Typical site conditions.



Figure 4. Typical site conditions.



Figure 5. Typical soil conditions where rockiness and underlying bedrock limit soil cropping suitability.

8 SITE SENSITIVITY VERIFICATION

A specialist agricultural assessment is required to include a verification of the agricultural sensitivity of the development site as per the sensitivity categories used by the web-based environmental screening tool of the Department of Forestry, Fisheries and the Environment (DFFE). The screening tool's classification of sensitivity is merely an initial indication of what the sensitivity of a piece of land might be, as indicated by the only data that is available. What the screening tool attempts to indicate is whether the land is suitable for crop production (high and very high sensitivity) or unsuitable for crop production (low and medium sensitivity). To do this, the screening tool uses three independent criteria, from three independent data sets, which are all indicators of suitability for crop production but are limited and were not designed for this purpose. The three criteria are:

1. Whether the land is classified as cropland or not on the field crop boundary data set (Crop Estimates Consortium, 2019). All classified cropland is, by definition, either high or very high sensitivity.
2. Its land capability rating as per the Department of Agriculture's updated and refined, country-wide land capability mapping (DAFF, 2017). Land capability is defined as the combination of soil, climate, and terrain suitability factors for supporting rain-fed agricultural production. The direct relationship between land capability rating, agricultural sensitivity, and rain-fed cropping suitability is summarised by this author in Table 2.
3. Whether the land is classified as a protected agricultural area (PAA) or not (DALRRD, 2020). All classified PAAs are, by definition, either high or very high sensitivity.

The limitations for determining cropping suitability based on these data are as follows:

1. The field crop boundary data set used by the screening tool is very outdated
2. Land capability mapping is fairly coarse, modelled data which is not accurate at site scale.
3. PAAs are demarcated broadly, not at a fine scale, and there is therefore much variation of cropping suitability within a PAA. All land within these demarcated areas is not necessarily of sufficient agricultural potential to be suitable for crop production, due to finer scale terrain, soil, and other constraints, and therefore not all land within a PAA necessarily deserves to be classified as more than medium agricultural sensitivity.

These three inputs operate independently, and the screening tool's agricultural sensitivity is simply determined by whichever of these gives the highest sensitivity rating. The agricultural sensitivity of the site, as classified by the screening tool, is shown in Figure 6.

Table 2: Relationship between land capability, agricultural sensitivity, and rain-fed cropping suitability.

Land capability value	Agricultural sensitivity	Rain-fed cropping suitability	
		Summer rainfall areas	Winter rainfall areas
1 - 5	Low	Unsuitable	Unsuitable
6	Medium		
7			Suitable
8 - 10	High	Suitable	
11 - 15	Very High		

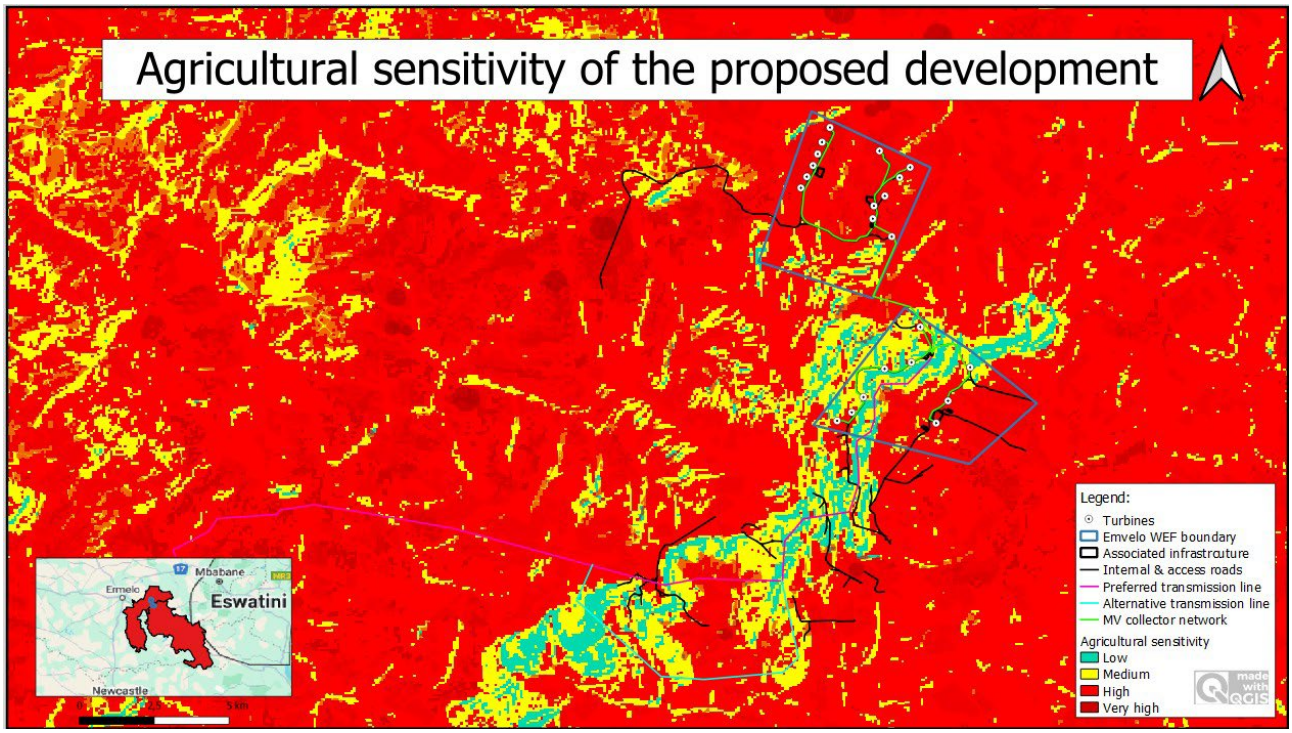


Figure 6. The assessed footprint, overlaid on agricultural sensitivity, as given by the screening tool (green = low; yellow = medium; red = high; dark red = very high). All verified areas of high sensitivity (viable croplands) are shown in green outline. All areas outside of these are rated as medium sensitivity.

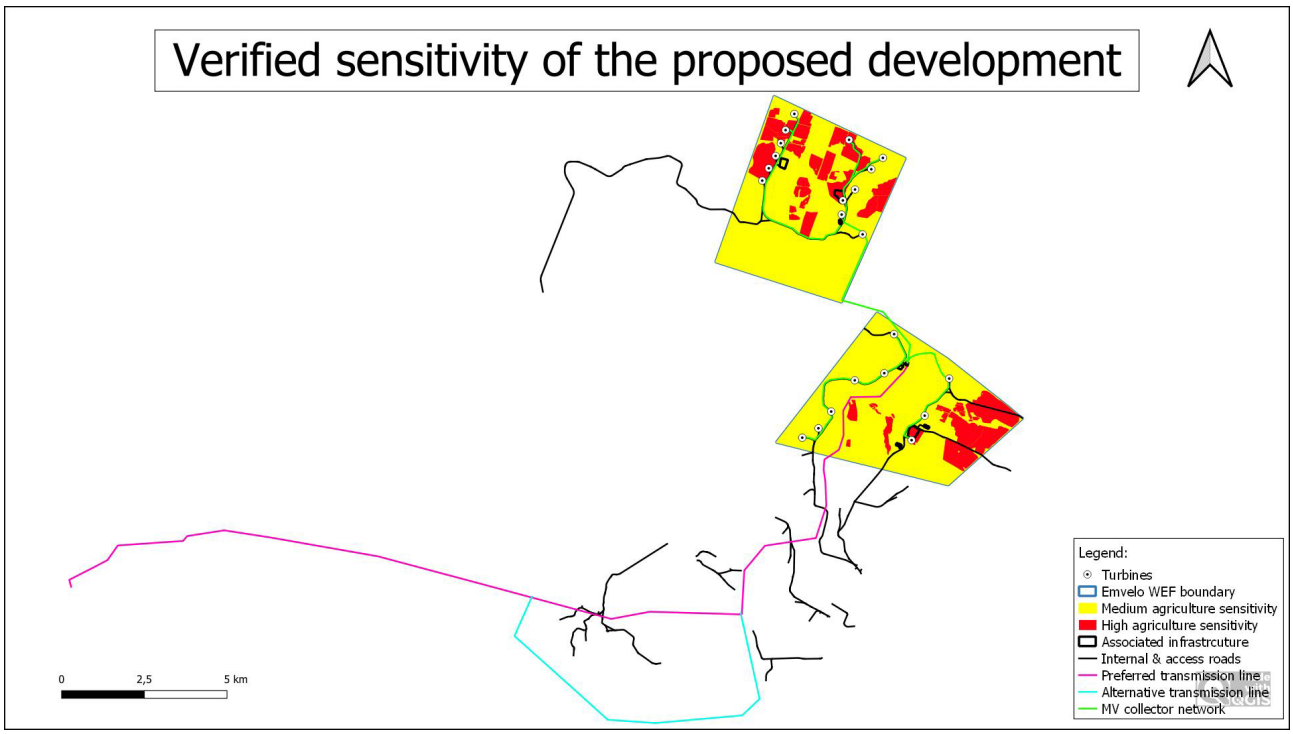


Figure 7. Verified sensitivity of the proposed development.

The screening tool classifies the assessed site as ranging from low to very high agricultural sensitivity and therefore classifies the overall site sensitivity, which is the highest sensitivity encountered across the site, as very high. The very high sensitivity classification by the screening tool is due to the PAA status of the site. The underlying high sensitivity classification by the screening tool is due to a combination of some land being classified as cropland (high sensitivity) and some land being classified as high sensitivity because of its land capability rating of 7 to 11.

However, as shown in Section 7, only parts of the site have suitability for cropping and therefore deserve to be classified as high sensitivity. Those parts of the site that have been verified in this assessment as being of high sensitivity are shown in Figure 7 and differ from those shown by the screening tool. This assessment therefore disputes some of the detail of the sensitivity classification by the screening tool, in terms of which lands are viable for cropland, and which are not but it confirms the overall site sensitivity - that is the highest sensitivity encountered across the site.

9 ASSESSMENT OF AGRICULTURAL IMPACT

9.1 Impact identification and assessment

An agricultural impact is a change to the future agricultural production potential of land. In most developments, this is primarily caused by the exclusion of agriculture from the footprint of the development. Soil erosion and degradation may also contribute to loss of agricultural production potential. The significance of the impact is a direct function of the following three factors:

1. the size of the footprint of land from which agriculture will be excluded (or the footprint that will have its potential decreased)
2. the baseline production potential (particularly cropping potential) of that land
3. the length of time for which agriculture will be excluded (or for which potential will be decreased).

In the case of wind farms, the first factor, size of footprint, is so small that the total extent of the loss of future agricultural production potential is insignificantly small, regardless of how much production potential the land has, and regardless of the duration of the impact. This is because the required spacing between turbines means that the amount of land excluded from agricultural use is extremely small in relation to the surface area over which a wind farm is distributed. Wind farm infrastructure (including all associated infrastructure and roads) typically occupies less than 2% of the surface area, according to the typical surface area requirements of wind farms in South Africa (DEA, 2015). Most wind energy facilities, for which I have recently done assessments, occupy less than 1% of the surface area. All agricultural activities can continue unaffectedly on all parts of the farmland other than this small footprint, from which agriculture is excluded, and the actual loss of production potential is therefore insignificant.

A study done to measure the impact of existing wind farms on agricultural production potential (Lanz, 2018) is highly informative of the extent of the agricultural impact that is likely for this proposed development. Although the study was done in a different agricultural environment, it is similar in terms of being a highly productive and intensively farmed environment with cultivation. There is no reason that the results obtained in that study would not be applicable to the area in this assessment. The overall conclusion of the study was that, although wind farms have been established within an area of cultivated farmland that supports intensive and productive farming, it is highly unlikely that this has caused a reduction in agricultural production. Small amounts of production land have been lost, but the consequence of this for agricultural production has been negligible. It is likely that the positive financial impacts of wind farming have outweighed the negative impacts, and that wind farming has benefited agriculture and agricultural production in the area.

As identified in the study, it is important to note that wind farms have both positive and negative effects on the production potential of land. It is the net sum of these positive and negative effects that determines the extent of the change in future production potential. The positive effects are:

1. **increased financial security for farming operations -** Reliable and predictable income will be generated by the farming enterprises through the lease of land to the energy facility. This will increase financial security and could improve farming operations and productivity through increased investment into farming.
2. **improved security against stock theft and other crime** due to the presence of security infrastructure and security personnel at the energy facility.
3. **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.

There are two additional effects, but because they are highly unlikely to influence agricultural production, they are not considered further. They are:

- **Prevention of crop spraying by aircraft over land occupied by turbines** – ground based or using drones for spraying are effective, alternative methods that can be used without implications for production or profitability.
- **Interference with farming operations** - 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.

The loss of agricultural potential by soil degradation can effectively be prevented for renewable energy developments by generic mitigation measures that are all inherent in the project engineering and/or are standard, best-practice for construction sites. Soil degradation does not therefore pose a significant impact risk.

Due to the facts that the proposed development will exclude agricultural production from only a very small area of land, and that its negative impact is offset by economic and other benefits to farming, the overall negative agricultural impact of the development (loss of future agricultural production potential) is assessed here as being of low significance and as acceptable.

The agricultural protocol requires an indication of the potential losses in production and employment from the change of the agricultural use of the land as a result of the proposed development. As this assessment has shown, the agricultural use of the land will be integrated with the renewable energy facility, and it will continue with no discernible change in terms of production.

The expected losses in production and employment will therefore be zero.

9.1.1 Formal impact assessment

An Agricultural Agro-Ecosystem Specialist Assessment is required by the agricultural protocol to identify the extent of the impact of the proposed development on agricultural resources. The assessment of impacts in an environmental impact assessment is done according to a prescribed, semi-quantitative rating methodology that is supposed to cover all specialist disciplines and allow comparison of the impacts across them. However, the system was designed for biological components of the ecosystem such as plants and animals and does not rate agricultural impacts in a sensible or particularly useful way. As has been discussed above, the significance of the agricultural impact is simply the degree to which the future agricultural production potential of the site will be changed and that is predominantly a function of the size of the area of land that is impacted and the production potential of that impacted land. The main factors in this case are the insignificant size of the area of land that is impacted and the limitations on the agricultural potential of that land. The prescribed methodology complicates and obscures what is actually a simple and straight forward assessment. Aspects of the prescribed methodology, such as probability, do not make sense and tend to skew the calculation of significance. Other aspects of agricultural impact, such as compliance with the prescribed allowable development limits, are much more important and relevant than the prescribed methodology.

Furthermore, it is not sensible or useful to distinguish agricultural impact during different phases of the development. A loss of agricultural potential is not confined to any particular phase of such a development.

Generic mitigation measures that are effective in preventing soil degradation are all inherent in the engineering of such a project and/or are standard, best-practice for construction sites and it does not therefore make sense to consider the significance of impacts in the absence of these standard measures.

9.2 Cumulative impact assessment

Specialist assessments for environmental authorisation are required to include an assessment of 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.

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 of future agricultural production potential 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?

The Department of Forestry, Fisheries and the Environment (DFFE) 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.

This cumulative impact assessment determines the quantitative loss of agricultural land if all renewable energy project applications within a 30 km radius become operational. These projects are listed in Appendix 4 of this report. Note that electrical grid infrastructure projects do not contribute to a loss of agricultural land and are not therefore included in this calculation of cumulative land loss. The area of land taken out of agricultural use as a result of all the projects listed in Appendix 4 (total generation capacity of 920 MW) will amount to a total of approximately 276 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 30 km radius (approximately 282,700 ha), this amounts to only 0.1% of the surface area. This is well within an acceptable limit in terms of loss of low potential agricultural land, and of which there is no scarcity in the country.

All the projects contributing to cumulative impact for this assessment have the same kind of agricultural impact in a very similar agricultural environment, and therefore the same mitigation measures apply to all.

The loss of agricultural potential by soil degradation can effectively be prevented for renewable energy developments by generic mitigation measures that are all inherent in the project engineering and/or are standard, best-practice for construction sites. Soil degradation does not therefore pose a

cumulative impact risk.

Due to all the considerations discussed above, the cumulative impact of loss of future agricultural production potential is assessed as low. It will not have an unacceptable negative impact on the agricultural production capability of the area, and it is therefore recommended, from a cumulative agricultural impact perspective, that the development be approved.

Due to the fact that the assessed infrastructure contributes negligibly to a loss of agricultural land it cannot cause acceptable levels of change in terms of agricultural land loss to be exceeded. The cumulative impact of the power line and associated infrastructure can therefore confidently be assessed as being of very low significance and therefore as acceptable. It will not have an unacceptable negative impact on the agricultural production capability of the area, and it is therefore recommended, from a cumulative agricultural impact perspective, that the power line be approved.

9.3 Assessment of alternatives

The agricultural protocol requires identification of any alternative development footprints within the preferred site which would be of “medium” or “low” sensitivity for agricultural resources as identified by the screening tool and verified through the site sensitivity verification.

The site includes croplands, and it is highly likely that some of the turbines will need to be located within these. The positioning of turbines in a wind farm is complex and there are multiple, interacting factors that determine the locations that will ensure the viability of the wind farm. Each turbine influences the amount of wind that the other turbines receive. Therefore, the location of one turbine cannot simply be shifted without requiring other turbines to be shifted as well, to retain the viability of all the turbines. Turbines cannot therefore simply be shifted off the cropland. However, as has been discussed above, the agricultural impact of these turbines within croplands is so small that it does not make sense to compromise the viability of the wind farm, to make only an insignificant change to the agricultural impact.

Specialist assessments for environmental authorisation are required to assess the impacts of alternatives, including the no-go alternative. 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, on the other hand, 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, 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.

10 MITIGATION MEASURES

Generic mitigation measures that are effective in preventing soil degradation are all inherent in the engineering of such a project and/or are standard, best-practice for construction sites.

- A system of storm water management, which will prevent erosion on and downstream of the site, will be an inherent part of the engineering design on site. 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. As part of the 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 excavations done during the construction phase, in areas that will be re-vegetated at the end of the construction phase, must separate the upper 40 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. Across the majority of the site, including construction lay down areas, it will be much more effective for rehabilitation, to retain the topsoil in place. If levelling requires significant cutting, topsoil should be temporarily stockpiled and then re-spread after cutting, so that there is a covering of topsoil over the entire cut surface.

11 ADDITIONAL ASPECTS REQUIRED IN AN AGRICULTURAL ASSESSMENT

11.1 Micro siting

The agricultural protocol requires confirmation that all reasonable measures have been taken through micro-siting to minimize fragmentation and disturbance of agricultural activities. An aspect of wind farm layout that can cause unnecessary fragmentation of croplands is the location of turbine access roads within croplands. In this development, access roads have deliberately been laid out on existing roads and on the edges of croplands wherever possible, so that croplands are not unnecessarily fragmented.

11.2 Confirmation of linear activity impact

If linear infrastructure has been given exclusion from complying with certain requirements of the agricultural protocol because of its linear nature, the protocol requires confirmation that the land

impacted by that linear infrastructure can be returned to the current state within two years of completion of the construction phase. The overhead power line is the only linear component of the project, to which this provision is applicable. It is hereby confirmed that the land under the overhead power line, where it is not occupied by other facility infrastructure, can be returned to the current state of agricultural production potential within two years of construction, with the obvious disclaimer that the pylons will continue to be present for the duration of the operational lifetime of the power line. The service and maintenance track underneath the power lines will also be present for the duration of the operational lifetime of the power line. However, no service and maintenance track needs to be kept within croplands because the cultivation ensures that the land remains accessible for maintenance without a track. The track therefore has no significant impact on agricultural potential underneath the lines.

11.3 Compliance with the allowable development limits

The agricultural protocol stipulates allowable development limits for renewable energy developments of > 20 MW. Allowable development limits refer to the area of a particular agricultural sensitivity category that can be directly impacted (i.e. taken up by the physical footprint) by a renewable energy development. The agricultural footprint is defined in the protocol as the area that is directly occupied by all infrastructures, including roads, hard standing areas, buildings, substations etc., that are associated with the renewable energy facility during its operational phase, and that result in the exclusion of that land from potential cultivation or grazing. It excludes all areas that were already occupied by roads and other infrastructure prior to the establishment of the energy facility but includes the surface area required for expanding existing infrastructure (e.g. widening existing roads). It excludes the corridor underneath overhead power lines but includes the pylon footprints. It therefore represents the total land that is actually excluded from agricultural use as a result of the renewable energy facility (the agricultural footprint).

As discussed above, the land outside of the existing viable croplands is rated as medium agricultural sensitivity with a land capability of < 8. It is on this land that most of the agricultural footprint is located. The allowable development limit on this land is 2.5 ha per MW. This means that, even though some of the agricultural footprint is on land with a much lower development footprint (up to 0.2 ha per MW), the total footprint is still in line with the allowable development limits contained in the agricultural protocol.

11.4 Long term benefits versus agricultural benefits

The development will generate a significant and reliable additional income for the farming enterprises, without compromising the existing farming income. It will also generate additional income and employment in the local economy. In addition, it will contribute to the country's need

for energy generation, particularly renewable energy that has lower environmental and agricultural impact than existing, coal powered energy generation.

11.5 Additional environmental impacts

There are no additional environmental impacts of the proposed development that are relevant to this assessment of agricultural impact.

12 CONCLUSION

The overall conclusion of this assessment is that the proposed development offers a valuable opportunity for integrating renewable energy with agricultural production in a way that provides benefits to agriculture but leads to insignificant loss of future agricultural production potential.

The site is classified as ranging from low to very high agricultural sensitivity by the screening tool. This site sensitivity verification verifies those parts of the site that are indicated as cropland in this assessment as being of high agricultural sensitivity, and the rest of the site as being of medium agricultural sensitivity.

In general, the soils across more than half of the site have insufficient capability for viable crop production and those on the remaining proportion are suitable for viable cropping. Soil limitations that prevent crop production are predominantly the result of limited depth due to underlying bedrock, clay, or hardpan, or the result of poor drainage. The crop-suitable versus unsuitable soils have been identified over time through trial and error. All the deep, well-drained, suitable soils are generally cropped and uncropped soils that are used for grazing can fairly reliably be considered to have various limitations that make them unsuitable for crop production.

In general, the agricultural production potential of the site is high, and it is within an area that makes a significant contribution to food production in the country. Due to the favourable climate, crop yields are high on the suitable soils with average maize yields of around 7 tons per hectare according to the farmers on site.

An agricultural impact is a change to the future agricultural production potential of land. This is primarily caused by the exclusion of agriculture from the footprint of a development. In the case of wind farms, the amount of land excluded from agriculture is so small that the total extent of the loss of future agricultural production potential is insignificantly small, regardless of how much production potential the land has, and regardless of the duration of the impact. Furthermore, wind farms have both positive and negative effects on the production potential of land, and it is the net sum of these positive and negative effects that determines the extent of the change in future

production potential. The positive effects are:

1. increased financial security for farming
2. improved security against stock theft and other crime
3. an improved road network, with associated storm water handling system

Due to the facts that the proposed development will exclude agricultural production from only a very small area of land, and that its negative impact is offset by economic and other benefits to farming, the overall negative agricultural impact of the development (loss of future agricultural production potential) is assessed here as being of low significance and as acceptable.

Its acceptability is further substantiated by the following points:

1. The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.
2. 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.
3. 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. Furthermore, a reduction in coal power saves water resources and therefore potentially makes more water available for irrigated agriculture.

13 REFERENCES

Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood. 2018. Present and future Köppen-Geiger climate classification maps at 1-km resolution, Nature Scientific Data. Available at: https://gis.elsenburg.com/apps/cfm/.

Crop Estimates Consortium, 2019. Field Crop Boundary data layer, 2019. Pretoria. Department of Agriculture, Forestry and Fisheries.

Department of Agriculture Forestry and Fisheries (DAFF). 2018. Long-term grazing capacity map for South Africa developed in line with the provisions of Regulation 10 of the Conservation of Agricultural Resources Act, Act no 43 of 1983 (CARA), available on Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

Department of Agriculture, Forestry and Fisheries (DAFF). 2017. National land capability evaluation raster data layer, 2017. Pretoria.

Department of Agriculture, Forestry and Fisheries (DAFF). 2002. National land type inventories data set. Pretoria.

Department of Agriculture, Land Reform and Rural Development (DALRRD). 2020. Protected agricultural areas – Spatial data layer. 2020. Pretoria.

Department of Environmental Affairs (DEA). 2015. Strategic Environmental Assessment for wind and solar photovoltaic development in South Africa. CSIR Report Number CSIR: CSIR/CAS/EMS/ER/2015/001/B. Stellenbosch.

Lanz, J. 2018. The impact of wind farms on agricultural resources and production: a case study from the Humansdorp area, Eastern Cape. Unpublished Report.

Schulze, R.E. 2009. South African Atlas of Agrohydrology and Climatology, available on Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

Soil Classification Working Group. 2018. Soil Classification: A Natural and Anthropogenic System for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

APPENDIX 1: SPECIALIST CURRICULUM VITAE

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - 1997
B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I have been registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science since 2012 (registration number 400268/12) and am a member of the Soil Science Society of South Africa.

Soil & Agricultural Consulting **Self employed** **2002 - present**

Within the past 5 years of running my soil and agricultural consulting business, I have completed more than 170 agricultural assessments (EIAs, SEAs, EMPRs) in all 9 provinces for renewable energy, mining, electrical grid infrastructure, urban, and agricultural developments. I was the appointed agricultural specialist for the nation-wide SEAs for wind and solar PV developments, electrical grid infrastructure, and gas pipelines. My regular clients include: Zutari; CSIR; SiVEST; SLR; WSP; Arcus; SRK; Environamics; Royal Haskoning DHV; ABO; Enertrag; WKN-Windcurrent; JG Afrika; Mainstream; Redcap; G7; Mulilo; and Tiptrans. Recent agricultural clients for soil resource evaluations and mapping include Cederberg Wines; Western Cape Department of Agriculture; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; and Goedgedacht Olives.

In 2018 I completed a ground-breaking case study that measured the agricultural impact of existing wind farms in the Eastern Cape.

Soil Science Consultant **Agricultural Consultors International (Tinie du Preez)** **1998 - 2001**

Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

Contracting Soil Scientist **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

Completed a contract to advise soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

APPENDIX 2: SPECIALIST DECLARATION FORM AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE: THE PROPOSED EMVELO WIND ENERGY FACILITY NEAR ERMELO IN MPUMALANGA PROVINCE

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)'*, where applicable.

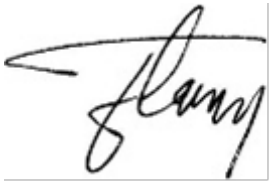
1. SPECIALIST INFORMATION

Title of Specialist Assessment	Agricultural Assessment
Specialist Company Name	SoilZA (sole proprietor)
Specialist Name	Johann Lanz
Specialist Identity Number	6607045174089
Specialist Qualifications:	M.Sc. (Environmental Geochemistry)
Professional affiliation/registration:	Registered Professional Natural Scientist (Pr.Sci.Nat.) Reg. no. 400268/12 Member of the Soil Science Society of South Africa
Physical address:	1a Wolfe Street, Wynberg, Cape Town, 7800
Postal address:	1a Wolfe Street, Wynberg, Cape Town, 7800
Telephone	Not applicable
Cell phone	+27 82 927 9018
E-mail	johann@soilza.co.za

2. DECLARATION BY THE SPECIALIST

I, **Johann Lanz** declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing
    - any decision to be taken with respect to the application by the competent authority; and;
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

Name of Company: SoilZA (sole proprietor)

Date**:** 7 April 2025

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Johann Lanz**, swear under oath that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

SoilZA – sole proprietor

Name of Company

7 April 2025

Date

Signature of the Commissioner of Oaths

07/04/2025

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the content of this affidavit; that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me at CONSTANTIA on the 7th day of APRIL 2025 and that the administering oath complied with the regulations contained in Government Gazette No R1258 of 21 July 1972, as amended.

COLIN POULTNEY
COMMISSIONER OF OATHS
BY APPOINTMENT - REPUBLIC OF SA
POSTNET CONSTANTIA, SHOP 6, OLD VILLAGE S/C,
MAIN ROAD, CONSTANTIA, 7806
TEL: 021 794 0447

APPENDIX 3: SACNASP REGISTRATION CERTIFICATE

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Johan Lanz

Registration Number: 400268/12

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Soil Science (Professional Natural Scientist)

Effective **15 August 2012** Expires **31 March 2026**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

APPENDIX 4: PROJECTS INCLUDED IN CUMULATIVE IMPACT ASSESSMENT

Table 3**:** Table of all projects that were included in the cumulative impact assessment.

DFFE Reference	Project name	Technology	Capacity (MW)
14/12/16/3/3/2/2135	The proposed Camden II Wind Energy Facility (WEF) and associated infrastructure, near Ermelo, Mpumalanga Province	WEF	200
14/12/16/3/3/2/2137	The proposed Camden I Wind Energy Facility (WEF) and associated infrastructure, near Ermelo, Mpumalanga Province	WEF	200
TBC	Emvelo Wind Energy Facility	WEF	260
TBC	Sheepmoor Wind Energy Facility	WEF	260
Total solar			
Total wind			920
Total			920

Note: Electrical grid infrastructure projects do not contribute to a loss of agricultural land and are not therefore included in this table and in the calculation of cumulative land loss.

APPENDIX 5: SOIL DATA

Table of land type soil data

Land type	Soil series (forms)	Depth (mm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Bb35	Cv	450 - 900	25 - 45	30 - 60	so	18,0
Bb35	Av	600 - 1200	20 - 30	30 - 40	sp	13,3
Bb35	Cf, Lo, Wa	400 - 900	12 - 25		so,sp,hp	12,3
Bb35	Ms	100 - 450	12 - 25		hp	9,5
Bb35	Hu	600 > 1200	30 - 45	35 - 60	so,hp	9,0
Bb35	Gf	> 1200	30 - 45	35 - 60		7,3
Bb35	Gs	300 - 450	15 - 25		lc	6,3
Bb35	Gs	300 - 450	15 - 25		lc	6,0
Bb35	Ka	> 1200	25 - 40		gc	5,0
Bb35	Ms	100 - 300	12 - 25		hp	4,3
Bb35	Gc	450 - 900	20 - 30	20 - 30	hp	3,5
Bb35	S					3,0
Bb35	R					2,8
Ac39	Hu	450 - 1200	20 - 35	30 - 45	so,hp	36,8
Ac39	My	300 - 450	30 - 45		lc	7,8
Ac39	R					7,5
Ac39	Ms	200 - 450	15 - 25		R	7,4
Ac39	Sd	400 - 800	30 - 45	35 - 60	so	7,4
Ac39	Cv	500 - 1200	20 - 35	25 - 45	so	7,3
Ac39	Gc	500 - 1200	20 - 30	25 - 35	hp	4,9
Ac39	Gs	300 - 450	15 - 25		lc	4,9
Ac39	Bo	> 1200	30 - 50	35 - 60		3,0
Ac39	Sw, Va	200 - 450	30 - 40	40 - 55	vp	2,8
Ac39	Mw	300 - 450	30 - 45		R	2,7
Ac39	Lo	450 - 900	15 - 25	30 - 40	sp	2,6
Ac39	Ms	200 - 450	15 - 25		hp	2,5
Ac39	Gf	> 1200	30 - 45	35 - 60		2,4

Land type	Soil series (forms)	Depth (mm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Fa162	Ms, Gs	200 - 450	15 - 25		R,lc	25,0
Fa162	R					24,8
Fa162	Sd	400 - 600	30 - 35	30 - 45	so	15,6
Fa162	My	300 - 500	30 - 45		lc	9,3
Fa162	Hu	400 - 600	20 - 30	25 - 35	so	8,9
Fa162	Cv	400 - 600	15 - 25	20 - 30	so	5,7
Fa162	Sw	400 - 500	30 - 35	35 - 50	so	4,1
Fa162	Hu	450 > 1200	25 - 30	25 - 40	so,hp	3,8
Fa162	Bo	900 > 1200	35 - 45	40 - 50	so	2,2
Fa162	Sd	450 > 1200	30 - 35	30 - 40	so	0,8

SOCIAL IMPACT ASSESSMENT

EMVELO WIND ENERGY FACILITY
AND
GRID CONNECTION

MPUMALANGA PROVINCE

MAY 2025

Prepared

by

Tony Barbour and Schalk van der Merwe

Tony Barbour
ENVIRONMENTAL CONSULTING

10 Firs Avenue, Claremont, 7708, South Africa
(Cell) 082 600 8266
(E-Mail) tony@tonybarbour.co.za, www.tonybarbour.co.za

EXECUTIVE SUMMARY

INTRODUCTION AND LOCATION

ERM Consulting was appointed to manage the Environmental Impact Assessment (EIA) process for the proposed up to 260 MW Emvelo Wind Energy Facility (WEF) located approximately 30 km east of the town of Ermelo in the Msukaligwa Municipality in the Mpumalanga Province. Tony Barbour Environmental Consulting was appointed to undertake a specialist Social Impact Assessment (SIA) as part of an EIA process. This report contains the findings of the SIA for the Emvelo WEF.

SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning.
- Construction phase impacts.
- Operational phase impacts.
- Cumulative impacts.
- Decommissioning phase impacts.
- No-development option.

POLICY AND PLANNING ISSUES

The development of renewable energy is strongly supported at a national, provincial, and local level. The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The development of renewable energy is also supported by the Msukaligwa Municipality Spatial Development Framework (MMSDF). In this regard the SDF acknowledges the importance of the mining sector and notes that it will need to be accommodated over the short to medium term. However, of relevance to the proposed development the SDF refers to green industries and indicates that the existing site of the Camden Power Station and surrounds should be made available for new industrial development in the long term, to manage the long-term impact of the Power Station being decommissioned.

CONSTRUCTION PHASE

The construction phase will extend over a period of approximately 18-24 months and create in the region of 200-250 employment opportunities. Members from the local communities in Ermelo and the MM would qualify for the majority of low skilled and semi-skilled employment opportunities and a number of skilled opportunities. The Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members from the local community. Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. The total wage bill will be in the region of R 40 million (2024 Rand values). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in Ermelo and the MM. The capital expenditure associated with the construction phase will be approximately R 6.5 billion (2024 Rand value). This will create opportunities for local companies and the regional and local economy. Due to the presence of the mining and energy sector, there are

likely to suitably qualified companies in Ermelo that can provide the required services and products. 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.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of jobseekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles.
- Impact on productive farmland.

The findings of the SIA indicate that the significance of the potential negative impacts with mitigation will be **Low Negative**. The potential negative impacts associated with the proposed construction phase can therefore be effectively mitigated if the recommended mitigation measures are implemented. Table 1 summarises the significance of the impacts associated with the construction phase.

Table 1: Summary of social impacts during construction phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Medium (Positive)	Medium (Positive)
Presence of construction workers and potential impacts on family structures and social networks	Medium (Negative)	Low (Negative)
Influx of job seekers	Low (Negative)	Low (Negative)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Medium (Negative)	Low (Negative)
Increased risk of grass fires	Medium (Negative)	Low (Negative)

OPERATIONAL PHASE

Potential positive impacts

- Establishment of infrastructure to improve energy security and support renewable sector.
- Creation of employment opportunities.
- Benefits for local landowners.
- Benefits associated with socio-economic contributions to community development.

The proposed project will 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.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Potential impact on property values.
- Potential impact on tourism.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation will be **Low Negative**. The potential negative impacts can therefore be effectively mitigated. The significance of the impacts associated with the operational phase are summarised in Table 2.

Table 2: Summary of social impacts during operational phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Establishment of infrastructure to improve energy security and support renewable sector	High (Positive)	High (Positive)
Creation of employment and business opportunities during maintenance	Low (Positive)	Medium (Positive)
Benefits associated with socio-economic contributions to community development	Medium (Positive)	High (Positive)
Benefits for landowners	Low (Positive)	Medium (Positive)
Visual impact and impact on sense of place	High (Negative)	Moderate (Negative)
Impact on property values	Low (Negative)	Low (Negative)
Impact on tourism	Low (Negative)	Low (Negative)

CUMULATIVE IMPACTS

Cumulative impact on sense of place
The establishment of the WEF and other wind energy facilities in the area will create the potential for combined and sequential visibility impacts. The significance is rated as **Medium Negative** without and with mitigation.

Cumulative impact on local services and accommodation
The potential cumulative impact on local services and accommodation will depend on the timing construction phases for the different renewable energy projects in the area. With effective planning the significance of the potential impact is rated as **Low Negative** with mitigation.

Cumulative impact on local economy
The significance of this impact with enhancement is rated as **High Positive** with enhancement.

DECOMMISSIONING PHASE

Given the relatively small number of people employed during the operational phase (~ 20), the potential negative social impact on the local economy associated with decommissioning will be limited. In addition, the potential impacts associated with the decommissioning phase can also 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. The significance of this impact was assessed to be **Low Positive**.

NO-DEVELOPMENT OPTION

The No-Development option 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. The No-Development option is not supported by the findings of the SIA.

ASSESSMENT OF TRANSMISSION LINE ALTERNATIVES

The Preferred Alignment is shorter than the alternative alignment (~6.5 km), affects fewer properties and follows an existing Eskom transmission line corridor along the central 16 km section. The impact on cropped fields is greater than the Alternative Alignment and largely impacts a single owner, Mr Meyer.

The Alternative Alignment is longer and affects four additional properties that are not affected by the Preferred Alternative and does not follow an existing Eskom transmission line corridor. The Alternative Alignment also impacts on cropped fields. However, the impact lower.

Based on the findings of the SIA the social impacts associated with the Preferred and Alternative Alignments are similar as most of the alignment is shared. While the Alternative Alignment avoids the impacts on a single landowner, it impacts on four additional properties. From a social perspective the Preferred Alternative is therefore more socially acceptable. However, Mr Meyer has indicated that he does not support the establishment of a transmission line over his property.

CONCLUSION AND RECOMMENDATIONS

The findings of the SIA study indicate that the proposed Emvelo WEF and associated components, including the grid infrastructure, will create several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phase.

The project will create economic development opportunities for the local community. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts

associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole.

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.

In terms of the grid infrastructure, the social impacts associated with the Preferred and Alternative Alignment are similar for most of the alignment. While the Alternative Alignment avoids concentrating the impacts on a single landowner, it impacts on four additional landowners. From a social perspective the Preferred Alternative is therefore more socially acceptable. However, Mr Meyer has indicated that he does not support the establishment of a transmission line over his property.

Recommendations

- The proponent should, in consultation with the owners of Schimmelhoek 272/1 (De Villiers), 274/2 and 274/5 (Cloete) and Schiedam 274/2 (Randall) investigate the opportunity to micro-site turbines 2, 4, 6, and 17 and associated access roads, and the construction camp sites on Schimmelhoek 272/1 and Schiedam 274/2.
- The proponent should, in consultation with the owner of Schiedam 274/2 discuss the impact on wind turbines on the Vlakplaas landing strip on Schiedam 274/2.
- Install radar activated civil aviation light system on wind turbines where technically feasible.

Statement and reasoned opinion

The establishment of the proposed Emvelo WEF and associated infrastructure and grid connection is supported by the findings of the SIA.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
SECTION 1: INTRODUCTION 1
1.1 INTRODUCTION 1
1.2 TERMS OF REFERENCE AND APPROACH 2
1.3 PROJECT DESCRIPTION 2
1.4 ASSUMPTIONS AND LIMITATIONS 6
1.4.1 Assumptions 6
1.4.2 Limitations 6
1.5 SPECIALIST DETAILS 6
1.6 DECLARATION OF INDEPENDENCE 6
1.7 REPORT STUCTURE 6
SECTION 2: POLICY AND PLANNING ENVIRONMENT 8
2.1 INTRODUCTION 8
2.2 NATIONAL POLICY ENVIRONMENT 8
2.2.1 National Energy Act (Act No 34 of 2008) 8
2.2.2 White Paper on the Energy Policy of the Republic of South Africa 8
2.2.3 White Paper on Renewable Energy 9
2.2.4 Integrated Resource Plan (2019) 10
2.2.5 National Development Plan 12
2.2.6 The New Growth Path Framework 12
2.2.7 National Infrastructure Plan 12
2.3 PROVINCIAL AND LOCAL LEVEL POLICY AND PLANNING 13
2.3.1 Mpumalanga Spatial Development Framework (2019) 13
2.3.2 Msukaligwa Integrated Development Plan 17
2.2.3 Msukaligwa Municipality Spatial Development Framework 19
2.3 OVERVIEW RENEWABLE ENERGY SECTOR IN SOUTH AFRICA 25
2.4.1 Independent Power Producers Procurement Programme (IPPPP): An Overview 25
2.4.2 Green Jobs Study 32
2.4.3 Powering the Future: Renewable Energy Roll-out in South Africa 35
2.4.4 WWF SA Renewable Energy Vision 2030 35
2.4.5 The impact of the green economy on jobs in South Africa 37
2.4.6 The potential for local community benefits 38
SECTION 3: OVERVIEW OF STUDY AREA 39
3.1 INTRODUCTION 39
3.2 ADMINISTRATIVE CONTEXT 39
3.3 DEMOGRAPHIC OVERVIEW 40
3.4 MUNICIPAL SERVICES 41
3.5 HEALTH, EDUCATION AND COMMUNITY FACILITIES 42
3.6 ECONOMIC OVERVIEW 43
3.7 OVERVIEW OF STUDY AREA 45
3.7.1 Introduction 45
3.7.2 Proposed infrastructure 49
3.7.3 Relationship to receptors 52
3.7.4 Other renewable energy projects 58
SECTION 4: ASSESSMENT OF KEY SOCIAL ISSUES 60
4.1 INTRODUCTION 60
4.2 ASSESSMENT OF POLICY AND PLANNING FIT 60
4.3 CONSTRUCTION PHASE SOCIAL IMPACTS 60
4.3.1 Creation of employment and business opportunities 61
4.3.2 Impact of construction workers on local communities 63
4.3.3 Influx of job seekers 65
4.3.4 Risk to safety, livestock, and farm infrastructure 66
4.3.5 Nuisance impacts associated with construction related activities 67
4.3.6 Increased risk of grass fires 68
4.3.7 Impact on farming operations and farmland 69
4.4 OPERATIONAL PHASE SOCIAL IMPACTS 71

4.4.1 Improve energy security and support the renewable energy sector 71
4.4.2 Creation of employment and business opportunities 73
4.4.3 Benefits for affected landowners 74
4.4.4 Benefits associated with the socio-economic development contributions 75
4.4.5 Visual impact and impact on sense of place 76
4.4.6 Potential impact on property values 77
4.4.7 Potential impact on tourism 78
4.5 CUMULATIVE IMPACT ON SENSE OF PLACE 80
4.6 CUMULATIVE IMPACT ON LOCAL SERVICES AND ACCOMMODATION 81
4.7 CUMULATIVE IMPACT ON LOCAL ECONOMY 82
4.8 ASSESSMENT OF DECOMMISSIONING PHASE 83
4.9 ASSESSMENT OF NO-DEVELOPMENT OPTION 84
SECTION 5: KEY FINDINGS AND RECOMMENDATIONS 86
5.1 INTRODUCTION 86
5.2 SUMMARY OF KEY FINDINGS 86
5.2.1 Policy and planning issues 86
5.2.2 Construction phase impacts 86
5.2.3 Operational phase impacts 87
5.2.4 Assessment of cumulative impacts 88
5.2.5 Decommissioning phase 89
5.2.6 Assessment of no-development option 89
5.3 ASSESSMENT OF TRANSMISSION LINE ALTERNATIVES 89
5.4 CONCLUSION AND RECOMMENDATIONS 89
ANNEXURE A 91
ANNEXURE B 93
ANNEXURE C 96
ANNEXURE D 97
ANNEXURE E 98

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Section 1.5, Annexure A
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 1.6, Annexure D
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1, Section 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.2, Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Annexure A
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.2, Annexure B
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 4
(g) an identification of any areas to be avoided, including buffers;	Section 4
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.4,
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Section 4
(k) any mitigation measures for inclusion in the EMPr;	Section 4
(l) any conditions for inclusion in the environmental authorisation;	Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 4
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 5
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	Annexure A
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Annexure A
(q) any other information requested by the competent authority	N/A
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Comply with the Assessment Protocols that were published on 20 March 2020, in Government

	Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed. As at September 2020, there are no sensitivity layers on the Screening Tool for Socio-economic-features. Part A has therefore not been compiled for this assessment.

ACRONYMS

BESS	Battery Energy Storage System
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DM	District Municipality
GSDM	Gert Sibande District Municipality
HD	Historically Disadvantaged
EIA	Environmental Impact Assessment
IDP	Integrated Development Plan
IPP	Independent Power Producer
kV	Kilovolts
LED	Local Economic Development
LM	Local Municipality
MM	Msukaligwa Municipality
MW	Megawatt
SDF	Spatial Development Framework
SEF	Solar Energy Facility
SIA	Social Impact Assessment
WEF	Wind Energy Facility

SECTION 1: INTRODUCTION

1.1 INTRODUCTION

ERM Consulting was appointed to manage the Environmental Impact Assessment (EIA) process for the proposed up to 260 MW Emvelo Wind Energy Facility (WEF) located approximately 30 km east of the town of Ermelo in the Msukaligwa Municipality in the Mpumalanga Province (Figure 1.1). Tony Barbour Environmental Consulting was appointed to undertake a specialist Social Impact Assessment (SIA) as part of an EIA process. This report contains the findings of the SIA for the Emvelo WEF.

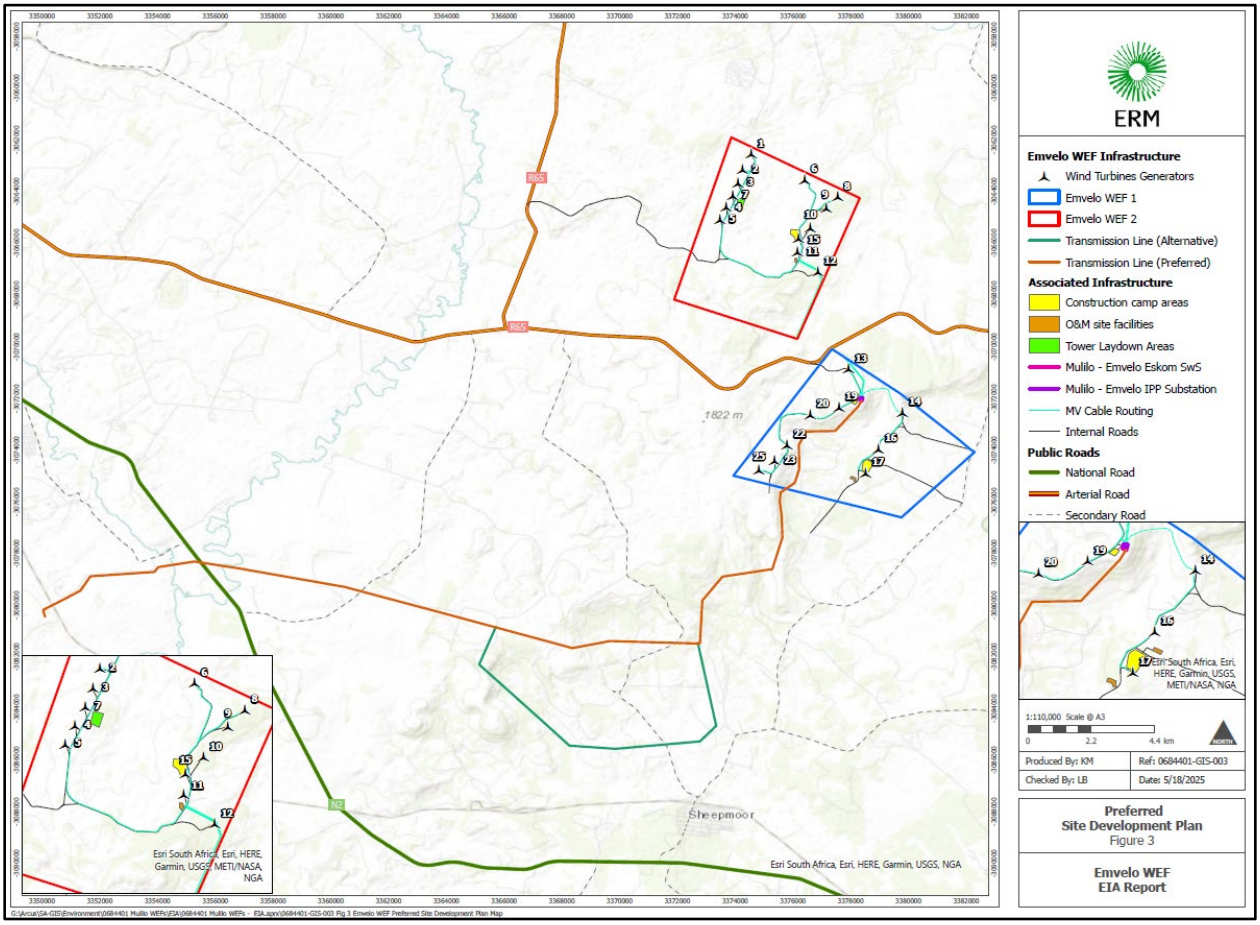


Figure 1.1: Location of Emvelo WEF

1.2 TERMS OF REFERENCE AND APPROACH

The terms reference and approach to the SIA is based on the Guidelines for SIA endorsed by Western Cape Provincial Environmental Authorities (DEA&DP)[1] in 2007 and IAIA Guidance for Assessing and Managing Social Impacts (2015).

- Describing and obtaining an understanding of the proposed intervention (type, scale, and location), the settlements, and communities likely to be affected by the proposed project.
- Collecting baseline data on the current social and economic environment.
- Identifying the key potential social issues associated with the proposed project.
- Assessing and documenting the significance of social impacts associated with the proposed intervention.
- Identifying alternatives and mitigation measures.

In this regard the study involved:

- Review of socio-economic data for the study area.
- Review of relevant planning and policy frameworks for the area.
- Site visit and interviews with key stakeholders.
- Identifying the key potential social issues associated with the proposed project.
- Assessing the significance of social impacts associated with the proposed project.
- Identification of enhancement and mitigation measures aimed at maximizing opportunities and avoiding and or reducing negative impacts.

Annexure A contains a list of the secondary information reviewed. Annexure B summarises the assessment methodology used to assign significance ratings to the assessment process.

1.3 PROJECT DESCRIPTION

The Emvelo WEF is proposed to comprise up to 22 wind turbines with a maximum output capacity of up to 260 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 25-30 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design. It is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation.

Two transmission line alignments have been identified. The Preferred Alignment (Brown line Figure 1.1) runs from the Emvelo on-site substation in the north in a southerly direction for ~ 10km before swinging west for ~ 15km. The alignment swings to the south-west as it crosses the N2 and feeds into the Camden B substation ~ 5km to the southwest of the N2. This section follows an existing Eskom transmission line corridor. The Alternative Alignment follows the same alignment for the first 10km south of the Emvelo substation, but continues south for an additional 3km, before swinging west for ~ 4.5km and then turning northwest for 4km and then north for 1.3km and linking up with the preferred alignment. The alignment then follows the preferred alignment in a westerly direction for ~ 9.3 km to where it crosses the N2 and then feeds into the Camden B substation ~ 5km south of the N2 (Greem line

[1] These guidelines are used throughout South Africa.

Figure 1.1). The Alternative Alignment is therefore a loop located to the south of the middle section of the Preferred Alignment. The Alternative Alignment does not follow an existing Eskom transmission line corridor.

It is intended that the project will be bid in the eighth bidding window of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the aim of evacuating the generated power from the WEFs into the National Eskom Grid. This will aid in the diversification and stabilisation of the country's electricity supply in line with the objectives of the Integrated Resource Plan (IRP).

Table 1.1 provides a summary of the technical details of the Emvelo WEF. Table 1.2 lists the affected properties.

Table 1.1: Technical details of Emvelo WEF

Developer / Applicant	Emvelo Wind Energy Facility (Pty) LTD
DFFE Reference	To be confirmed
WEF Generation Capacity	Up to 260 MW
Site Access	Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3m width for underground 33 kV reticulation.
Number of Turbines	Up to 22
Hub Height from ground level	Up to 150 m
Blade Length	Up to 91 m
Rotor Diameter	Up to 220 m
Length of internal roads	Unknown at this point.
Width of internal roads	Up to 12 m to be rehabilitated to up to 9 m.
On-site substation capacity	Up to 132 kV
Proximity to grid connection	Approximately 30 km
Grid Connection Capacity	Up to 132 kV
Temporary turbine construction laydown and storage areas.	Crane platforms and hardstand laydown area up to 40 ha (Up to 1 ha per turbine)
Permanent footprint area dimensions, including roads, turbine hardstand areas, O&M buildings and battery pad.	O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha

Operations and maintenance buildings (O&M building) with parking area	Up to 1 ha
Height of fencing	2.8 m
Type of fencing	Where site offices are required, temporary screen fencing used to screen offices from the wider landscape.

Table 1.2: List of landowners for Emvelo WEF

Emvelo WEF			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
Rozina Elizabeth De Villiers	Schimmelhoek	272	1
Wiek Cloete Trust	Schimmelhoek	272	2
Wiek Cloete Trust	Schimmelhoek	272	5
DC Geldenhuys Family Trust	Remainder of the Farm Schiedam No. 274	274	RE
Randell's Ranch Trust (Philip Randall)	Portion 2 of the Farm Schiedam No. 274	274	2
Emvelo WEF Grid Connection			
DC Geldenhuys Family Trust	Remainder of the Farm Schiedam No. 274	274	RE
Randell's Ranch Trust (Philip Randall)	Schiedam	274	2
Antonette Swart	Remainder Portion 1 of the Farm Schiedam No. 274	274	1
Henry Goodwin Geldenhuys	Portion 6 of the Farm Schiedam No. 274	274	6
Loufried Testamentere Trust	Portion 5 of the Farm Schiedam No. 274	274	5
Johan Saaiman Trust	Portion 9 of the Farm Waaihoek No. 286	286	9
Johannes Stephanus Roberts	Remainder Portion 6 of the Farm Waaihoek No. 286	286	6
Johannes Stephanus Roberts	Remainder Portion 13 of the Farm Waaihoek No. 286	286	13
Johannes Stephanus Roberts	Remainder Portion 2 of the Farm Waaihoek No. 286	286	2
Freddie Van Oudtshoorn Trust	Portion 11 of Farm Waaihoek No. 286	286	11
Josua Meyer Trust	Waaihoek	286	3
Josua Meyer Trust	Waaihoek	286	12
Josua Meyer Trust	Waaihoek	286	4

Emvelo WEF			
Landowner	**Farm Name**	**Farm No.**	**Portion No.**
Tallyprops 7 Pty Ltd (Pieter Langenhoven)	Remainder Portion 8 of the Farm Windhoek No. 291	291	8
	Onverwacht	287	RE
National Government of SA	Zwartwater	288	6
National Government of SA	Zwartwater	288	1
Dream World Inv 450 Pty Ltd	Weltevreden	289	10
Dream World Inv 450 Pty Ltd	Weltevreden	289	11
Dream World Inv 450 Pty Ltd	Weltevreden	289	6
Van Der Merwe Broers Trust	Weltevreden	289	RE/3
National Government of SA	Witpunt	267	RE/7
National Government of SA	Mooiplaats	290	7
National Government of SA	Mooiplaats	290	8
Eglin Inv No 44 Pty Ltd	Mooipaats	290	RE/1
Eglin Inv No 44 Pty Ltd	Mooiplaats	290	RE/9



Photograph 1.1: Typical example of wind turbine

1.4 ASSUMPTIONS AND LIMITATIONS

1.4.1 Assumptions

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.

1.4.2 Limitations

Demographic data
Ward level data from the 2022 Census was not available at the time of preparing the report. These limitations do not have a material bearing on the findings of the SIA.

1.5 SPECIALIST DETAILS

Tony Barbour, the lead author of this report, is an independent specialist with 30 years' experience in the field of environmental management. In terms of SIA experience Tony Barbour has undertaken in the region of 300 SIAs and is the author of the Guidelines for Social Impact Assessments for EIA's adopted by the Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape in 2007. Annexure C contains a copy of Tony Barbour's CV.

Schalk van der Merwe, the co-author of this report, has an MPhil in Environmental Management from the University of Cape Town and has worked closely with Tony Barbour over the last eighteen years.

1.6 DECLARATION OF INDEPENDENCE

This confirms that Tony Barbour and Schalk van der Merwe, the specialist consultants responsible for undertaking the study and preparing the SIA Report, are independent and do not have any vested or financial interests in the proposed power line being either approved or rejected. Annexure D contains a signed declaration of independence.

1.7 REPORT STUCTURE

The report is divided into five sections, namely:

- Section 1: Introduction.
- Section 2: Policy and planning context.

- Section 3: Overview of study area.
- Section 4: Identification and assessment of key issues.
- Section 5: Summary of key findings.

SECTION 2: POLICY AND PLANNING ENVIRONMENT

2.1 INTRODUCTION

Legislation and policy embody and reflect key societal norms, values, and developmental goals. The legislative and policy context therefore plays an important role in identifying, assessing, and evaluating the significance of potential social impacts associated with any given proposed development. An assessment of the "policy and planning fit[2]" of the proposed development therefore constitutes a key aspect of the Social Impact Assessment (SIA). In this regard, assessment of "planning fit" conforms to international best practice for conducting SIAs.

Section 2 provides an overview of the policy and planning environment affecting the proposed project. For the purposes of meeting the objectives of the SIA the following policy and planning documents were reviewed:

- The National Energy Act (2008).
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998).
- The White Paper on Renewable Energy (November 2003).
- Integrated Resource Plan (IRP) for South Africa (2010-2030).
- The National Development Plan (2011).
- Mpumalanga Spatial Development Framework (2019).
- Msukaligwa Municipality Integrated Development Plan (2022-2027).
- Msukaligwa Spatial Development Framework (2019).

The section also provides a review of the renewable energy sector in South Africa.

2.2 NATIONAL POLICY ENVIRONMENT

2.2.1 National Energy Act (Act No 34 of 2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including solar and wind:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (…); to provide for (…) increased generation and consumption of renewable energies…"(Preamble).

2.2.2 White Paper on the Energy Policy of the Republic of South Africa

Investment in renewable energy initiatives, such as the proposed Wind Energy Facility (WEF), is supported by the White Paper on Energy Policy for South Africa (December 1998). In this regard, the document notes:

[2] Planning fit" can simply be described as the extent to which any relevant development satisfies the core criteria of appropriateness, need, and desirability, as defined or circumscribed by the relevant applicable legislation and policy documents at a given time.

"Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential".

"Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future".

The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly ***solar*** and **wind** and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented.
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential, and compared to investments in other energy supply options.
- Addressing constraints on the development of the renewable industry.

The White Paper also acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive, and many appropriate applications exist.

2.2.3 White Paper on Renewable Energy

The White Paper on Renewable Energy (November 2003) (further referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognizes that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals, and objectives for promoting and implementing renewable energy in South Africa.

The White Paper notes that while South Africa is well endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. As signatory to the Kyoto Protocol[3], Government is determined to make good the country's commitment to reducing greenhouse gas emissions. To this purpose, Government has committed itself to the development of a framework in which a national renewable energy framework can be established and operate.

South Africa is also a signatory of the Copenhagen Accord, a document that delegates at the 15th session of the Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change agreed to "take note of" at the final plenary on 18 December 2009. The accord endorses the continuation of the Kyoto Protocol and confirms that climate

[3] The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of November 2009, 187 states have signed and ratified the protocol (Wikipedia).

change is one of the greatest challenges facing the world. In terms of the accord South Africa committed itself to a reduction target of 34% compared to business as usual. In this regard, the Integrated Resource Plan (IRP) 2010 aims to allocate 43% of new energy generation facilities in South Africa to renewables.

Apart from the reduction of greenhouse gas emissions, the promotion of renewable energy sources is aimed at ensuring energy security through the diversification of supply (in this regard, also refer to the objectives of the National Energy Act).

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

2.2.4 Integrated Resource Plan (2019)

South Africa's National Development Plan (NDP) 2030 offers a long-term plan for the country. It defines a desired destination where inequality and unemployment are reduced, and poverty is eliminated so that all South Africans can attain a decent standard of living. Electricity is one of the core elements of a decent standard of living. In formulating its vision for the energy sector, the NDP took as a point of departure the Integrated Resource Plan (IRP) 2010–2030 promulgated in March 2011. The IRP is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment (minimize negative emissions and water usage).

On 27 August 2018, the then Minister of Energy published a draft IRP which was issued for public comment (Draft IRP). Following a lengthy public participation and consultation process the Integrated Resource Plan 2019 (IRP 2019) was gazetted by the Minister of Mineral Resources and Energy, Gwede Mantashe, on 18 October 2019, updating the energy forecast for South Africa from the current period to the year 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.

The IRP notes that South Africa is a signatory to the Paris Agreement on Climate Change and has ratified the agreement. The energy sector contributes close to 80% towards the country's total Green House Gas (GHG) emissions of which 50% are from electricity generation and liquid fuel production alone. A transmission from a fossil fuel-based energy sources is therefore critical to reducing GHG emissions. In September 2021 South Africa released its latest emission targets, indicating that it intended to limit Green House Gas (GHG) emissions to 398-510 MrCo2e by 2025, and 350-420 MrCo2e by 2030. These emissions are significantly lower than 2016 emission targets and will see South Africa's emissions decline in absolute terms from 2025, a decade earlier than planned (World Resource Institute, 2021). The IRP (2019) notes that 39 730 MW of new generation capacity must be developed. Of the 39 730 MW determined, about 18 000 MW has been committed to date. This new capacity is made up of 6 422 MW under the REIPPP with a total of 3 876 MW operational on the grid. Under the Eskom build programme, the following capacity has been commissioned: 1 332MW of Ingula pumped storage, 1 588MW of Medupi, 800MW of Kusile and 100MW of Sere Wind Farm. In addition, IPPs have commissioned 1 005MW from two Open Cycle Gas Turbine (OCGT) peaking plants.1 005 MW from OCGT for peaking has also been commissioned (IRP 2019, page 14). In terms of IRP (2019) provision has been made for the following new additional capacity by 2030:

- 1 500MW of coal.
- 2 500MW of hydro.

- 6 000MW of solar PV.
- 14 400MW of wind.
- 1 860MW of nuclear.
- 2 088MW for storage.
- 3 000MW of gas/diesel.
- 4 000MW from other distributed generation, co-generation, biomass and landfill technologies.

Figure 2.1 provides a summary of the allocations and commitments between the various energy sectors.

	Coal	Coal (Decommis-sioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37,149		1 860	2,100	2 912	1 474	1 980	300	3 830	499
2019	2,155	-2,373					244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1,433	-557				114	300			
2021	1,433	-1403				300	818			
2022	711	-844			513	400 1,000	1,600			
2023	750	-555				1000	1,600			500
2024			1,860				1,600		1000	500
2025						1000	1,600			500
2026		-1,219					1,600			500
2027	750	-847					1,600		2000	500
2028		-475				1000	1,600			500
2029		-1,694			1575	1000	1,600			500
2030		-1,050		2,500		1000	1,600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33,364		1,860	4,600	5,000	8,288	17,742	600	6,380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3	17.8	0.6	1.3	

Installed Capacity
Committed/Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

- 2030 Coal Installed Capacity is less capacity decommissioned between years 2020 and 2030.
- Koeberg power station rated/installed capacity will revert to 1,926MW (original design capacity) following design life extension work.
- Other/ Distributed generation includes all generation facilities in circumstances in which the facility is operated solely to supply electricity to an end-use customer within the same property with the facility.
- Short term capacity gap is estimated at 2,000MW.

Figure 2.1: Summary of energy allocations and commitments (2019 IRP)

As indicated above, the changes from the Draft IRP capacity allocations see an increase in solar PV and wind, and a significant decrease in gas and diesel; and new inclusions include nuclear and storage.

In terms of renewable energy five bidding rounds have been completed for renewable energy projects under the RE IPP Procurement Programme. The most dominant technology in the IRP2019 is renewable energy from wind and solar PV technologies, with wind being identified as the stronger of the two technologies. There is a consistent annual allocation of 1 600MW for wind technology commencing in the year 2022 up to 2030. The solar PV allocation of 1 000MWs per year is incremental over the period 2022 to 2030, with no allocation in the years 2024 (being the year the Koeberg nuclear extension is expected to be commissioned) and the years 2026 and 2027 (presumably since 2 000MW of gas is expected in the year 2027). The

IRP 2019 states that although there are annual build limits, in the long run such limits will be reviewed to take into account demand and supply requirements.

2.2.5 National Development Plan

The National Development Plan (NDP) contains a plan aimed at eliminating poverty and reducing inequality by 2030. The NDP identifies 9 key challenges and associated remedial plans. Managing the transition towards a low carbon national economy is identified as one of the 9 key national challenges. Expansion and acceleration of commercial renewable energy is identified as a key intervention strategy.

2.2.6 The New Growth Path Framework

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 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.

The New Growth Path also identifies five other priority areas as part of the programme to create jobs, through a series of partnerships between the State and the private sector. The Green Economy is one of the five priority areas, including expansions in construction and the production of technologies for solar, wind and biofuels. In this regard clean manufacturing and environmental services are projected to create 300 000 jobs over the next decade.

2.2.7 National Infrastructure Plan

Government adopted a National Infrastructure Plan (NIP) in 2012. The aim of the plan is to transform the economic landscape while simultaneously creating significant numbers of new jobs and strengthening the delivery of basic services. The aim of the NIP is support 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.

As part of the National Infrastructure Plan, Cabinet established the Presidential Infrastructure Coordinating Committee (PICC). The Committee identified and developed 18 strategic integrated projects (SIPS). The SIPs cover social and economic infrastructure across all nine provinces (with an emphasis on lagging regions) and included three energy SIPs, namely SIP 8, 9 and 10.

- SIP 8: Green energy in support of the South African economy.
- SIP 9: Electricity generation to support socio-economic development.
- SIP 10: Electricity transmission and distribution for all.

The NIP 2050 was gazetted for public comment on 10 August 2021[4]. The first phase of the NIP 2050 focuses on four critical network sectors that provide a platform, namely, energy,

[4] Gazette No. 44951

freight transport, water, and digital infrastructure. In line with the NDP, the vision for the energy sector is to promote:

- Economic growth and development through adequate investment in energy infrastructure" (generation, transmission, and distribution) and reliable and efficient energy service at competitive rates, while supporting economic growth through job creation by stimulating supply chains.
- Social equity through expanded access to energy at affordable tariffs and through targeted, sustainable subsidies for needy households.
- Environmental sustainability through efforts to reduce pollution, reduce water usage and mitigate the effects of climate change.

The NIP 2050 notes that by 2030, the NDP set a target that more than 90% of the population should enjoy access to grid connected or off-grid electricity by 2030. To realise this vision, South Africa's energy system will be supported by effective policies, institutions, governance systems, regulation and, where appropriate, competitive markets. In terms of energy mix, NIP 2050 notes that coal will contribute significantly less to primary-energy needs in the future, while gas will have an important enabling role, energy supply will be ***increasingly dominated by renewable energy resources– especially wind and solar which are least cost and where South Africa has a comparative advantage.***

NIP 2050 also notes that South Africa is signatory of the Paris Agreement which aims to achieve Net Zero greenhouse gas emissions by 2050. To achieve this will require a shift to a least cost energy path that is increasingly reliant on renewables.

2.3 PROVINCIAL AND LOCAL LEVEL POLICY AND PLANNING

2.3.1 Mpumalanga Spatial Development Framework (2019)

The spatial vision for Mpumalanga Province is "A sustainable, vibrant and inclusive economy, Mpumalanga". The SDF identifies a number of opportunities and challenges facing the province. The opportunities are linked to the province's natural resources, well developed economy, and established economies.

Natural Environment: The natural environment is diversified and is associated with the Highveld and the Lowveld areas in the province. Five major rivers systems in the flow through Mpumalanga and it is an important catchment area.

Connectivity and Infrastructure: The province is well connected in terms of infrastructure and is connected to Maputo and Richards Bay ports by both rail and road.

Economy: The province's rich biodiversity and scenic beauty support the tourism industry, while at the same time mining, specifically coal mining, plays a key role in the province's economy. The availability of high potential soil and diverse climatic condition also support a range of crops.

Urban settlements: The key urban centres are well established economic centres and offer the opportunity for further economic development by leveraging on the towns' economic bases.

In terms of challenges, climate change is identified as a key challenge. In this regard the activities in the province, specifically the generation of coal powered energy, account for 90% of South Africa's scheduled emissions. The province is also home to 50% of the most polluted

towns in the country. The predicted impacts associated with climate change include decreased rainfall in the province and increase temperatures. This will increase the risk of natural disasters, including droughts, flooding and fires.

The SDF identifies five spatial objectives, namely:

Connectivity and corridor functionality: The aim is to ensure connectivity between nodes, secondary towns, marginalised areas, the surrounding area, and to green open space systems.

Sustainable concentration and agglomeration: The aim is to promote the creation of an agglomeration economy that will encourage people and economic activities to locate near one another in urban centres and industrial clusters.

Conservation and resource utilisation: The aim is to promote the maximisation, protection and maintenance of ecosystems, scarce natural resources, high-potential agricultural land, and integrated open space systems.

Liveability and sense of place: The aim is to create settlements that contribute to people's sense of personal and collective wellbeing and to their sense of satisfaction in being residents of a settlements.

Rural diversity and transformation: The aim is to create Urban-Rural anchors and choices for residents within the rural economy linked to access to markets, food security and security of land tenure.

Connectivity and corridor functionality, Sustainable concentration and agglomeration, and Conservation and resource utilisation are of specific relevance the proposed development.

Connectivity and corridor functionality
The strategic objectives (SOs) that are relevant the study area and the proposed development include:

- Strategic Objective 2: Development of the existing corridors and building new linkages to increase capacity and economic opportunities and ensure connectivity to the surrounding areas
- Strategic Objective 5: Decongestion of the coal haul roads and Improvement of Freight Network

In terms of SO 2, the spatial linkages identified for development and upgrading include the upgrade of N17, N17/N2 Corridor and the N12 and N11 corridor. The site is flanked by the N2 to the south and N11 to the southwest.

Sustainable concentration and agglomeration
Of specific relevance, Strategic Objective 4, Diversify Economy, focusses on the need to diversify the economy. The SDF notes that mining sector contributes 25% to Mpumalanga's GVA. In addition, there are a number of other sectors directly or indirectly dependent on mining such as manufacturing (specifically metal processing) and utilities (specifically power generation). The combined GVA of these three sectors makes up more than 40% of the provincial GVA.

However, the SDF recognises that mining is not a sustainable industry and resources are finite. There is therefore a need for a gradual shift from mining-oriented sectors to the

sustainable economic sectors to maintain sustained growth of the provincial economy. Mpumalanga's Coal Mining and Coal Fired Power Plant region (located mainly in the Highveld area) will be come under increasing pressure due to environmental considerations. As a result, the region is likely to experience a decline in demand for coal and with it a decline in the associated employment it creates. There is therefore a need to diversify the regional economy and facilitate the gradual transition of economic activities in the region. The proposed development supports the objective of diversifying the provinces economy.

Conservation and resource utilisation

The strategic objectives (SOs) that are relevant the study area and the proposed development include:

- Strategic Objective 2: Ensure conservation of all water resources and catchment Areas.
- Strategic Objective 4: Promote a low carbon and climate resilient economy.
- Strategic Objective 6: To optimally utilise the mining potential without compromising the long-term sustainability of the natural environment.

Strategic Objective 2: Ensure Conservation of all Water Resources and Catchment Areas

Achieving Strategic Objective 2, Ensure Conservation of all Water Resources and Catchment Areas is closely linked to diversifying the economy. The SDF notes that the provinces water resources are under pressure from high demand activities, including Eskom's power stations, mining, and industrial uses. The proposed development represents a low consumer of water.

Strategic Objective 4: Promote a Low Carbon and Climate Resilient Economy

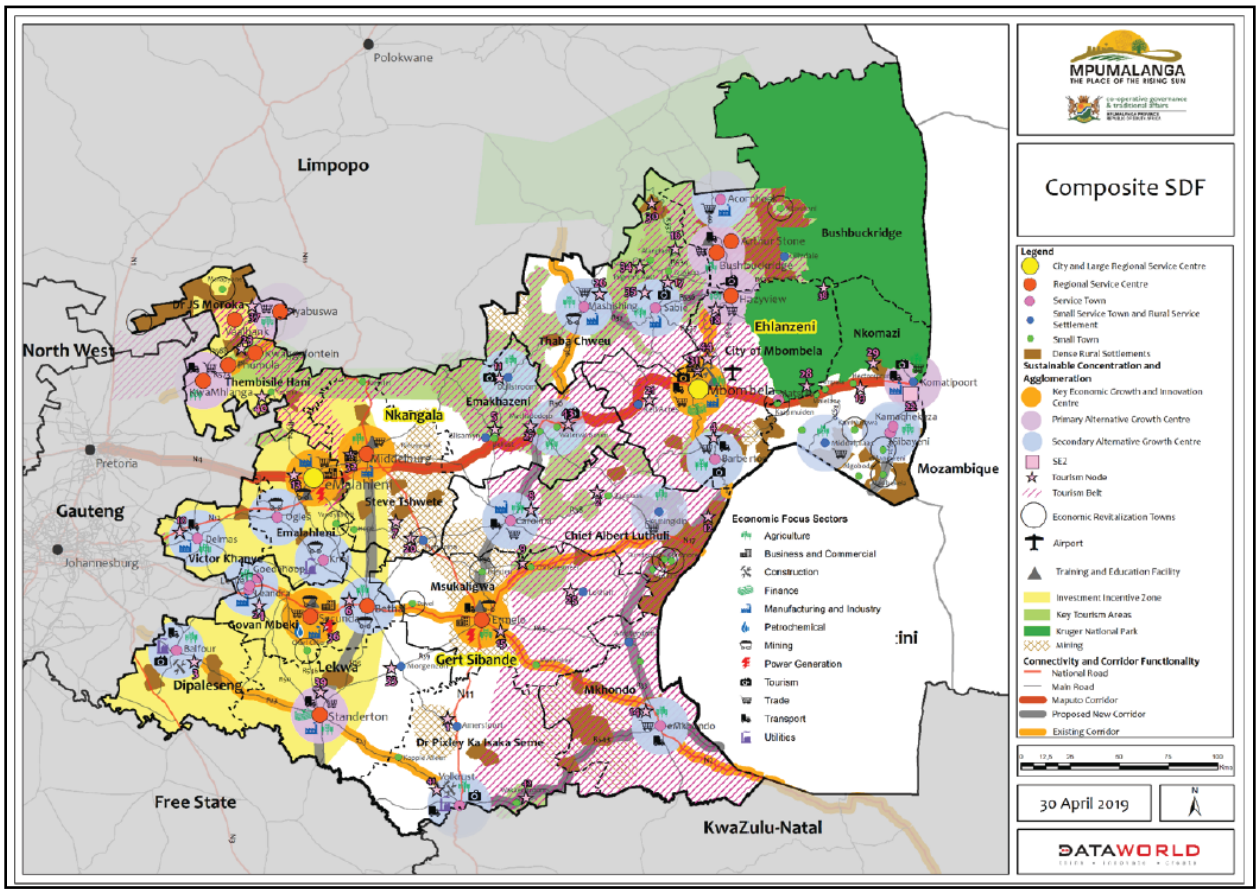
Mpumalanga is home to 12 of Eskom's 15 coal-fired power stations; petrochemical plants including Sasol's refinery in Secunda; metal smelters; coal and other mines; brick and stone works; fertiliser and chemical producers; explosives producers; and other smaller industrial operations, making the Highveld one of South Africa's industrial heartlands (CER, 2017). As a result, the air quality within the Mpumalanga Province, especially within the Highveld area, 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). Achieving Strategic 4, Promote a low carbon and climate resilient economy, is closely linked to diversifying the economy. The proposed development supports the development of a low carbon, climate resistant economy.

Strategic Objective 6: To optimally utilise the mining potential without compromising the long-term sustainability of the natural environment

Mining contributes R 49.6 billion (approximately 25%) to the provincial economy. The key mining sector is coal, which represents 83% of South Africa's coal production. The mining sector, specifically coal mining, creates employment opportunities and supports the manufacturing and power generation sector. However, mining is also associated with many issues including water and soil contamination, air pollution and environmental degradation.

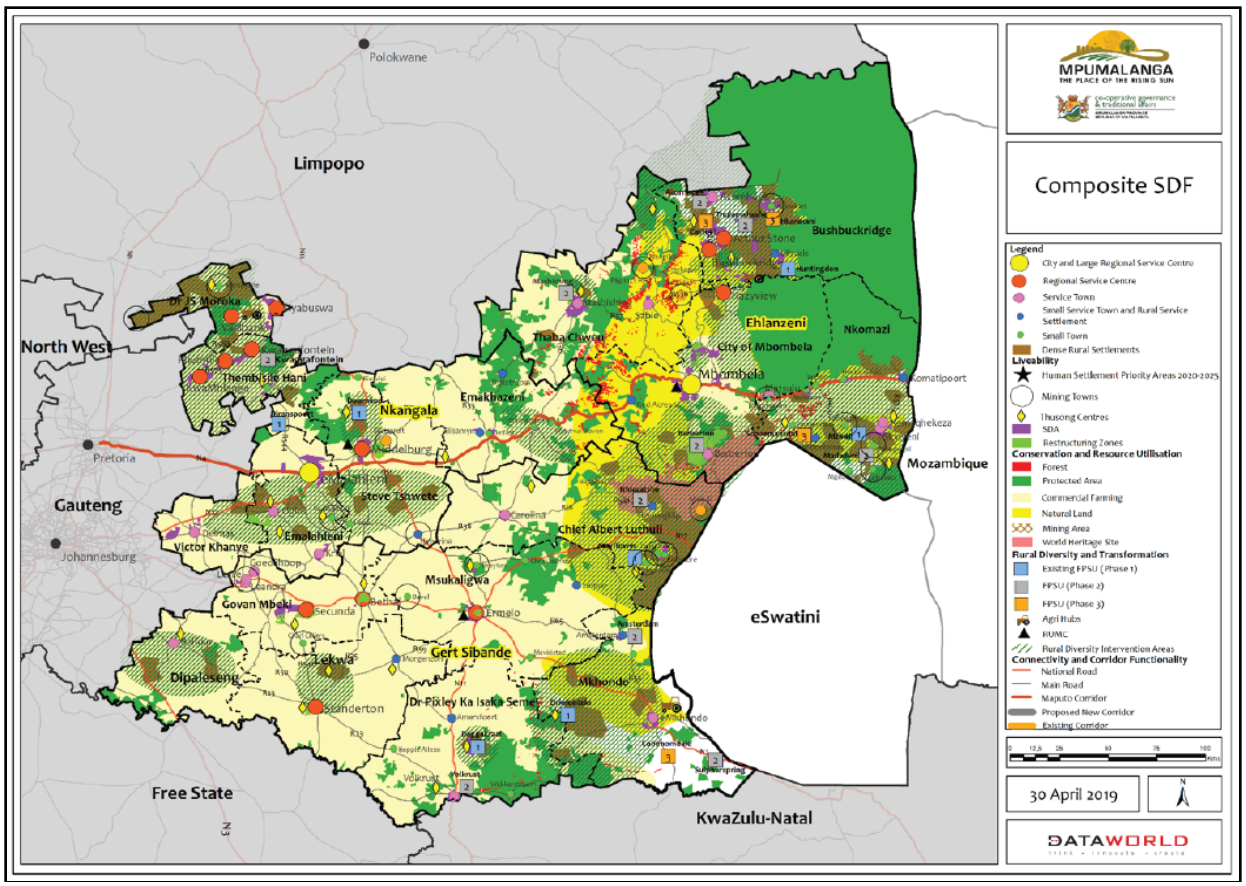
Achieving Strategic 6, To optimally utilise the mining potential without compromising the long-term sustainability of the natural environment is closely linked to diversifying and developing a low carbon climate resistant economy. The proposed development supports the objective of diversifying and developing a low carbon, climate resistant economy. In terms of the high-level composite spatial development framework, Ermelo is identified as a Regional Service Centre (red dot) and the development area located to the east of the town falls within area defined as a Tourism Belt (pink hatched) (Figure 2.2). The economic sectors in the area

include mining and power generation. The dominant land use in the study area is commercial agriculture (yellow, Figure 2.3).



Source: Mpumalanga SDF

Figure 2.2: Mpumalanga Composite SDF-Economic Activities



Source: Mpumalanga SDF

Figure 2.3: Mpumalanga Composite SDF-Land Uses

2.3.2 Msukaligwa Integrated Development Plan

The Vision of Msukaligwa Municipality (MM) is to be "A Beacon of Service Excellence". The associated mission to meet the vision is:

- Enhancing community participation to steer development initiatives towards community needs.
- Advocating and stimulating local economy to promote economic growth and development.
- Improving good governance and measurable service delivery techniques.
- Enhancing effectiveness and efficiency in the utilization of available resources.
- Empowering our communities and the vulnerable groups in particular.
- Working in partnership with all its stakeholders.
- Continuously mobilizing resources to achieve high standards in service.

A SWOT analysis undertaken as part of the IDP process identified and number of opportunities and threats that are relevant to the development, namely.

Opportunities

- Power utility, government services, mining, tourism, agriculture, and forestry.
- National corridor developments (N2, N11 and N17).
- Strategic location of the municipality.

Threats
- Ageing infrastructure.
- High unemployment rate.
- Mines that are not rehabilitated.

Based on the outcome of the SWOT analysis a number of key focus areas were identified for attention over the 5-year IDP planning period of which the following are relevant.

- Unemployment and poor economic development.
- Insufficient access to basic services.
- Poor maintenance and upgrading of services infrastructure.
- Poor roads and storm water drainage system.

The community engagement process undertaken as part of the IDP process indicated that a number of key issues in the rural areas that are relevant to the development. These include:

Basic services
A number of the rural areas in the MM that do not have access to basic services, including potable water, electricity, and toilets. Some of these challenges can be addressed through the SED initiatives associated with the development.

Skills development and job opportunities
There is a need to support skills development and create employment opportunities. The initiatives listed in the IDP include building of skills development centres or multipurpose centres, employing local contractors on projects implemented within municipality, creating opportunities for skills transfers by contractors and the provision of bursaries and learnerships. The proposed development will create opportunities for skills development and employment.

Sports and recreation
There is a shortage of sports and recreation facilities and opportunities in many of the rural areas within the MM. The initiatives identified in the IDP to address this include the refurbishment of existing sports facilities, including the provision of ablution facilities, the construction of new sport facilities in remote areas and upgrading of security to prevent vandalism. Some of these challenges can be addressed through the SED initiatives associated with the development.

Section E of the IDP lists the developmental goals, objectives, strategies, and performance indicators. The strategic goals that are relevant to the development include:

- Sustainable and reliable delivery of basic services.
- Reduced unemployment and poverty.
- Social cohesion and spatial transformation.

The key priorities in terms of basic services with specific reference to rural areas includes the establishment of new and or up-grading of existing clinics, and the provision of mobile clinic services for more remote rural areas. The need for clinics outside Ermelo to operate 24 hours and seven days a week due to the absence of hospitals nearby was also raised as a key issue. reach the areas.

In terms of community facilities, the needs identified included, community halls and more Thusong Centres. Centres also need to be established for disabled members of the community.

The key priority in terms of unemployment and poverty is to support economic development and create employment opportunities.

The strategic objectives that are relevant to the development include:

- To provide sustainable and reliable services to communities.
- To coordinate efforts to address unemployment and poverty.

2.2.3 Msukaligwa Municipality Spatial Development Framework

The spatial vision for the MM is "*a diversified, vibrant rural economy that make optimal use of natural resources, supported by a well-connected network of sustainable rural service and economic nodes, where people have access to services and economic opportunity*".

The SDF is informed by a number of spatial objectives, namely:

- Provide a spatial structure that facilitates access to services for all communities.
- Protect strategic water sources and sensitive eco-systems.
- Provide space for the diversification of the local economy.
- Eliminate past spatial settlement patterns.

The provision of space of the diversification of the local economy is of specific relevance to the proposed development.

A SWOT analysis was undertaken as part of the preparation of the SDF. The key outcomes of the analysis are summarised below.

Strengths
- Rich natural resource base – minerals, high potential agricultural land, water resources, natural environment (lakes region).

Weakness
- Typical rural population distribution making it difficult to reach people with services.
- Remaining service backlogs (water, sanitation, refuse removal).
- Increasing poverty levels.
- Relatively low skills levels
- Declining functional literacy.

Opportunities
- National projects to enhance regional links may strengthen the locational advantage of Ermelo / Wesselton.
- Potential for tourism linked to natural assets.
- Potential for larger scale beneficiation supported by current nodal structure and transport links.
- Legislative investment by mines (social and labour plans) and the associated opportunity for service provision and socio-economic development[5].

[5] Opportunities associated with SLPs would also apply to Community Trusts associated with renewable energy projects.

Threats

- Declining coal reserves threatens mining economy and employment. Impact on mining sector also impacts on other related industries, such as manufacturing and transport.
- Global and national move away from carbon-based economy will lead to decline in mining, coal power generation economy and employment. This will also impact on mining related industries.
- Competing land uses – mining, agriculture, urban expansion, conservation
- Climate change – decreased rainfall and increased temperatures will have impact on agriculture, forestry, and settlements.
- Population growth exceeding expected and current economic growth.

The results of the SWOT analysis informed the identification of a set of priority issues centred around natural resource management and human development. The issues that are relevant to the proposed development include:

Strategic water source areas

Msukaligwa is part of a catchment area which is classified as strategic water source area at a national scale. The preservation and sustainable use of these water sources is becoming increasingly important in view of climate change. Decisions about the future development of the area should take cognisance of this issue and not sacrifice long term water security in favour of meeting short term economic or development targets.

Conflicting land uses

Msukaligwa is richly endowed with natural resources including water, high potential land, minerals, and sensitive ecosystems that occur in attractive natural landscapes. However, these natural resources and the demand to exploit them spatially overlap and often conflict. The SDF highlights the need to address and manage potential land use conflicts.

Reliance on Carbon Economy

The area's economy is currently strongly dependent on coal mining. In addition to coal mining, the area also hosts the Camden Power Station. The SDF notes that the eventual decline of the mining sector and coal-based power generation, based on declining coal deposits and a move away from a carbon-based economy, is a long-term certainty for the area. Emphasis in spatial planning should be on the creation of opportunities to diversify the economy to lessen the impact of the decline. Development of renewable energy development also decreases the need for coal power and thereby contributes to reducing the impact of open cast coal mining on highly productive agricultural land in coal mining areas of the country. Furthermore, a reduction in coal power saves water resources and therefore potentially makes more water available for irrigated agriculture

The SDF highlights the risks posed by climate change, specifically given that large section of the economy is reliant on agriculture and forestry. The area is also the source area of some of the main strategic waterways of the country.

The SDF identifies a number of structuring elements that inform the spatial concept for the MM. These include urban development nodes, transportation corridors, mining areas and commercial agriculture and conservation areas.

The main town of Ermelo is designated as a Primary Node. The function of a Primary Node is to:

- Provide higher order services to the growing urban population, as well as the rural catchment area surrounding the node.

- Provide space for economic diversification and higher intensity economic development, with a focus on agriculture and related activities, mining, utilities, and ***power generation***, as well as transport and logistics. Support should also be provided too industrial and commercial uses, as well as business incubation centres and innovation centres, training facilities and educational institutes.

Sheepmoor, located in the southern part of the study area, is designated as Rural Node and has been identified as a site for the establishment of a Farmer Production Support Unit in terms of the Department of Rural Development and Land Reform's Agri-Park Programme. The economic focus on Sheepmoor is on forestry and agriculture (livestock, grains (maize and beans) and vegetables). Economic initiatives such as the establishment of grain silo, training in tree farming and provision of connecting infrastructure should be prioritised. The development of small agri-villages in consultation with Mondi/ Sappi is also identified as an initiative. The Socio-Economic Development (SED) spend linked to the proposed development could support for these initiatives.

The N2 and N17 are identified as Primary Transportation Corridors, while the N11 is identified as a Secondary Corridor. The SDF notes that development of nodes along these corridors are proposed, in order to intensify development at specific points and achieve economies of scale.

The SDF highlights the key role and spatial extent of mining in the MM, including reference to the Camden coal-fired power station south of Ermelo. Over the longer term the rehabilitation of mining areas and a range of alternative peri-urban uses should be considered for the impacted areas in view of the decrease reliance on coal. Commercial Agriculture also represents a key economic activity in the MM. However, the SDF notes that climate change will pose a risk to the agricultural sector.

The structuring elements have been used to identify spatial focus areas. The areas of relevance to the development include:

- Agriculture and Forestry Focus Areas.
- Conservation and Tourism Focus Area.
- Mining and Peri-Urban Focus Areas.

Agriculture and Forestry Focus Areas

In terms of agricultural development, the SDF notes that the recommendations of the District Rural Development Plan for Gert Sibande District Municipality be implemented. The Plan identifies a number of rural intervention areas (RIAs). As indicated in Figure 2.4, the study area is not located in an RIA. The main land uses in the study area consist of Forestry (Strategic Water Resource Area, Green) and Commercial Farming (Brown). With careful planning the footprint and impact on agricultural land associated with wind turbines can be minimised. In addition, farming activities can continue to take place between the turbines.

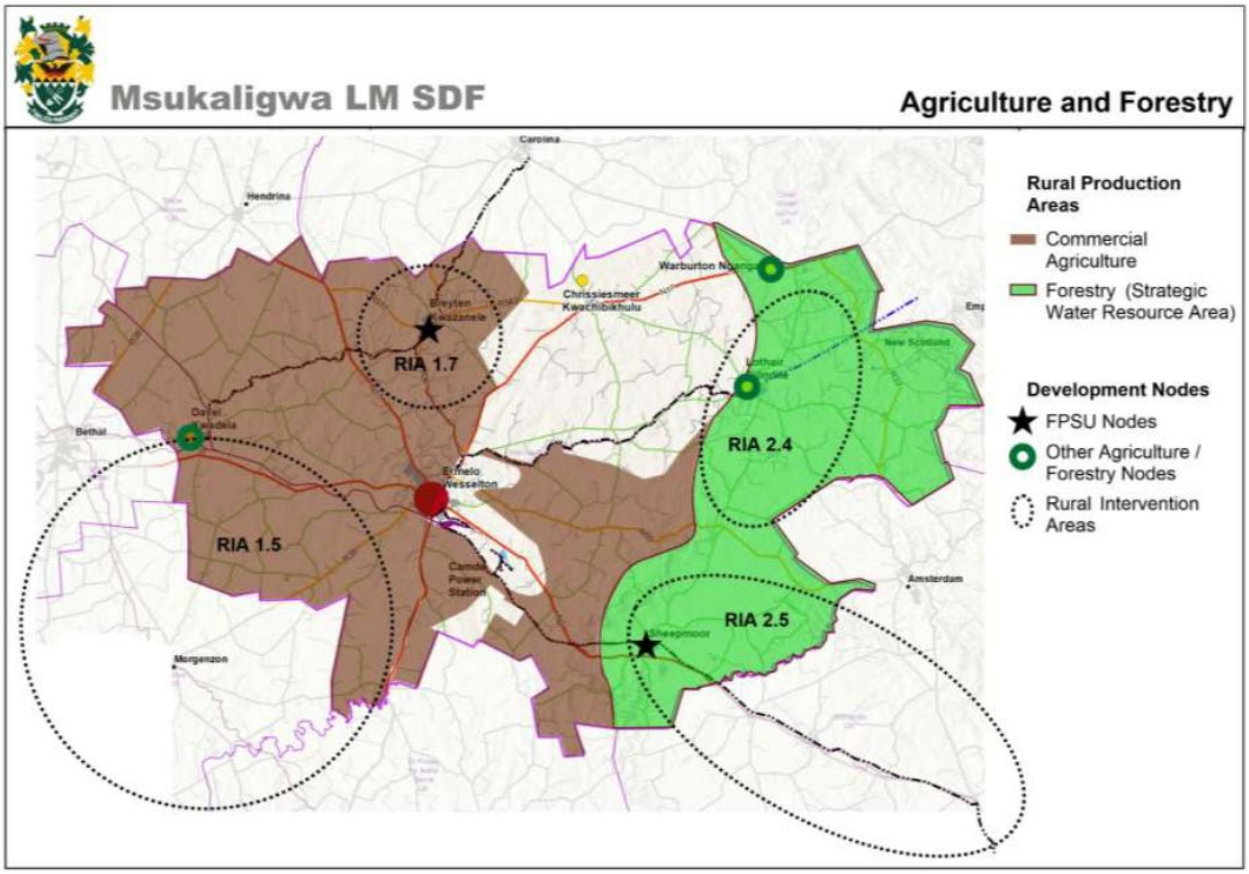


Figure 2.4: Msukaligwa SDF-Agriculture and Forestry

Conservation and Tourism Focus Areas

The SDF notes that the entire Msukaligwa area is environmentally sensitive, and all human activity should be conducted in such a way as to minimise impact. The key areas of significance identified include:

- The lakes region – this natural asset is not only an economic asset for tourism, but also an important ecosystem and an important mechanism to mitigate the impacts of climate change.
- Strategic water source areas and river headwaters – the area makes an important contribution to national water security and requires clean water for human development and economic activities such as agriculture.
- Protected areas – a number of small, protected areas exist outside the lake's region. There areas are not only important ecologically, but also from a tourism perspective.

The natural and cultural assets of Msukaligwa, notable the lakes region, has the potential to serve as a major attraction. In addition, the area's proximity to the large markets of Gauteng and good regional connectivity should be harnessed in attracting more local tourists.

As indicated in Figure 2.5, most of the proposed development area is located in a Protected Area. This will need to be assessed as part of the relevant specialist studies.

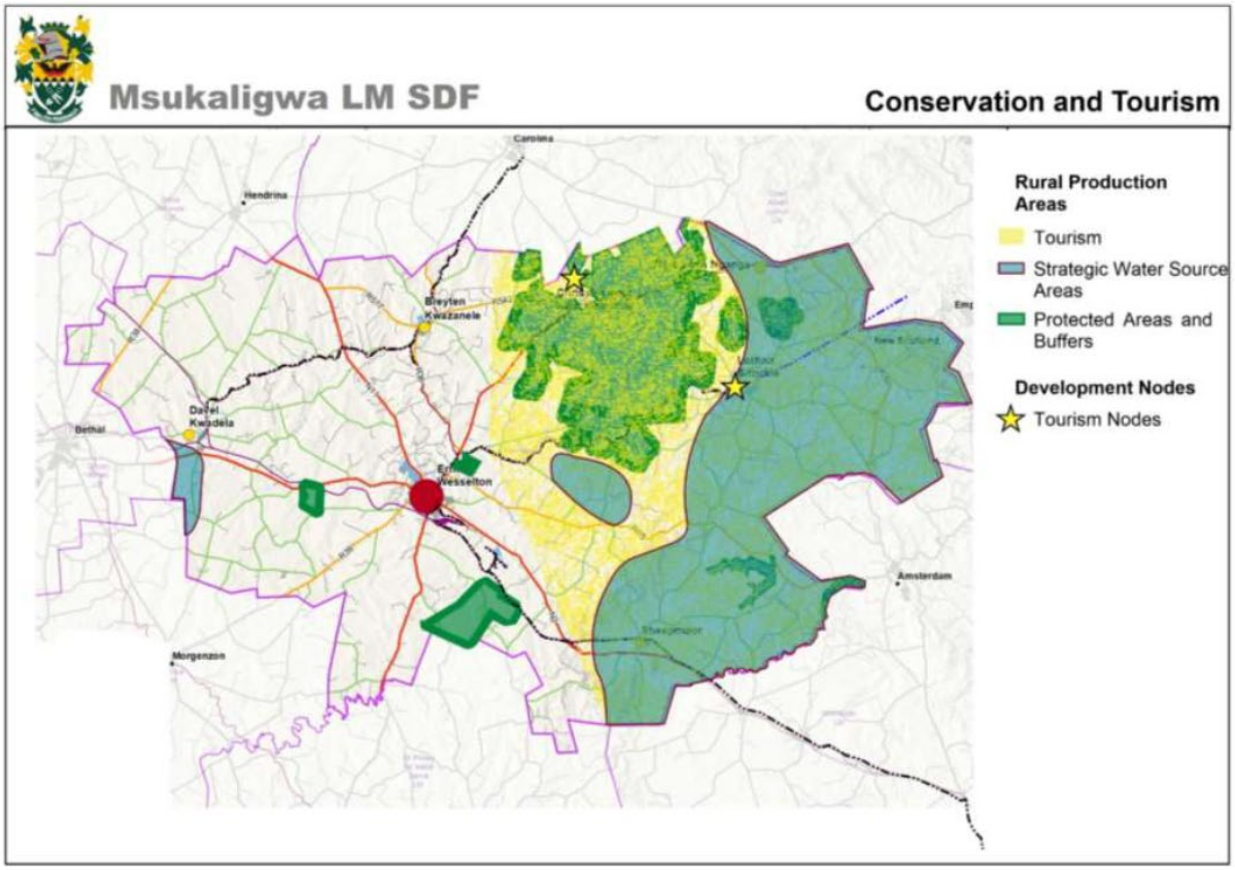


Figure 2.5: Msukaligwa SDF-Conservation and Tourism

Mining Areas

The SDF acknowledges the importance of the mining sector and notes that it will need to be accommodated over the short to medium term. However, of relevance to the proposed development the SDF refers to green industries and indicates that the existing site of the Camden Power Station and surrounds should be made available for new industrial development in the long term, to manage the long-term impact of the Power Station being decommissioned. The existing road and rail infrastructure render the area in the vicinity of the Power Station and the site itself highly accessible creating an opportunity for redevelopment with alternative uses requiring extensive space and good connectivity. The SDF also notes that the mining belt area holds other potential that should be harnessed with a long-term view of diversifying the local economy to soften the long-term impact of eventual decline in mining. As indicated in Figure 2.6, the development area is located in an area of moderate to no mining potential with a limited number of mining activities (brown areas). The composite spatial development framework for the MM is informed by the various structuring elements. The spatial layout is reflected in Figure 2.7. As indicated in Figure 2.7, most the development area falls within area that consists of tourism, protected area and buffers.

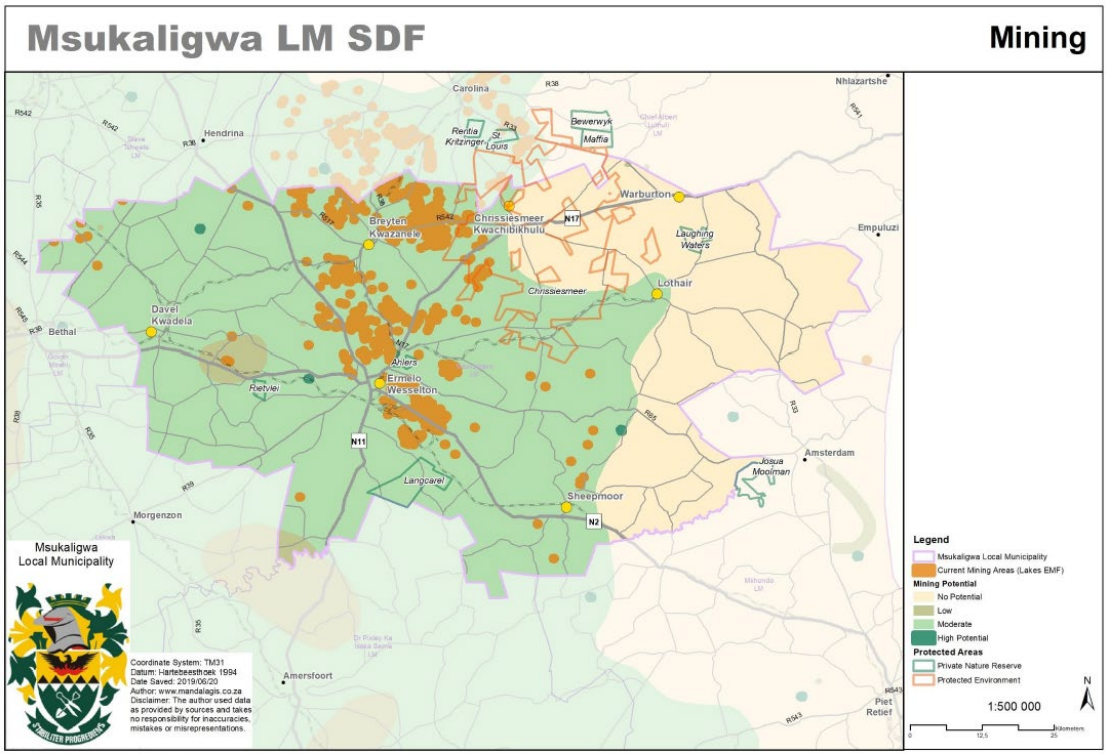


Figure 2.6: Msukaligwa SDF-Mining

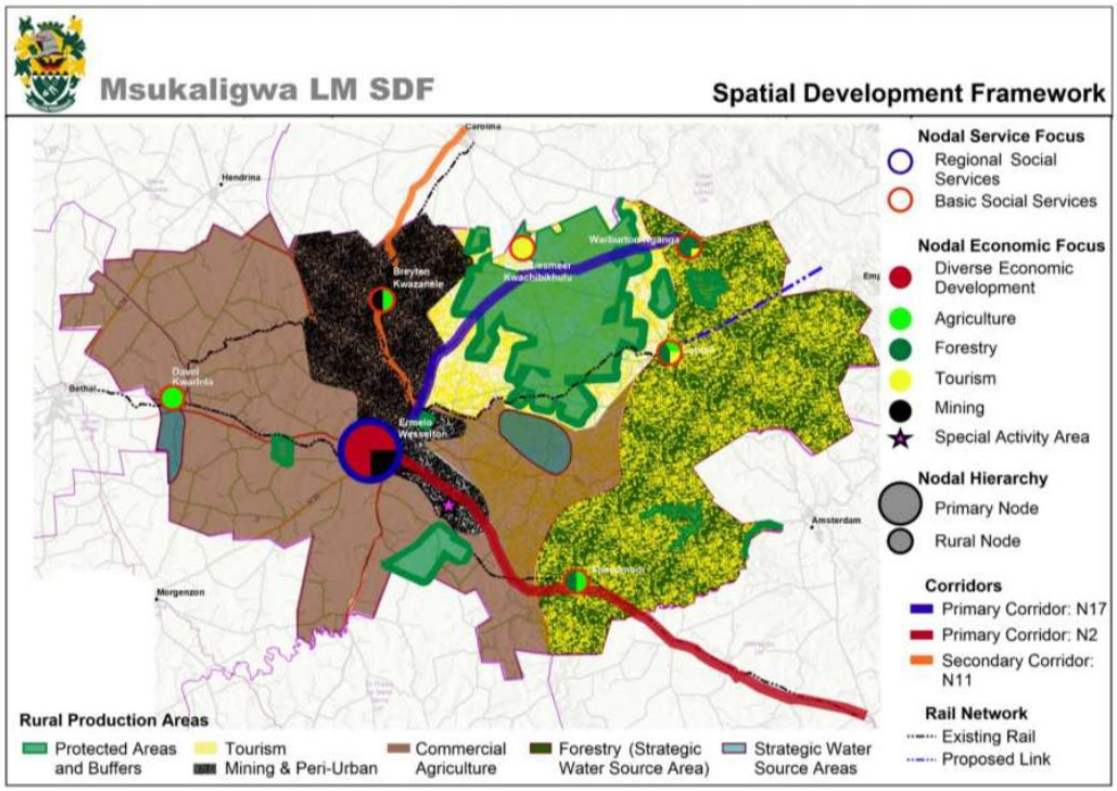


Figure 2.7: Msukaligwa SDF-Composite Spatial Development Framework

2.3 OVERVIEW RENEWABLE ENERGY SECTOR IN SOUTH AFRICA

intention is not to provide a critical review of renewable energy. The focus is therefore on the contribution of renewable energy, specifically in terms of supporting economic development.

The following documents were reviewed:

- Independent Power Producers Procurement Programme (IPPPP): An Overview (December 2021), Department of Energy, National Treasury and DBSA.
- Green Jobs Study (2011), IDC, DBSA Ltd and TIPS.
- Powering the Future: Renewable Energy Roll-out in South Africa (2013), Greenpeace South Africa.
- WWF SA, Renewable Energy Vision 2030, South Africa, 2014.
- Jacqueline M. Borel-Saladin, Ivan N. Turok, (2013). The impact of the green economy on jobs in South Africa), South African Journal of Science, *Volume 109 /Number 9/10, September/October 2013.*
- The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town.

2.4.1 Independent Power Producers Procurement Programme (IPPPP): An Overview

The document presents an overview of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) undertaken by the Department of Energy, National Treasury, and the Development Bank of South Africa in December 2021. The programme's primary mandate is to secure electrical energy from the private sector for renewable and non-renewable energy sources. With regard to renewables, the programme is designed to reduce the country's reliance on fossil fuels, stimulate an indigenous renewable energy industry and contribute to socio-economic development and environmentally sustainable growth. The IPPPP has been designed not only to procure energy but has also been structured to contribute to the broader national development objectives of job creation, social upliftment and broadening of economic ownership.

The Integrated Resource Plan for electricity (IRP) provides South Africa's long-term plan for electricity generation. It primarily aims to ensure security of electricity supply, minimise the cost of that supply, limit water usage and reduce greenhouse gas (GHG) emissions, while allowing for policy adjustment in support of broader socio-economic developmental imperatives. The IRP 2019 was promulgated in October 2019 and replaced the IRP 2010 as the country's official electricity infrastructure plan.

It calls for 37 696MW of new and committed capacity to be added between 2019 and 2030 from a diverse mix of energy sources and technologies as ageing coal plants are decommissioned and the country transitions to a larger share of renewable energy. By2030, the electricity generation mix is set to comprise of 33 364MW (42.6%) coal, 17 742MW (22.7%) wind, 8 288MW (10.6%) solar photovoltaic (PV), 6 830MW (8.7%) gas or diesel, 5 000MW (6.4%) energy storage, 4 600MW (5.9%) hydro, 1 860MW (2.4%) nuclear and 600MW (0.8%) concentrating solar power (CSP). Additionally, a short-term gap at least 2000MW is to be filled between 2019 and 2022, thereby further raising new capacity requirements, while distributed or embedded generation for own use is positioned to add 4 000MW between 2023 and 2030. The IRP is intended to be frequently updated, which could impact future capacity allocations from various energy sources and technologies.

Energy supply
By the end of December 2021, the REIPPPP had made the following significant impacts.

- 6 323 MW of electricity had been procured from 92 RE Independent Power Producers (IPPs) in BW1-4.
- 5 661 MW of electricity generation capacity from 85 IPP projects has been connected to the national grid.
- 71 073GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational in November 2013.

Renewable energy IPPs have proved to be very reliable. Of the 85 projects that have reached COD, 77 projects have been operational for longer than a year. The energy generated over the past 12-month period for these 77 projects is 14 117GWh, which is 95% of their annual energy contribution projections (P50) of 14 924GWh over a 12-month delivery period. Thirty-one (31) of the 77 projects (40%) have individually exceeded their P50 projections.

Comparatively, the following statistics were presented at the REIPPPP Bid Window 6 Bidders Conference on 7 July 2022 by the IPP Office based on data as of March 2022 following seven bid rounds (IPP Office, 2022[6]):

- 92 IPPs have been selected as preferred bidders.
- 6 323 MW of electricity capacity procured.
- 5 826 MW already operational from 87 IPPs.
- 74 805 GWh energy generated by Renewable Energy sources.

Energy costs
In line with international experience, the price of renewable energy is increasingly cost competitive when compared with conventional power sources. The REIPPPP has effectively captured this global downward trend with prices decreasing in every bid window. Energy procured by the REIPPPP is progressively more cost effective and has approached a point where the wholesale pricing for new coal-and renewable-generated energy intersect.

Through the competitive bidding process, the IPPPP effectively leveraged rapid, global technology developments and price trends, buying clean energy at lower and lower rates with every bid cycle, resulting in SA getting the benefit of renewable energy at some of the lowest tariffs in the world. The price for wind power has dropped by 50% to R0.94/kWh, while solar PV has dropped with 75% to R1.14/kWh between BW1 and BW4.

Prices contracted under the REIPPPP for all technologies are well below the published REFIT prices. The REIPPPP has effectively translated policy and planning into delivery of clean energy at very competitive prices with the BW4 price directly comparable with the per kWh price of new coal generation. As such it is contributing to the national aspirations of secure, affordable energy, lower carbon intensity and a transformed 'green' economy. Solar PV has dropped most significantly with a price decrease of 75% to R1.10/kWh between BW1 and BW4. This compares with the industry estimates in April 2020 of R1.45/kWh for Medupi. Considering the on-going delays incompletion, indications are that these costs may even be significantly higher.

[6] IPP Office (2022). RENEWABLE ENERGY INDEPENDENT POWER PRODUCER PROCUREMENT PROGRAMME (REIPPPP) BID WINDOW 6 BIDDERS' CONFERENCE, 7 JULY 2022 [online]. Accessed July 2022. https://www.ipp-renewables.co.za/PressCentre/GetPressRelease?fileid=16a21004-f9fd-ec11-9578-2c59e59ac9cd&fileName=BW6%20Bidders%20Conference%20Consolidated.pdf.

Investment
The document notes that the REIPPPP has attracted significant investment in the development of the REIPPs into the country. The total investment (total project costs[7]), including interest during construction, of projects under construction and projects in the process of closure is R209.6 billion (this includes total debt and equity of R209 billion, as well as early revenue and VAT facility of R0.5 billion).

The REIPPPP has attracted R42 billion in foreign investment and financing in the seven bid windows (BW1 – BW4). This is almost double the inward FDI attracted into South Africa during 2015 (R22.6 billion). The document notes that the share of foreign investment and equity showed an increase in the most recent bid window (2S2), suggesting that the REIPPPP continued to generate investor confidence despite the poor economic conditions in South Africa in recent years.

Comparatively, based on the information presented at the REIPPPP Bid Window 6 Bidders Conference on 7 July 2022 by the IPP Office (IPP Office, 2022), approximately R209.6 billion investment has been attracted for energy infrastructure in all bid windows; and as at March 2022 an actual R1.9 billion contribution was realised for socio-economic development.

South African citizen shareholding
The importance of retaining local shareholding in IPPs is key condition of the procurement requirements. The RFP notes that bidders are required to have South African Equity Participation of 40% in order to be evaluated. South African (local) equity shareholding across BW1-4 equates to 52% (R31.4 billion) of the total equity shareholding (R61.0 billion) was held by South African's across BW1 to BW4, 1S2 and 2S2. This equates to substantially more than the 40% requirement. Foreign equity amounts to R29.6 billion and contributes 49% of total equity.

The REIPPPP also contributes to Broad Based Black Economic Empowerment (BBBEE) and the creation of black industrialists. In this regard, Black South Africans own, on average, 34% of projects that have reached financial close (BW1-BW4), which is 4% higher than the 30% target. This includes black people in local communities that have ownership in the IPP projects that operate in or near their communities and represents the majority share of total South African Entity Participation.

On average, black local communities own 9% of projects that have reached financial close. This is well above the 5% target. In addition, an average of 21% shareholding by black people in engineering, procurement, and construction (EPC) contractors has been attained for projects that have reached financial closure. This is higher than 20% target. The shareholding by black people in operating companies of IPPs has averaged 30% (against the targeted 20%) for the 85 projects in operation (i.e. in BW1–4).

The target for shareholding by black people in top management has been set at 40%, with an average 68% achieved to date. The target has therefore been significantly exceeded.

Community shareholding and community trusts
The regulations require a minimum ownership of 2.5% by local communities in IPP projects as a procurement condition. This is to ensure that a substantial portion of the investments has been structured and secured as local community equity. An individual community's dividends earned will depend on the terms of each transaction corresponding with the relevant

[7] Total project costs mean the total capital expenditure to be incurred up to the commercial operations date in the design, construction, development, installation, and or commissioning of the project)

equity share. To date all shareholding for local communities have been structured through the establishment of community trusts. For projects in BW1 to BW4, qualifying communities will receive R25.5 billion net income over the life of the projects (20 years). The report notes that the bulk of the money will however only start flowing into the communities from 2028 due to repayment obligations in the preceding years (repayment obligations are mostly to development funding institutions). However, despite the delay this represents a significant injection of capital into mainly rural areas of South Africa. If the net projected income for the first seven bid windows (BW1-BW4) was structured as equal payments overtime, it would represent an annual net income of R1.27 billion per year.

Income to all shareholders only commences with operation of the facility. Revenue generated to date by the 85 operational IPPs amounts to R149.9 billion.

Procurement spend

In addition to the financial investments into the economy and favourable equity structures aimed at supporting BEE, the REIPPPP also targets broader economic and socio-economic investment. This is through procurement spend and local content.

The total projected procurement spend for BW1 to BW4 during the construction phase was R71.1 billion, while the projected operations procurement spend over the 20 years operational life is estimated at 75.2 billion. The combined (construction and operations) procurement value is projected as R146.3 billion of which R92.1 billion has been spent to date. For construction, of the R71.1 billion already spent to date, R71 billion is from the 85 projects which have already been completed. These 85 projects had planned to spend R64.2 billion. The actual procurement construction costs have therefore exceeded the planned costs by 11% for completed projects.

Preferential procurement

The share of procurement that is sourced from Broad Based Black Economic Empowered (BBBEE) suppliers, Qualifying Small Enterprises (QSE), Exempted Micro Enterprises (EME) and women owned vendors are tracked against commitments and targeted percentages. The IA target requirement for BBBEE is 60% of total procurement spend. However, the actual share of procurement spend by IPPs from BBBEE suppliers for construction and operations combined is currently reported as 83%, which is significantly higher than the target of 60%, but also the 71% that had been committed by IPPs. BBBEE, as a share of procurement spend for projects in construction, is also reported as 84% with operations slightly lower at 74%.

The majority of the procurement spend to date has been for construction purposes. Of the R76 billion spent on procurement during construction, R64.3 billion has reportedly been procured from BBBEE suppliers, achieving 84.6% of total procured. Actual BBBEE spend during construction for BW1 and BW2 alone was R25.5 billion, 81% more than the 14.1 billion planned by the IPPs. The R64.3 billion spent on BBBEE during construction is 30% more than the R49.7 billion that had originally been anticipated by all IPPs procured in BW1-4.
Total procurement spend by IPPs from QSE and EMEs has amounted to R28.1 billion (construction and operations) to date, which exceeds commitments by 250% and is 30% of total procurement spend to date (while the required target is 10%). QSE and EME's procurement spend for construction was 31% of construction procurement to date and 26% of operational procurement, exceeding the 10% targets set. QSE and EME share of construction procurement spend totals R23.8 billion, which is 5.4 times the planned spend for construction of R4.4 billion during this procurement phase.

In terms of procurement from women-owned vendors to date, 5% of total construction procurement spend has been from woman-owned vendors (against a targeted 5%), and 6%

of operational procurement spend has been realised from woman-owned vendors to date, thereby exceeding the targeted 5%. In terms of construction spend, R 4.1 billion was undertaken by women-owned vendors, which is almost double the R 1.8 billion expected to be spent for the construction of projects that have reached financial close.

The REIPPPP has therefore created significant employment opportunities for black South African citizens and local communities beyond planned targets. This highlights the importance of the programme in terms of employment equity and the creation of more equal societies.

Local Content[8]

The report notes that the REIPPP programme represents the country's most comprehensive strategy to date in achieving the transition to a greener economy. Local content minimum thresholds and targets were set higher for each subsequent bid window. The report notes that for a programme of this magnitude, with construction procurement spend alone estimated at R71.1 billion, the result is a substantial stimulus for establishing local manufacturing capacity. The local content strategy has created the required incentives for a number of international technology and component manufactures to establish local manufacturing facilities.

The documents notes that for the portfolio as a whole, the expectation would reasonably be for local content spend to fall between 25% and 65% of the total project value (considering the range of targets and minimum requirements). Local content commitments by IPPs amount to R66.3 billion or 45% of total project value (R148.2 billion for all bid windows).

Actual local content spend reported for IPPs that have started construction amounts to R63.3 billion against a corresponding project value (as realised to date) of R127.2 billion. This means that 50% of the project value has been locally procured, exceeding the 45% commitment from IPPs and the thresholds for BW1 – BW4 (25-45%).

To date, the R63.3 billion local content spend reported by active IPPs is already 96% of the R66 billion local content expected. This is with 6 projects still in construction, and 85 of the 91 active projects having reached COD (i.e. 93% of the active portfolio complete). For the 85 projects that have reached COD, local content spend has been R 58.72 billion of a committed R58.67 billion, which is 0.1 more than the planned local spend.

Leveraging employment opportunities

To date, a total of 63 291 job years[9] have been created for South African citizens, of which 48 110 job years were in construction and 15 182 in operations. These job years should rise further past the planned target as more projects enter the construction phase. Employment opportunities across BW1-4 are 143% of the planned number during the construction phase (i.e. 33 707 job years), with 6 projects still in construction and employing people. The number of employment opportunities is therefore likely to continue to grow beyond the original expectations.

By the end of December 2021, 85 projects had successfully completed construction and moved into operation. These projects created 44 172 job years of employment, compared to the anticipated 30 488. This was 45% more than planned.

[8] Local content is expressed as a % of the total project value and not procurement or total project costs.

[9] The equivalent of a full-time employment opportunity for one person for one year

The report notes that employment thresholds and targets were consistently exceeded across the entire portfolio. The average share of South African citizens of total South Africa based employees for BW1 – BW4 was 91% during construction (against a target of 80%), while it was 96% during operations for BW1 – BW4 (against a target of 80%). The report notes that the construction phase offers a high number of opportunities over shorter durations, while the operations phase requires fewer people, but over an extended operating period.

To date, 48 110 job years for SA citizens were achieved during construction, which is 43% above the planned 33 707 job years for active projects. These job years are expected to rise further since 6 projects are still in construction.

In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. For active projects, the expectation for local community participation was 13 284 job years. To date 25 272 job years have been realised (i.e. 90% more than initially planned), with 6 projects still in, or entering, construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 74%.

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 81%, 44% and 48% of total job opportunities created by IPPs to date. However, woman and disabled people could still be significantly empowered as they represent a mere 10% and 0.4% of total jobs created to date, respectively. Nonetheless, the fact that the REIPPPP has raised employment opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

The share of black citizens employed during construction (81%) and the early stages of operations (85%) has significantly exceeded the 50% target and the 30% minimum threshold. Likewise, the share of skilled black citizens (as a percentage of skilled employees) for both construction (71%) and operations (82%) has also exceeded the 30% target and minimum threshold of 18%. The share of local community members as a share of SA-based employees was 48% and 70% for construction and operations respectively – significantly exceeding the minimum threshold of 12% and the target of 20%.

Socio-economic development (SED) contributions

An important focus of the REIPPPP is to ensure that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. In this regard, IPPs are required to contribute a percentage of projected revenues accrued over the 20-year project operational life toward SED initiatives. These contributions accrue over the 20-year project operation life and are used to invest in housing and infrastructure as well as healthcare, education, and skills development.

The minimum compliance threshold for SED contributions is 1% of the revenue with 1.5% the targeted level over the 20-year project operational life. For the current portfolio of projects, the average commitment level is 2%, which is 101% higher than the minimum threshold level. To date (across BW1-4) a total contribution of R22.8 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

As a percentage of revenue, SED obligations become effective only when operations commence, and revenue is generated. Of the 91 IPPs that have reached financial close (BW1–BW4), 85 are operational. The SED contributions associated with these 85 projects has amounted to R 1.8 billion to date.

In terms of ED and SED spend, education, social welfare, and health care initiatives have a SED focus. SED spend on education has been almost double the expenditure on enterprise development. This is despite enterprise development being a stand-alone commitment category in terms of the IA. This is, in part, due to the fact that some early childhood development programmes have also been incorporated in educational programmes. IPPs have supported 1 388 education institutions with a total of R437 million in contributions, from 2015 to the end of June 2021. A total of 1 276 bursaries, amounting to R210.8 million, have been awarded by 67 IPPs from 2015 until the end of June 2021. The largest portion of the bursaries were awarded to African and Coloured students (97.4%), with women and girls receiving 56.3% of total bursaries. The Northern Cape province benefitted most from the bursaries awarded, with 57.2%, followed by the Eastern Cape (20.2%) and Western Cape (14.1%). Enterprise development and social welfare are the focus areas that have received the second highest share of the contributions to date.

Enterprise development contributions

The target for IPPs to spend on enterprise development is 0.6% of revenues over the 20-year project operational life. However, for the current portfolio, IPPs have committed an average of 0.63% or 0.03% more than the target. Enterprise development contributions committed for BW1-4, amount to R7.2 billion. Assuming an equal distribution of revenue over the 20-year project operational life, enterprise development contributions would be R358 million per annum. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development.

Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. A total contribution of R504.1 million has already been made to the local communities (i.e. 94%of the total R537.9 million enterprise development contributions made to date).

Contribution to cleaner energy and water savings

As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The REIPPPP contributes constructively to economic stability, energy security and environmental sustainability.

The emission reductions for the programme during the preceding 12 months (June 2019-June 2020) is calculated as 15.1 million tonnes CO_2 ($MtonCO_2$) based on the 14 835 GWh energy that has been generated and supplied to the grid over this period. This represents 75% of the total projected annual emission reductions ($20.5MtonCO_2$) achieved with only partial operations. A total of 72.1 Mton CO_2 equivalent reduction has been realised from programme inception to date.

The March 2019 Report also notes that since operation, the IPPs have saved 42.8 million kilolitres of water related to fossil fuel power generation. This saving will have increased with the increase in energy generated by renewable energy since 2019. The REIPPPP therefore contributes significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability, and environmental sustainability.

2.4.2 Green Jobs Study

The study notes that South Africa has one of the most carbon-intensive economies in the world, therefore making the greening of the electricity mix a national imperative. Within this context the study notes that the green economy could be an extremely important trigger and lever for enhancing a country's growth potential and redirecting its development trajectory in the 21st century. The attractiveness of wind and solar technologies is not only supported by local conditions, but also by the relatively mature stage of their technological development.

The aim of the Green Jobs study was to provide information on the net direct job creation anticipated to emerge in the formal economy across a wide range of technologies/activities that may be classified as green or contributing to the greening of the economy. The study looked at the employment potential for several green sectors, including power generation, over three consecutive timeframes, namely, the short term (2011 – 12), medium term (2013 – 17) and long term (2018 – 25). The analysis attempts to estimate the employment potential associated with building, construction and installation activities; operations and maintenance services; as well as the possible localisation spin-offs for the manufacturing sector as the domestic production of equipment, parts and components benefits from preferential local procurement.

It is also worth noting that the study only considered direct jobs in the formal economy. Multiplier effects were not taken into account. As a result, the analysis only captures a portion of the potential employment impact of a greening economy. International studies have indicated that there are considerable backward and forward linkages through various value chains of production, as well as of indirect and induced employment effects. The employment figures can therefore be regarded as conservative.

The analysis reveals the potential of an unfolding green economy to lead to the creation of approximately 98 000 new direct jobs, on average, in the short term, almost 255 000 in the medium term and around 462 000 employment opportunities in the formal economy in the long term. The number of jobs linked to the power generation was estimated to be ~ 12 500 in the short term, 57 500 in the medium term and 130 000 in the long term. Power generation jobs therefore account for 28% of the employment opportunities created in the long term. However, the report notes that the contribution made by a progressively expanding green energy generation segment increases from 14% of the total in the short term, or just over 13 500 jobs, to more than 28% in the long term (166 400) (Table 2.3). The study also found that energy generation is expected to become an increasingly important contributor to green job creation over time, as projects are constructed or commissioned.

Table 2.3: Net direct employment potential estimated for the four broad types of activity and their respective segments in the long term, and an indication of the roll-out over the three timeframes

Broad green economy category		Segment	Technology/product	Total net direct employment potential in the long-term	Net direct manufacturing employment potential in the long-term	Total net direct employment potential (ST, MT, LT)	Net direct manufacturing employment potential (ST, MT, LT)
ENERGY GENERATION	Renewable (non-fuel) electricity	Wind power	Onshore wind power	5 156	2 105	VL, L, M	L, M, H
			Offshore wind power				
		Solar power	Concentrated solar power	3 014	608	N, VL, M	N, VL, M
			Photovoltaic power	13 541	8 463	M, H, H	H, VH, VH
		Marine power	Marine power	197	0	N, N, VL	N, N, N
		Hydro power	Large hydro power	272	111	VL, VL, VL	VL, M, VL
			Micro-/small-hydro power	100	0	VL, VL, VL	N, N, N
	Fuel-based renewable electricity	Waste-to-energy	Landfills	1 178	180	VL, VL, L	VL, VL, L
			Biomass combustion	37 270	154	VL, H, VH	VL, VL, L
			Anaerobic digestion	1 429	591	VL, VL, L	VL, L, M
			Pyrolysis/Gasification	4 348	2 663	VL, L, M	VL, H, H
			Co-generation	10 789	1 050	L, M, H	M, H, H
	Liquid fuel	Bio-fuels	Bio-ethanol	52 729	6 641	M, H, VH	L, H, VH
			Bio-diesel				
ENERGY GENERATION SUB-TOTAL				**130 023**	**22 566**		
ENERGY & RESOURCE EFFICIENCY		Green buildings	Insulation, lighting, windows	7 340	838	L, M, M	L, M, M
			Solar water heaters	17 621	1 225	L, H, H	L, M, H
			Rain water harvesting	1 275	181	VL, VL, L	VL, VL, L
		Transportation	Bus Rapid Transport	41 641	350	VH, VH, VH	H, M, L
		Industrial	Energy efficient motors	-566	4	VL, VL, VL	VL, VL, VL
			Mechanical insulation	666	89	VL, VL, VL	VL, VL, VL
ENERGY & RESOURCE EFFICIENCY SUB-TOTAL				**67 977**	**2 686**		
EMMISIONS AND POLLUTION MITIGATION		Pollution control	Air pollution control	900	166	N, VL, VL	N, L, L
			Electrical vehicles	11 428	10 642	VL, L, H	N, H, VH
			Clean stoves	2 783	973	VL, VL, L	VL, L, M
			Acid mine water treatment	361	0	VL, VL, VL	N, N, N
		Carbon Capture and Storage		251	0	N, VL, VL	N, N, N
		Recycling		15 918	9 016	M, H, H	H, VH, VH
EMMISIONS AND POLLUTION MITIGATION SUB-TOTAL				**31 641**	**20 797**		
NATURAL RESOURCE MANAGEMENT		Biodiversity conservation & eco-system restoration		121 553	0	H, VH, VH	N, N, N
		Soil & land management		111 373	0	VH, VH, VH	N, N, N
NATURAL RESOURCE MANAGEMENT SUB-TOTAL				**232 926**	**0**		
TOTAL				**462 567**	**46 049**		

(Source: Green Jobs Study, 2011)

Notes:

- VH = very high (total employment potential > 20 000 direct jobs; manufacturing employment potential > 3 000 direct jobs);
- H = high (total employment potential > 8 000 but < 20 000; manufacturing employment potential > 1 000 but < 3 000);
- M = medium (total employment potential > 3 000 but < 8 000; manufacturing employment potential > 500 but < 1 000);
- L = low (total employment potential > 1 000 but < 3 000; manufacturing employment potential > 150 but < 500);
- VL = very low (total employment potential > 0 but < 1 000; manufacturing employment potential > 0 but < 150);
- N = negligible/none (total employment potential = 0; manufacturing employment potential = 0).

Of relevance the study also notes that the largest gains are likely to be associated with operations and maintenance (O&M) activities, particularly those involved in the various natural resource management initiatives. In this regard, operations and maintenance employment linked to renewable energy generation plants will also be substantial in the longer term. The employment growth momentum related to building, construction and installation activities peaks in the medium term, largely propelled by mass transportation infrastructure, stabilising thereafter as green building methods become progressively entrenched.

In addition, as projects related to a greening economy are progressively commissioned, the potential for local manufacturing also become increasingly viable. Employment gains in manufacturing are also expected to be relatively more stable than construction activities, since the sector should continue exhibiting growth potential as new and replacement components are produced, as additional markets are penetrated, and as new green technologies are introduced. Manufacturing segments with high employment potential in the long term would include suppliers of components for wind and solar farms. The study does note that a shortage of skills in certain professional fields pertinent to renewable energy generation presents a challenge that must be overcome.

The study also identifies several advantages associated with renewable energy with a large 'technical' generation potential. In this regard, renewable energy, such as solar and wind, does not emit carbon dioxide (CO_2) in generating electricity and is associated with exceptionally low lifecycle emissions. The construction periods for renewable energy projects are much shorter than those of conventional power stations, while an income stream may, in certain instances, be provided to local communities through employment and land rental. The study also notes that the greenhouse gases (GHG) associated with the construction phase are offset within a short period of time compared with the project's lifespan. Renewable power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, renewable energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

Of relevance, the study also notes that renewable energy projects in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues.

2.4.3 Powering the Future: Renewable Energy Roll-out in South Africa

The study notes that South Africa has higher CO_2 emissions per GDPppp (2002 figures) from energy and cement production than China or the USA (Letete, T et al). Energy accounts for 83% of the total GHG emissions (excluding land use, land use change and forestry) with fuel combustion in the energy industry accounting for 65% of the energy emissions of South Africa (DEA, 2011).

Within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations. Eskom uses an estimated 10 000 litres of water per second due to its dependency on coal (Greenpeace, 2012).

The report notes that the concerns relating to whether South Africa can afford renewable energy arise out of the perception that renewable energy (RE) is expensive while fossil and nuclear technologies are cheap. The premise also ignores life cycle costing of the technologies which is favourable to renewable technologies where the sources of fuel are free or cheap.

2.4.4 WWF SA Renewable Energy Vision 2030

In its vision the WWF motivated for a more ambitious plan, suggesting that the IRP should provide for an 11-19% share of electricity capacity by 2030, depending on the country's growth rate over the next fifteen years. The vision is to increase renewable energy at the expense of new coal-fired and nuclear capacity. The report notes that in addition to the obvious environmental benefits of this scenario, it will enable South Africa to add flexibility to energy supply capacity on an on-demand basis.

The report notes that Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) introduced in 2011, has by all accounts been highly successful in quickly and efficiently delivering clean energy to the grid. Increasingly competitive bidding rounds have led to substantial price reductions. In this regard, the study indicates that in three years, wind and solar PV have reached pricing parity with supply from new coal-fired power stations from a levelised cost of electricity (LCOE) perspective.

In bidding window 3 of August 2013, the average tariffs bid for wind and solar PV were R0,66/kWh and R0.88/kWh respectively, well below the recent estimates of R1.05/kWh for supply from the coal-fired Medupi and Kusile power stations (Papapetrou 2014).

The report also notes that the REIPPPP has several contracting rounds for new renewables supply. A robust procurement process, extension of a 20-year sovereign guarantee on the power purchase agreement (PPA) and, especially, ideal solar power conditions, have driven the investment case for RE in South Africa. In this regard, South Africa has been identified as one of the worlds' leading clean energy investment destinations (Figure 2.8).

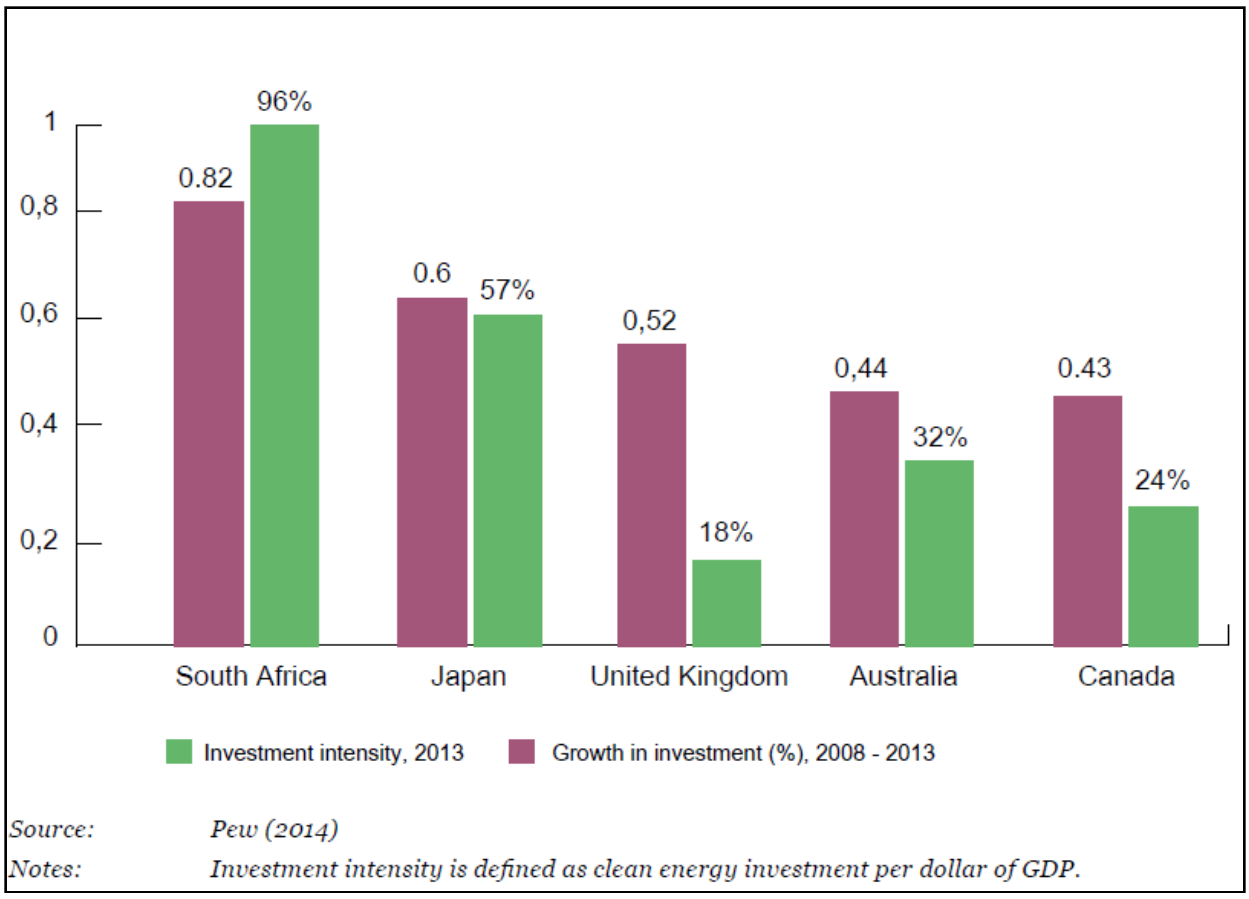


Figure 2.8: South Africa leads as a clean energy investment destination

With regard to local economic development, the REIPPPP sets out various local economic development requirements with stipulated minimum threshold and aspirational targeted levels, which each bidder must comply with. Based on the Broad-Based Black Economic Empowerment Codes, this requirement comprises the following components which make up a scorecard:

- Ownership by black people and local communities.
- Job creation.
- Local content.
- Management control.
- Preferential procurement.
- Enterprise development.
- Socio-economic development.

The final award is based on a combined evaluation in which price determines 70% of the ranking and performance on the local economic development scorecard the remaining 30%. This gives non-price criteria a much heavier weighting than they would normally enjoy under Government's preferential procurement policy.

Job creation, local content and preferential procurement accounted for the bulk of possible points on the scorecard in REIPPPP Round 3. Consequently, a requirement to source goods and services locally is considered to be the central driver of project costs associated with local

economic development. In terms of local content, the definition of local content is quite broad, being the value of sales less the costs associated with imports. However, through successive bidding rounds, the definition has become subject to more detailed definition, with an expanding list of exclusions and increased targeting in terms of key components identified by the Department of Trade and Industry for local manufacturing. This has benefitted local manufacturers and suppliers.

The WWF study considers a low and high growth renewable energy scenario. The capital requirements for the low growth scenario are estimated at R474 billion over the period 2014-2030 (2014 Rand value), rising to R1.084 trillion in the high-growth scenario, in which 35 GW of capacity is built. Each annual round of purchasing 2 200 MW of RE capacity would cost approximately R77 billion in 2014 Rand value terms. In relative economic terms, this equates to 2% of the GDP per annum or approximately one quarter of Government's planned annual investment in infrastructure over the medium term. In the low economic growth scenario, which is arguably the more realistic one, the average annual new liability over the period is approximately R40 billion.

The study also points out that infrastructure spend is more beneficial than other government expenditure due to the infrastructure multiplier effect. This refers to the beneficial impact of infrastructure on economic growth in both the short term, resulting from expansion in aggregate demand, as well as in the longer term (six to eight years) due to enhanced productive capacity in the economy. A recent USA study on highway expenditure revealed the infrastructure multiplier to be a factor of two on average, and greater during economic downturns (Leduc & Wilson 2013). This means that one dollar spent on infrastructure raises GDP by two dollars. If the same were to hold true, as similar analysis suggests it would (Kumo 2012, Ngandu et al 2010), this indicates that the construction of renewable energy plants could be a valuable economic growth driver at a time when fears of recession abound.

The report concludes that the WWF is optimistic that South Africa can achieve a much more promising clean energy future than current plans allow for. With an excellent solar resource and several good wind-producing pockets, the country is an ideal candidate for a renewable energy revolution.

The report indicates that the levelised cost of producing renewable energy already competes favourably with the three main alternatives, namely coal, gas and nuclear. In addition, renewable energy would contribute to a more climate-resilient future and insulate South Africa from dependence on expensive and unreliable fuel sources priced in dollars. Critical from a planning perspective, the report notes that renewable energy can also provide added flexibly on an 'as needed' basis, as electricity demand grows. This is vital in a highly uncertain environment.

2.4.5 The impact of the green economy on jobs in South Africa

The paper notes that greening the economy is particularly important in South Africa for two basic reasons: (1) the exceptional level of unemployment that the country is experiencing and (2) the high carbon impact of the economy.

In terms of employment, the paper refers to the IDC *Green Jobs R*eport (2011). In summary, the short-term (next 2 years) estimate of total net employment potential is 98 000 jobs, and the long-term (next 8 years) employment potential is 462 567 jobs. Natural resource management is predicted to lead to the greatest number of these at 232 926 long-term jobs. Green energy generation is estimated to produce 130 023 long-term jobs, with energy and resource efficiency measures adding another 67 977 long-term jobs.

The paper notes that the Green Jobs Report was prepared by seventeen primary researchers from three prominent organisations, namely the IDC, the Development Bank of South Africa, and Trade and Industrial Policy Strategies. Many role players from other organisations were also consulted, including the World Wide Fund for Nature, the Green Building Council, the Economic Development Department and private companies involved in green industries.

Despite questions surrounding the employment estimates contained in the Green Jobs Report, green economic activity does appear to generate more local jobs than fossil-fuel-based industries. Some of the estimates also indicate the potential for significant employment. The paper concludes that the figures represent a promising starting point that warrants further research and policy involvement in greening the economy in South Africa.

2.4.6 The potential for local community benefits

In her thesis, Tait[10] notes that the distributed nature of renewable energy generation can induce a more geographically dispersed pattern of development. As a result, RE sites can be highly suited to rural locations with otherwise poor potential to attract local inward investment therefore enabling to target particularly vulnerable areas.

In her conclusion, Tait notes that the thesis has found positive evidence for the establishment of community benefit schemes in the wind sector in South Africa. These benefits would also apply to solar projects. The BBBEE requirements for developers as set out in the DoE's IPPPP for renewables is the primary driver for such schemes. The procurement programme, in keeping with the objective of maximising the economic development potential from this new sector, includes a specific focus on local communities in which wind farms are located.

The procurement programme, typical of all Government tendering processes, includes a BBBEE scorecard on which renewable energy projects are evaluated. However, the renewables scorecard appears to play an important part in a renewed focus on the broad-based Aspects of the legislation, as enforced by a recent national review of the BBBEE Act. In this regard, the renewables scorecard includes specifications for local communities in respect of broad-based ownership schemes, socio-economic development and enterprise development contributions. This approach to legislating social responsibilities of business in all sectors definitely has a South African flavour, borne out of the political history of the country and the imperatives for social transformation laid out in the constitution.

While Tait notes that it is still early days for the development of this sector and one cannot determine the impact that such benefit schemes may have, it is clear though that targeted development expenditure will be directed to multiple rural communities and there seems to be a strong potential to deliver socio-economic benefits.

[10] The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town

SECTION 3: OVERVIEW OF STUDY AREA

3.1 INTRODUCTION

Section 3 provides a baseline description of the study area regarding:

- The administrative context.
- Provincial context.
- Overview of district and local municipalities.
- Overview of the site and the surrounding land uses.

3.2 ADMINISTRATIVE CONTEXT

The study area is located within the Msukaligwa Municipality (MM) within the Mpumalanga Province. The MM is one of the seven Local Municipalities that make up the Gert Sibande District Municipality (Figure 3.1). The town of Ermelo is the administrative seat of the MM. The study area is located approximately 20-30 km east of Ermelo.



Figure 3.1: Location of Msukaligwa Municipality within the Gert Sibande District Municipality and Mpumalanga Province

3.3 DEMOGRAPHIC OVERVIEW

Population
The population of the MM in 2022 was 199 314, compared to 164 608 in 2016 (Community Household Survey 2016). Of this total, 26.4% were under the age of 15, 69.4% fell within the economically active age group of 15 to 64, and the remaining 4.6% were 65 and older. The MM therefore had a high percentage of the population that fall within the economically active group of 18-65. The figures are similar to those for the GSDM, namely, 27.3%, 67.6% and 5.1% respectively.

The dependency ratio is the ratio of non-economically active dependents (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. Based on the 2022 Census data the dependency ratio for the MM was 44.6% compared to 52.6% in 2011. This represents a socio-economic improvement. However, the current high unemployment rates in South Africa, specifically youth unemployment, is likely to have a negative impact on the improved dependency ratio.

In terms of race groups, Black Africans made up 91.6% of the population on the MM, followed by Whites, 6.9% and Asian or Indians, 0.9%, and Coloureds, 0.6%. This figures for the GSDM are similar. The main first language spoken in the MM was isizulu, 79.1%, followed by Siswati, 7.3% and Afrikaans, 6.2%.

Households and house types
The total number of households in the MM in 2022 was 67 826 compared to 51 090 in 2016, which constituted approximately 18% of the total number of households in the GSDM. Of these 85% were formal houses, 11% were shacks or informal dwellings. The majority of dwellings in the MM are therefore formal structures.

In terms of household heads, approximately 38.9% of the households in the MM and 39.1% of the households in the GSDM in 2016 were headed by women[11]. These figures were similar to the provincial figure of 39.71%. The high percentage of households headed by women reflects the likelihood that the men have left the area in search of employment opportunities in Gauteng. Women headed households tend to be more vulnerable.

Household income[12]
Based on the data from the 2011 Census, 12.6% of the population of the MM had no formal income, 4.1% earned less than R 4 800, 7.1% earned between R 5 000 and R 10 000 per annum, 17.7% between R 10 000 and R 20 000 per annum and 20.9% 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 62.4% of the households in the MM and 65.2% in the GSDM live close to or below the poverty line. The low-income levels reflect the rural nature of the local economy and the limited formal employment opportunities outside in the urban areas. This is also reflected in the high unemployment rates. The low-income levels

[11] Data form the 2022 Census was not available at the time of preparing the report.
[12] Data form the 2022 Census was not available at the time of preparing the report.

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 MM. This in turn impacts on the ability of the MM 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 MM 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[13]
The official unemployment rate in the MM in 2016 was 15.6%, while 42.6% were employed, and 36.4% were regarded as not economically active. However, the COVID-19 pandemic is likely to have resulted in an increase in unemployment rates in the MM. South Africa's unemployment rate was 32.1% in Q4 of 2023, while the youth unemployment rate was 43.4% in Q3 2023, the highest recorded youth employment rate in the world.

Education
In terms of education levels, the percentage of the population over 20 years of age in the MM with no schooling in 2022 was 10.9%, an increase from 10.6% in 2016. The figure for the GSDM in 2022 was 10.3% compared to 10.8% in 2016. The percentage of the population over the age of 20 with matric in 2016 was 34.12%, compared to 34.3% and 36.1% for the GSDM and Mpumalanga[14]. The education levels for the MM are therefore similar to the DM and Provincial figures.

3.4 MUNICIPAL SERVICES

Electricity
Based on Census 2022, 87.2% of households in the MM had access to electricity, compared to 91.8% for the GSDM.

Access to water
Based on Census 2022, 64.6% of households in the MM had piped water provided inside their dwellings compared to 50% in 2016. The figure for the GSDM was 56.5% compared to 34.3% in 2016. The figures from the 2022 census reflect a significant improvement in the access to water for households in both the MM and GSDM.

Sanitation
Based on Census 2022, 79% of households in the MM had access to flush toilets compared to 74.3% in 2016. The figure for the GSDM was 73.2% compared to 67.1% in 2016. The figures from the 2022 census reflect a significant improvement in the sanitation for households in both the MM and GSDM.

Refuse collection
Based on Census 2022, 73.8 of households in the MM had their refuse removed on a weekly basis compared to 62.3% in 2016. The figure for the GSDM was 66.8% compared to 54.3% in 2016. The figures from the 2022 census reflect a significant improvement in the provision of waste removal services for households in both the MM and GSDM.

[13] Data form the 2022 Census was not available at the time of preparing the report.
[14] Data form the 2022 Census was not available at the time of preparing the report.

3.5 HEALTH, EDUCATION AND COMMUNITY FACILITIES

Health Services

The MM IDP indicates that there is 1 government and 1 private hospital in the MM, 10 primary health care clinics, and 4 mobile clinics (Table 3.1).

Table 3.1: Health services in Msukaligwa Municipality

Facilities	Number
Private Hospitals	1
Primary Health Care Clinics	10
Mobile Clinics	4
Government hospitals	1
Infectious Hospital (TB)	1
Dentists	4
Gynaecologist	1
Social Workers	12
Private Doctors	20

Educational Facilities

The MM IDP indicates that there are 71 primary schools, 6 high schools, 12 combined schools and 11 secondary schools in the MM. There is 1 FET College, but no tertiary facility (Table 3.2). The IDP notes that given the growth in the area there is a need for at least a tertiary institution within the GSDM. Development within Ermelo has also created a need for more primary and high schools.

Table 3.2: Educational Facilities in Msukaligwa Municipality

Facility	Number
No. of Primary Schools	71
No. of High School	6
No. of Combined Schools	12
No. of Secondary Schools	11
No. of Tertiary Education Facilities	0
No. of FET Colleges	1
No. of Training Centres/Adult Education	9
No. of Private Schools	3
Day Care Centres	40

Community Facilities

Table 3.3 lists the community facilities in the MM. As indicated in the table, Ermelo as the administrative centre is relatively well catered for in terms of community facilities, including police stations, sports facilities, libraries, community halls and pension pay out points.

Table 3.3: Community facilities

Area/Town	Police Station	Sport Public Facilities	Public Libraries	Community Halls	MPCC/TSC	Post Offices	Pension pay points	Comments
Breyten/KwaZanele	1	4	2	2	1	1	1	There is one informal soccer field at Breyten
Ermelo, Wesselton, Cassim Park and Thusiville	2	9	4	5	-	1	2	There are five informal soccer field at Wesselton. The Thusiville library is completed but not yet operating.
Chrissiesmeer/Kwachibikhulu	1	1	1	1	-	1	1	There is one informal soccer field at Chrissiesmeer
Davel/Kwadela	1	2	1	1	-	1	1	There is one informal soccer field at KwaDela. There is a complaint that the existing library at Davel is far from the majority users who reside at KwaDela.
Lothair/Silindile	1	1	1	1	1	1	1	The TSC is almost completed and postal services run by agency at Lothair
Sheepmoor	1	1	-	1	-	1	1	There is one informal soccer field at Sheepmoor. No library at Sheepmoor
Warburton/Nganga	-	1	-	-	-	1		Postal services run by agency at Warburton. The sport facility is an informal soccer field. No library service at Warburton.
TOTAL	**7**	**19**	**8**	**11**	**2**	**6**		

3.6 ECONOMIC OVERVIEW

The economic growth rate for Msukaligwa was at 3.0% per annum on average over the period 1996 to 2017 and forecasted average annual GDP growth for 2017-2022 relatively low at 1.3%. The contribution of Msukaligwa to the Mpumalanga economy was around 4.3%, making it the fifth largest local economy in the province. It is the second largest economy in the District, contributing around 15.5%. The key economic sectors in the MM in 2017 in terms of

contribution to GDP were mining (20.3%), community services (18.5%), trade (including industries such as tourism) (18.2%) and finance (14.2%) (Table 3.4). Despite the importance of agriculture, it only contributed 6% to GDP in 2017. The IDP notes that the MM has a comparative advantage in economic sectors such as agriculture, transport, and mining.

Table 3.4: Contribution of sectors to Msukaligwa Municipality GDP

Economic Sector	2014	2017	Change
Agriculture	5,3%	6,0%	0,7%
Community Services	18,4%	18,5%	0,1%
Construction	2,7%	2,7%	0,0%
Finance	13,3%	14,2%	0,9%
Manufacturing	5,1%	5,1%	0,0%
Mining	20,8%	20,3%	-0,5%
Trade	18,5%	18,2%	-0,3%
Transport	11,3%	11,3%	0,0%
Utilities	4,5%	3,8%	-0,7%

Finance and Agriculture achieved the highest, although slight, growth in contribution from 2014 to 2017. The contribution of utilities, mining and trade declined slightly.

In terms of employment, the trade sector (20.6%) was the most important sector in terms of employment, followed by community services (15.3%), mining (12.8%), finance (11.6%) and manufacturing (10.1%) (Table 3.5).

Table 3.5: Contribution to employment of sectors in Msukaligwa Municipality

Employment Sector	2014	2017	Change
Agriculture	6%	6,3%	0,3%
Community Services	14,5%	15,3%	0,8%
Construction	7,9%	8,5%	0,6%
Finance	11,2%	11,6%	0,4%
Manufacturing	9,9%	10,1%	0,2%
Mining	14,7%	12,8%	-1,9%
Trade	21,1%	20,6%	-0,5%
Transport	4,5%	4,7%	0,2%
Utilities	2,5%	2,4%	-0,1%

In terms of unemployment, the MM unemployment rate was the 6th lowest among all the municipal areas of Mpumalanga. The unemployment rate deteriorated slightly from 23.1% in 2014 to 24.1% in 2017. Unemployment rates are higher for females at 29.8% and for males at 24.1%. However, youth unemployment at 34.5% is a key concern.

The IDP notes that in terms of future economic development, coal mining can be expected to remain an important sector for the short to medium term. However, the role of this sector is expected to decline in the medium to long term due to limited coal resources, and a move away from a coal-based economy locally and globally due the impact on climate. The current transport and logistics sector is also likely to be impacted on by a decline in coal mining.

3.7 OVERVIEW OF STUDY AREA

3.7.1 Introduction

The Emvelo WEF site is located approximately 30 km (linear) east of Ermelo (Figure 3.2). Ermelo functions as regional services centre and is the administrative seat of both the MM and the Gert Sibande District Municipality. The regional economy is based on agriculture, forestry, and coal mining, all of which support a major logistics sector. Coal mining is concentrated in a north-south belt just to the east of Ermelo, stretching from Camden north to Breyten and beyond, i.e. not in proximity to the WEF sites. Eskom's large Camden power station is located 11 km south-east of Ermelo, approximately 30 km west of the site. Smaller settlements in the broader study area include Davel, Breyten, Chrissiesmeer, Lothair, Amsterdam/ eMvelo, Sheepmoor and Camden. Sheepmoor, a small residential settlement, is located approximately 11 km south of the site.

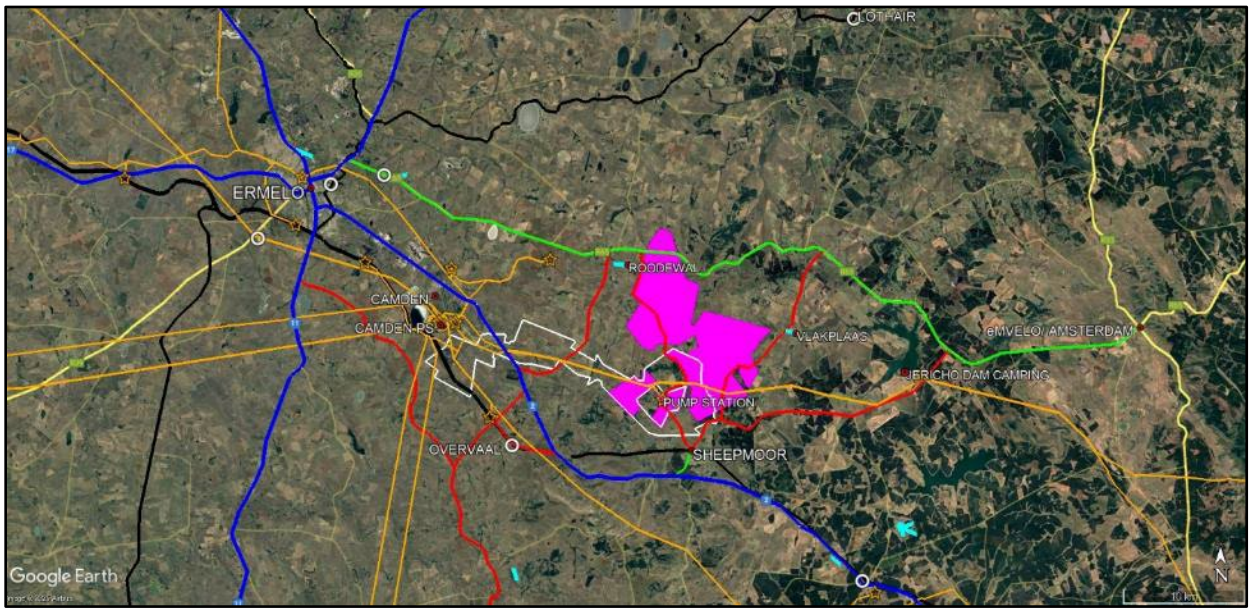
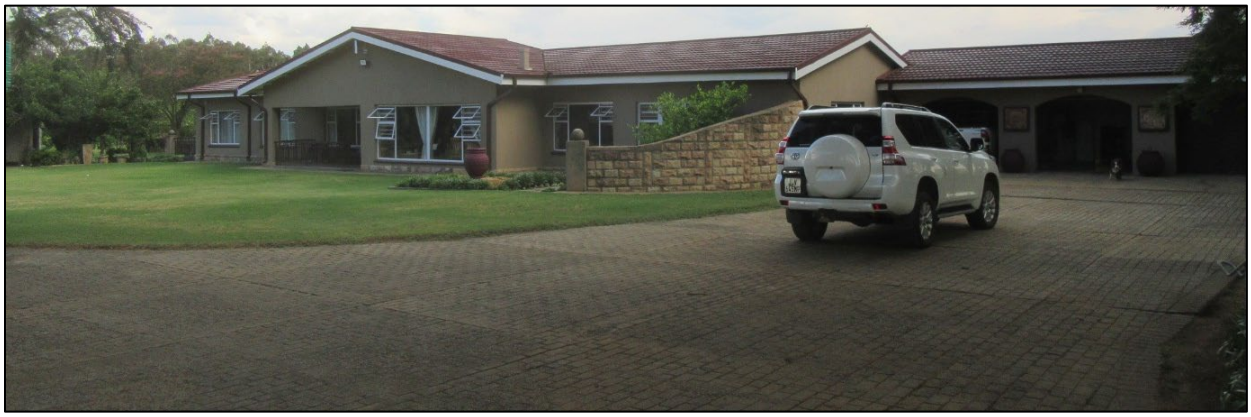


Figure 3.2: Sheepmoor WEF site (pink fill) and properties affected by grid connection (white outline) in relation to regional context. Also indicated are Eskom lines (88 kV and above, orange lines), railway lines (black lines), landing strips (light blue), silos/ grain bunkers (white circles), and key study area roads: national roads (dark blue), regional/ tarred roads (green), and public gravel roads (red)

The key tarred roads in the study area are the west-east aligned Lothair road (N17 north of Ermelo to Lothair) and R65/ Amsterdam Road (N17 north of Ermelo to eMvelo/ Amsterdam) to the north of the N2. The Emvelo site straddles the R65. These two roads are connected to the N2 by a series north-south aligned public gravel roads, locally referred to as the Roodewal Road, the Sheepmoor-Roodewal Road to the west of the southern Emvelo site, and the Bankplaas gravel road to the site's east (Photograph 3.1). The major road south of the N2 (area affected by grid connection proposal) is the north-south aligned De Emigratie Road off the N11. The De Emigratie Road is linked to the N2 by the Overvaal gravel road. The Lothair Road, R65 and relevant public gravel roads are primarily used by local communities.The study area settlement pattern is relatively sparse and concentrated along public roads. Farmsteads may be occupied by owners, family members, farm managers (Photograph 3.2).



Photograph 3.1: Junction of the Bankplaas gravel road off the R65. The road continues to Sheepmoor



Photograph 3.2. Farmstead on Vlakplaas to the east of the Emvelo site

Characteristic of the broader area are the small rural villages on many farms. These villages (locally referred to as 'statte') are loose clusters of homesteads (and associated buildings) belonging to different (extended) families (Photograph 3.3). These villages often accommodate farm workers on the relevant farms, but also former workers with tenure rights, and extended family members from other areas. Arrangements (e.g. grazing) between farm owners and resident families differ from operation to operation.

The study area is located on the eastern escarpment, in the transitional zone from the Highveld to the west, and the Lowveld to the east. The study area topography is undulating and broken along the escarpment (Photograph 3.4). The region enjoys high rainfall (summer), and further benefits from regular fog precipitation. The dominant vegetation type is mesic Highveld grassveld. Forested areas are mainly associated with kloofs along the escarpment. The good rainfall not only supports a strong agricultural sector, but also forestry. Eucalyptus and pine species are commonly planted, typically by forestry companies on private farming properties (Photograph 3.5). Black wattle, historically planted for bark tannin and poles, has become highly invasive on the study area.



Photograph 3.3: 'Statte' near the De Emigratie Road



Photograph 3.4: Undulating landscape typical of the study area



Photograph 3.5: Pine plantations along the Bankplaas gravel road.

The study area forms part of the well-established Ermelo commercial farming district. Mixed farming operations are typical. The area is suitable for both dryland cropping and raising livestock. The returns from cropping are significantly higher than from raising livestock, and most operations focus on cropping. Many farmers also lease additional land in the study area Most employment opportunities are associated with cropping-related activities.

Most summer field crops are grown under dryland conditions (Photograph 3.6). Field and fodder crops are additionally grown under centre pivot irrigation on some properties. Soil depth and slope are the key limiting factors to establishing new fields. The availability of high potential land is limited. As a result, land that is suitable for cropping is at a premium. The key crops are maize and soy, and in the immediate study area, field beans.



Photograph 3.6: Maize fields and Eucalyptus plantation in the study area.

Clearance distances for modern cropping machinery are substantial – for planters' horizontal distances of up to 20 m (but typically under 14.5 m) may be required. Crop spraying is typically done from the ground, but aerial spraying is also undertaken. Prominent vertical structures such as wind turbines, masts, and power lines pose a safety risk to pilots. Parallel-aligned infrastructure is generally preferred as this provides a clear path of approach, resulting in more effective spraying.

The planting period (October to December) is associated with an increase in traffic along local roads in the area. Traffic during harvesting (April to July) is mainly associated with the movement of mechanical harvesters, etc between properties, and trucks transporting the harvest to silos or bunkers. Six large silo complexes are located within a 40 km distance of Ermelo. The nearest silo to the Emvelo site is located at Overvaal rail siding approximately 20 km to the south-west (Photograph 3.7)



Photograph 3.7: Overvaal silo along the KZN railway line approximately 2 km south of the Overvaal gravel road

The area is also an established wool and cattle farming area (Photograph 3.8). While sheep farming has been phased out on farms closer to Ermelo (due to stock theft risk), sheep is still farmed on a large scale in the immediate study area. Many operations keep both sheep and cattle. The natural grassveld has a high carrying capacity of around 1 head of cattle (LSU) per 4.5 hectares.[15] Harvest residue is a key fodder component in most operations. Most operations also plant and manage pasture for hay production. Grassveld is prone to veldfires, specifically during the dry winter months. Planted pasture may take up to 3 years to recover to full productivity.



Photograph 3.8: Cattle at a salt lick seen from the Bankplaas road.

Few tourism receptors are located in the immediate study area, and these mainly to the north of the sites near the Lothair Road. Only one receptor, Foxhill Cottage, is located within 5 km of a proposed Emvelo turbine. Foxhill is a single cottage guest accommodation facility on a working farm (Foxhill Farm) located approximately 4.7 km north of the nearest turbine. The nearest major tourism receptor to the site, the well-established Smitsfield wedding venue along the Lothair Road, is located 15 km (north-west) from the nearest turbine, i.e., not in significant proximity.

3.7.2 Proposed infrastructure

The Sheepmoor WEF consists of three near-adjacent sites, two small western ones, and a large eastern one (Figure 3.3). The three sites account for 25 properties which belong to 9 owners. Only the southernmost properties (7 owners) would be affected by proposed infrastructure.

[15] https://gis.elsenburg.com/apps/cfm/

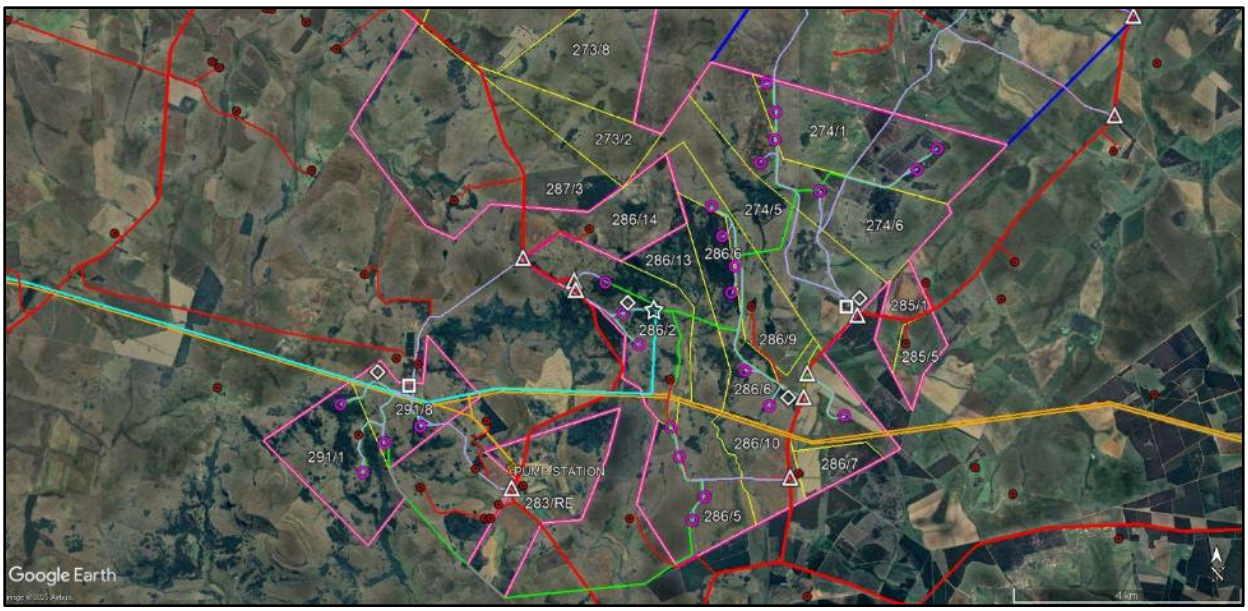


Figure 3.3: Properties (yellow outlines) directly affected by Sheepmoor WEF (pink outlines) and proposed infrastructure: turbines (pink circles), 132 kV line preferred alignment (light blue), MV cables (green), access points off public gravel roads (white tringles), project roads (grey), construction& laydown sites (diamonds), O&M sites (squares), and substations site (white star). Also indicated are the study area road network (red), Eskom lines (orange), Emvelo WEF (dark blue), and settlement pattern (red dots)

A total of 25 turbines is currently proposed, distributed across two of the three sites, and mainly concentrated on the escarpment or to its south. Six owners would be affected by between 2-9 turbines. The properties belonging to Mr Maseko would only be used for access and an O&M site. All turbines are proposed in veld or areas overgrown by Black wattle. No cropped fields are affected. Two O&M sites are proposed, namely on Windhoek 291/8 (western) and on Schiedam 274/5 (eastern). The site on 291/8 (Langenhoven) would occupy veld 400 m to the south of the Department of Water Affairs Windhoek reservoirs and associated dwellings. The site on 274/5 (Maseko) would occupy the remnant of a plantation. A small node consisting of farm buildings is located <100 m to the east of the site. Some of the small structures may inhabited. IPP and Eskom substations are proposed on back-to back sites on Waaihoek 286/2 (Robberts). The site is overgrown with invasive wattles. No dwellings are located within 1.3 km of the site. Three construction camp sites are proposed, all three near proposed operational phase sites, namely on 291/8(near O&M site), 286/2 (near substation site), 274/5 (near O&M site). All three camp sites are located in veld. The construction phase laydown area is proposed adjacent to the Bankplaas road on Waaihoek 286/6 (Robberts). The site is currently overgrown by wattles. All residential receptors are located >1 km of the site.

Eight site access points off public gravel roads are proposed, 4 each off the Sheepmoor-Roodewal - and Bankplaas roads. In addition, the site would be connected via internal roads to 3 access points proposed for the Emvelo WEF (one off the R65, two off the Bankplaas road). Six of the eight access roads serving Sheepmoor are entirely located on the site. Portions of the two other roads traverse properties which do not form part of the project, both off the Sheepmoor-Roodewal road, and both to provide access to development areas on Windhoek 291/1 and 291/8 (both Langenhoven), essentially as serving as alternative access routes. The

northernmost of the two would make use of a servitude road off the Sheepmoor-Roodewal road to Department of Water Affairs' Windhoek reservoir. The road traverses' properties which belong to Mr Joshua Meyer and Water Affairs (Windhoek reservoir). The southern road would essentially be a new road across Windhoek 291/4 (owner unknown). Most of the alignment is across veld, but approximately 100 m would traverse a cropped field.

The Sheepmoor project is proposed to feed into Eskom's planned Camden B substation south-east of Camden PS by means of an overhead 132 kV line corridor (3 parallel lines) (Figure 3.4). The lines would also serve the Emvelo project. The proposed Sheepmoor portion of the grid connection affects 32 properties, of which only 10 form part of the Amsterdam suite. Two alignment alternatives are proposed, a Preferred alignment, and an Alternative of which only a relatively small portion deviates from the Preferred.

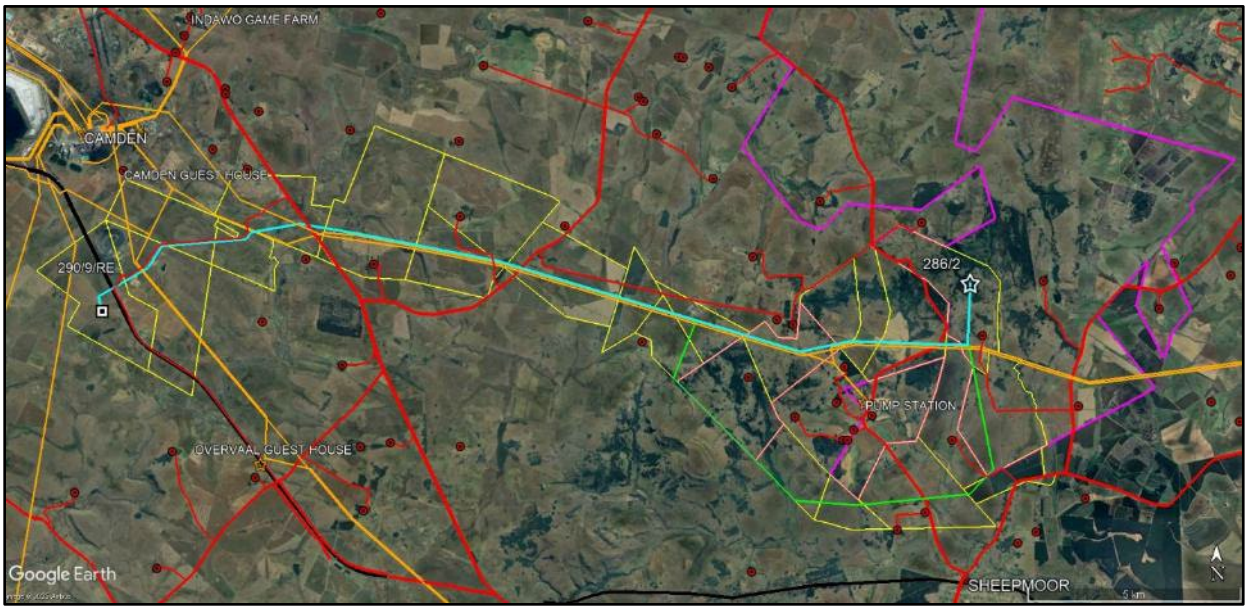


Figure 3.4: Properties (yellow outlines) directly affected by Sheepmoor WEF grid connection alternatives: preferred alignment (light blue line) and Alternative (green), Sheepmoor WEF substation (star) and grid feed-in point (white square). Also indicated are the Sheepmoor WEF sites (pink), the study area road network (red), railway lines (black, Eskom lines (orange), and settlement pattern (red dots).

The preferred alternative is approximately 23 km in length. The short initial north-south aligned portion of the alignment traverse's veld on more elevated terrain. The central (west-east) 16 km of the preferred alignment closely follows an existing Eskom corridor (one each 88 kV and 400 kV lines) (Photograph 3.9). The portion south of the N2 to Camden B traverses a sparsely populated area consisting of veld, the Mooifontein coal mine, and cropped fields (mainly to the south of the KZN railway line). The general area is affected by Eskom lines feeding into Camden. The Alternative alignment entails a diversion to the south of the portion (~6.5 km) of the Preferred alignment just to the west of the point where the alignment changes from north-south to west-east. The diversion is approximately 13 km (i.e. ~6.5 km longer) and would affect 4 more properties than the Preferred alignment. The 4 relevant properties (Windhoek 291/2, 291/4, 291/10, Witbank 300/4) do not form part of the Amsterdam suite. The affected area is sparsely populated and used for farming. It is not affected by any Eskom lines. Both Preferred and Alternative alignments affect cropped fields (see further below). The Sheepmoor sites would be connected by means of medium voltage

cables. Outside of the site, the alignment closely follows that of the Alternative 132 kV alignment, affecting the same 4 properties.



Photograph 3.9: Existing Eskom corridor through the study area.

3.7.3 Relationship to receptors

Access
Property access is linked to security and mobility. Dwellings along project roads may also be impacted by dust, noise, etc. Two access roads off public roads are proposed, namely off the Roodewal gravel road (portion Lothair road-R65), and off the Bankplaas gravel road skirting the southern Emvelo site to the east. The access road off the Roodewal road would require the upgrade of an existing servitude road across 5 adjacent properties (Figure 3.5). The servitude road terminates on the site. The project roads would not extend the road to create a thoroughfare to the public road network or roads on adjacent properties. Farmsteads and workers houses are located <150 m from the road on Blaauwkop 271/5, 271/8 and a further property, Schimmelhoek 272/7, and would potentially be exposed to construction traffic impacts associated with the project laydown area, construction camp and access to 13 turbines and the northern O&M site.

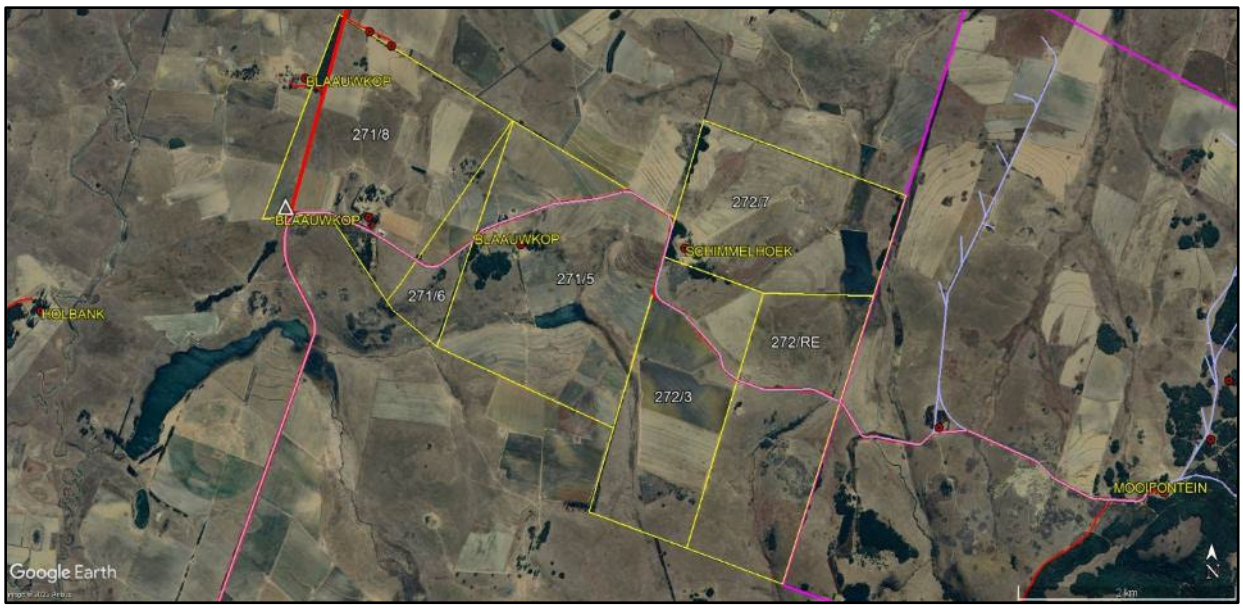


Figure 3.5: Non-site properties (yellow outlines) and residential receptors on non-site properties affected by access from the Roodewal gravel road to the northern site. Also indicated are existing gravel roads (red), access point off the Roodewal gravel road (white triangle), and the proposed site roads (grey)

The access roads off the Bankplaas gravel road to the southern site are proposed across properties or farms which form part of the Amsterdam project. A short portion (~300 m) of the road proposed off the R65 is across a peripheral portion of a property which does not form part of the project (Onverwacht 273/5/RE). All four southern access roads could also potentially serve Sheepmoor WEF. The roads proposed off the northernmost and southernmost access points off the Bankplaas road would pass through a large loose rural node on Schiedam 274/RE and near a smaller node on 274/5. The owner of Vlakplaas Farm affected by the central access road off the Bankplaas Road indicated a preference for this access road, as it would enable better surveillance of traffic onto the site from the Vlakplaas farmstead (Randall, pers. comm).

Aviation

Turbines and powerlines pose a risk to aviation. Light aircraft are used in the study area for several purposes, including crop spraying, firefighting, and surveying of farming estates. The forested steeper areas on the escarpment are only accessible to water bombers in cases of forest fires.

Only one airfield is located in significant proximity to proposed vertical infrastructure associated with the Emvelo project, namely that on Vlakplaats 284/6 to the east of the Bankplaas gravel road. The airfield on Roodewal to the west of the site is located >8 km of all proposed infrastructure, i.e., not in significant proximity. The Vlakplaas airfield is used on a weekly basis by the owners (Randall) to inspect the various portions of the estate (Randall's Ranch). The airfield and hangar are located near the Vlakplaas farmstead and are easily accessible to the owners (Photograph 3.10).



Photograph 3.10: Hangar on Vlakplaas

The airstrip is aligned roughly WNW by ESE (Figure 3.6). This is linked to the dominant wind direction which dictates approach and take-off. Take-off is towards the west and then banking either north or south to avoid the escarpment. It may take up to 5 km to gain sufficient height, depending on conditions. Three Emvelo turbines (14, 16, 17) are proposed 3-4 km to north-west of the site and are considered problematic by the owner. Turbines 18 and 21 on the Sheepmoor WEF is located 2-3 km west of the airstrip. The owner has indicated that either the relevant Emvelo turbines or the Sheepmoor ones would need to be relocated to avoid the impact on the airfield (Randall, pers. comm).

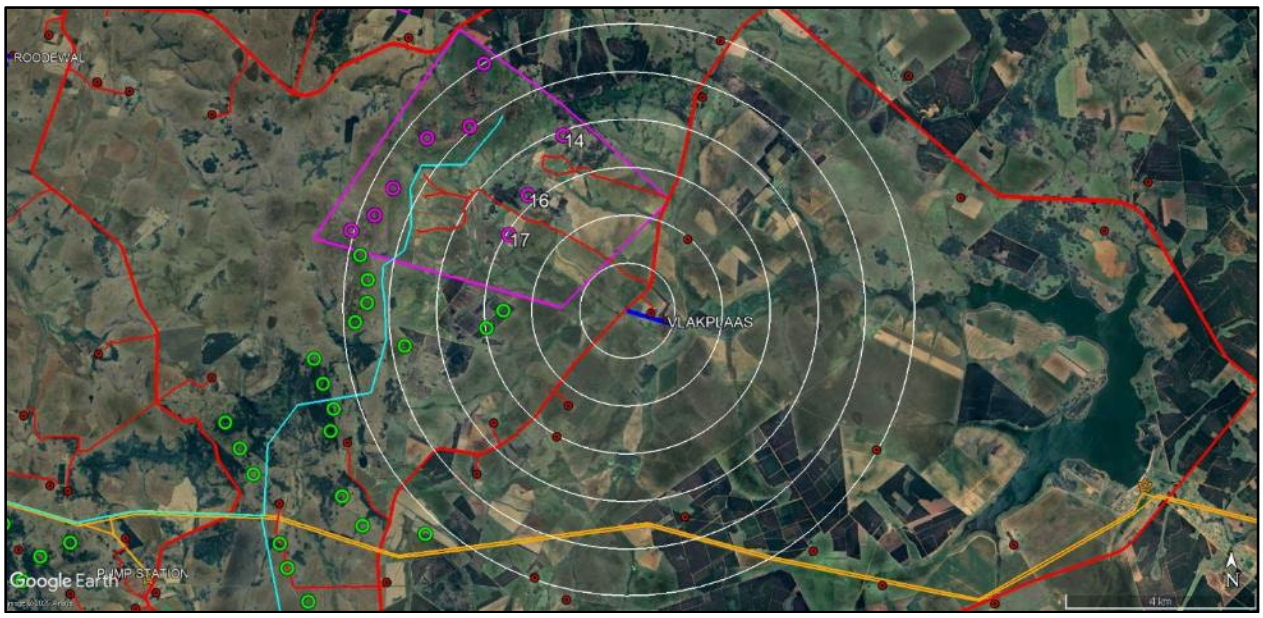


Figure 3.6: Proposed Emvelo (pink circles) and Sheepmoor (green) turbines and transmission line (preferred and Alt, light blue) in relation to Vlakplaas airstrip (dark blue line). White circles indicate 1 km increments from western terminus of landing strip up to 6 km. Also indicated are the Emvelo WEF site (pink outline), existing roads (red) and Eskom lines (orange)

Cropping activities

Key impacts on cropping activities are associated with permanent and temporary footprint losses on cropping areas, impact on access and ease of cultivation, and in the case of irrigated cropping, irrigation infrastructure. As indicated above, land suitable for cultivation is at a premium, and fields with deep soils are highly valued. Land suitable (near to water sources) for irrigated cropping are especially prized. Large dryland cropping machinery require wide clearances and large turning circles. Footprint losses, especially where cumulative, are therefore of importance. Actual footprint losses may be compounded by fragmentation of fields by e.g., roads, resulting in unviable field portions, and infrastructure posing obstacles to the effective use of machinery and implements (turning circles, clearing distances) or the safe and effective deployment of aerial crop dusters. Impacts around field margins (near roads or on headlands) are therefore less consequential than within fields, including associated roads cutting across fields.

Wind turbines

Three turbines (2, 4, 6) are proposed within existing cropped fields, all on the northern site, two on Schimmelhoek 272/2 (Cloete), 272/1 (De Villiers) (Figure 3.7). Hardstand areas and access roads would further impact on these fields. In addition, a construction camp is proposed on a further field on 272/1. Relatively peripheral portions of the relevant fields would be affected. While no permanent infrastructure is proposed in fields on the southern site, a construction camp sites is proposed within a field on Schiedam 274/2. Turbine 17 is proposed immediately to the west of the field. The area has recently been cleared to allow expansion of the field. The owner indicated that the area should preferably be avoided, and that the relevant infrastructure could instead be repositioned further to the north-west, closer to the property's northern boundary (Randall, pers. comm). The laydown area, O&M sites and substations site would not impact on any cropping areas.

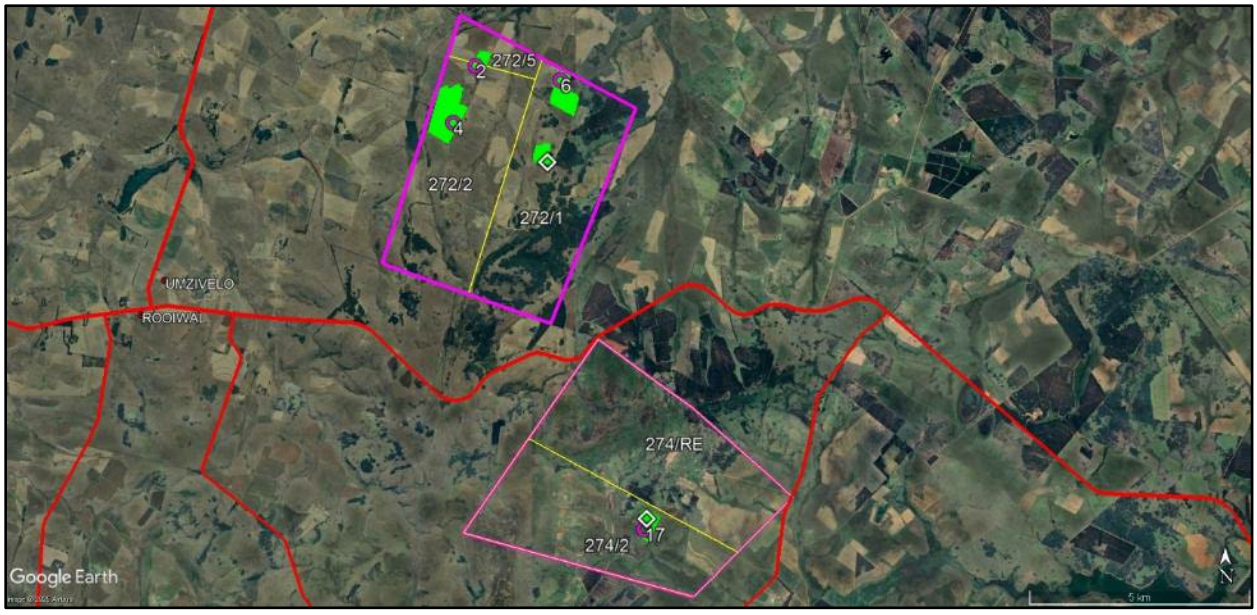


Figure 3.7: Proposed Emvelo turbines (pink circles) and construction camp sites within fields (green fill). Also indicated are affected properties (yellow outlines), and key study area roads (red)

Transmission lines

The Preferred transmission line alignment (light blue line) traverses 9 discrete fields, affecting 3 owners (Figure 3.8). Eight fields (2 owners) would be affected over distances >200 m. The Emvelo alignment closely follows an existing Eskom corridor across these fields. The three new lines would therefore essentially expand the existing corridor to the north. Neither of the two affected owners form part of the Amsterdam projects. The most significantly impacted owner, Mr Meyer (Waaihoek 286/3, 286/4 and 286/12), is affected over a linear distance of approximately 2.2 km (5 fields). At least two fields are affected over distances greater than 260 m and would require pylons to be placed within fields. A line turning point (pylon) would affect a third field. The proposed alignment across the Meyer property is near parallel (<50 m to the north) to the existing Eskom corridor. The owner has indicated that broadening of the Eskom corridor was not acceptable as it would exacerbate existing footprint losses and restrictions on movement of implements. The original corridor was historically expropriated by Eskom (400 kV Maputo line) (Meyer, pers. comm).

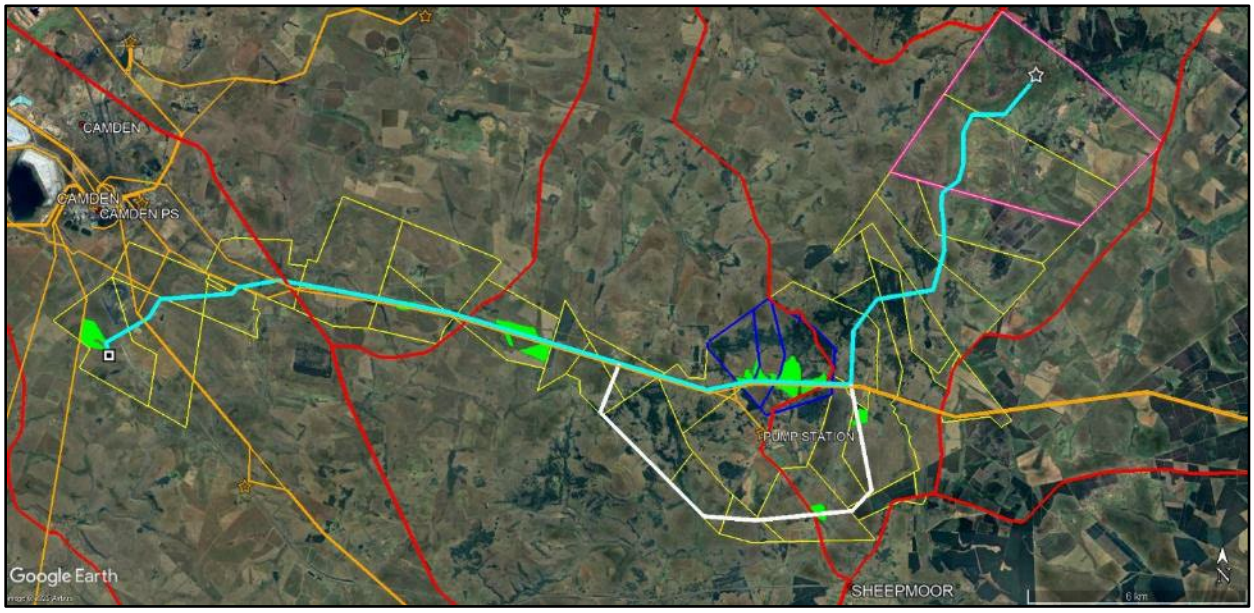


Figure 3.8. Cropped fields (green fill) in relation to proposed Emvelo 132 kV line alignments: Preferred (light blue) and Alternative (white). Also indicated are affected properties (yellow outlines), the affected Meyer properties (dark blue outline), existing Eskom lines (orange), and key study area roads (red).

The Alternative transmission alignment (white line) skirts (to the south) the 3 Meyer properties but affects 7 properties not affected by the preferred alternative, only two of which form part of the Amsterdam projects (number of affected owners unclear). While avoiding impacts on fields on the Meyer estate, the alternative alignment impacts on two fields not affected by the preferred alternative, namely over distances >300 m on Waaihoek 286/5 and Windhoek 291/3. As indicated, the area is not currently affected by Eskom lines. In conclusion, the Preferred Alignment is shorter (~6.5 km), affects (4) fewer properties and owners (unclear), and follows an Eskom corridor along the section bypassed by the alternative alignment. The Preferred Alignment however affects cropped fields over a slightly longer distance (~1.5 km) and a single owner (Mr Meyer) over the longest distance (2.2 km).

Livestock
Livestock – both cattle and sheep – is kept on most study area properties, typically as part of mixed operations. Risks are mainly associated with an increased exposure to construction workers during the construction phase. The study area is at risk of stock theft due to the many plantations and forested areas in the broader area which provide shelter for livestock that is stolen. Temporary de-stocking of affected camps may be required during the construction phase (or relevant sub-phase). However, as indicated above, the project roads would not establish through roads, and effective access monitoring would therefore be possible. Site access protocols should be agreed upon with owners and implemented. The option of installing CCTV cameras should be discussed with local famers in the area.

Veld fires are also a key issue in the area. The risk is exacerbated by presence of plantations and inaccessible terrain in forested kloofs on the escarpment. In addition to the impact on rangeland or crops, fires also pose a risk to plantations. An increase in fire risk may require landowners to increase insurance coverage.

Residential
Residential receptors may be affected by noise, dust, sense of place, traffic safety, property access and security impacts. No inhabited farmsteads are located on any of the site properties. A few farmworker families reside on the northern site. Traditional rural dwellings and associated yards ('statte') are located on both properties that make up the southern portion of the site. A node of approximately 15 statte is located on Schiedam 274/RE, and 6 at 6 different locations on 274/2 (Figure 3.9). Turbines 14, 16 (274/RE), 22 and 23 (274/2) are all located within 1 km of statte, the nearest (16) 550 m. As indicated, the laydown area, southern O&M site and substations site are located >1 km from receptors. The northern O&M site is located within 500 m of the dwellings of two farmworker families residing on Schimmelhoek 272/1. Provided that standard dust, noise, etc mitigation measures are implemented, no significant impacts are likely to be associated with the construction and operational phase of the WEF.

Only a few residential receptors are located within 1 km of the transmission line alternatives, and most of them along the Preferred alignment portion parallel to the existing Eskom line. The nearest receptors, and the only ones nearer than 500 m (significant proximity) are associated with the initial portion of the Preferred alignment between the Emvelo site and the Eskom corridor. These are the farmstead on Waaihoek 286/2 (Robberts, 350 m) and 4 statte on Schiedam 274/2 (>300 m). The Waaihoek yard fronts away from the line. Only one receptor is closer than 500 m from the alternative alignment, namely the farmstead on Windhoek 291/3, located approximately 310 m to the south. The farmstead fronts onto the proposed line. As indicated, the area is not currently affected by Eskom lines. The impacts on residential receptors associated with the Preferred and Alternative grid transmission line alignments are therefore likely to be limited.

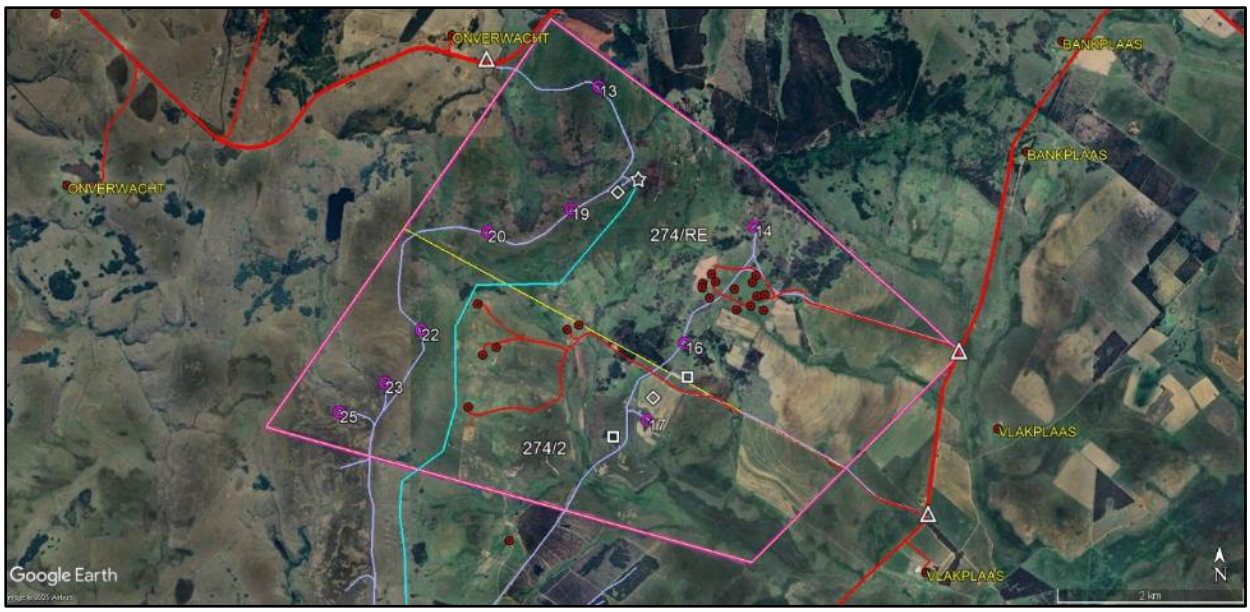


Figure 3.9: Location of 'statte' (red dots) on Schiedam 274/RE and 274/2 in relation to proposed infrastructure: turbines (pink circles), 132 kV line (blue), site roads (grey), construction/ laydown sites (white diamonds), substation site (white star) and O&M sites (squares). Also indicated are existing roads (red) and Emvelo WEF site

Tourism
As indicated above there are limited tourism receptors located in the immediate study area, and these mainly to the north of the site. Only one receptor, Foxhill Cottage, is located within 5 km of a proposed turbine (4.5 km). The Smitsfield wedding venue along the Lothair Road, is located 15 km from the nearest turbine, i.e., not in significant proximity.

3.7.4 Other renewable energy projects

The Emvelo WEF site is not located within a designated Renewable Energy Development Zone (REDZ). No operational REFs are currently located within significant proximity to the site. Sereti Green's 155 MW Ummbila Emoyeni WEF near Bethal to the west, is currently under construction. Commissioning is anticipated in the second quarter of 2026. The DFF&E's Renewable Energy applications interactive viewer indicates that approved Renewable Energy Facility (REF) applications within 30 km of the site are currently limited to the area south of Camden, namely Enertrag's Camden WEF 1 and WEF 2 (250 MW each), Camden PV 1 (100 MW), and associated grid connection infrastructure (all applied for in 2022) (Figure 3.10).[16]

Emvelo forms part of the proposed Mulilo Amsterdam WEF suite, which also includes Sheepmoor WEF to its south. Redcap's Leghoya WEF suite (3 WEFs, 128 turbines) is currently proposed to the west of the Amsterdam suite. The Redcap projects are currently in the EIA assessment phase. Together, the Leghoya and Amsterdam suites form a continuous band of 5 proposed WEFs east of Ermelo, stretching over a distance of approximately 50 km (furthest points). One more WEF is currently proposed within 30 km of Emvelo, namely Ntabande WEF (part of Daggakraal suite) south-west of Sheepmoor. The project is currently in the

[16] https://egis.environment.gov.za/renewable_energy (February 2025).

assessment phase. Thus, a total of 9 WEFs are proposed (7) or have been approved (2) within 30 km of Ermelo. All are located within 20 km of Camden substation.

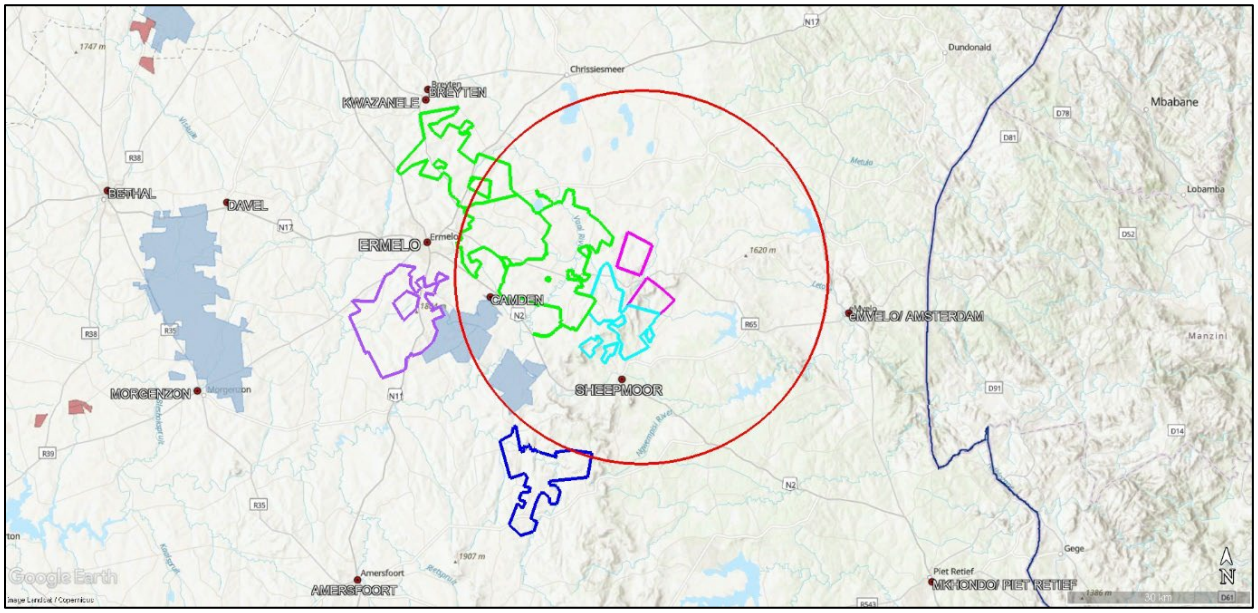


Figure 3.10: Emvelo WEF (pink outlines) in relation to REF projects within a 30 km radius (red circle): approved WEFs (blue fill), and proposed Sheepmoor WEF (light blue), Redcap Leghoya WEF suite, Ntabande WEF (dark blue), and Zephyr WEF (purple)

SECTION 4: ASSESSMENT OF KEY SOCIAL ISSUES

4.1 INTRODUCTION

Section 4 provides an assessment of the key social issues identified during the study. The identification of key issues was based on:

- Review of project related information.
- Review of key policy and planning documents.
- Site visit and interviews with key stakeholders.
- Experience with similar projects.

The section is divided into the following sections:

- Compatibility with relevant policy and planning context ("planning fit").
- Social issues associated with the construction phase.
- Social issues associated with the operational phase.
- Social issues associated with the decommissioning phase.
- Social implications of "no development" alternative.
- Social implications associated with cumulative impacts.

4.2 ASSESSMENT OF POLICY AND PLANNING FIT

The development of renewable energy is strongly supported at a national, provincial, and local level. The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The development of renewable energy is also supported by the MMSDF. In this regard the SDF acknowledges the importance of the mining sector and notes that it will need to be accommodated over the short to medium term. However, of relevance to the proposed development the SDF refers to green industries and indicates that the existing site of the Camden Power Station and surrounds should be made available for new industrial development in the long term, to manage the long-term impact of the Power Station being decommissioned.

4.3 CONSTRUCTION PHASE SOCIAL IMPACTS

Potential positive impacts

- Creation of employment and business opportunities.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of jobseekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles.

- Impact on productive farmland.

4.3.1 Creation of employment and business opportunities

The construction phase will extend over a period of approximately 18-24 months and create in the region of 200-250 employment opportunities that will benefit members from the local communities in the area, specifically Ermelo. These opportunities will include opportunities for low, semi and highly workers. Most of the employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. 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, specifically Ermelo. Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. Based on information from similar projects the total wage bill will be in the region of R 40 million (2024 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.

The capital expenditure will be approximately R 6.5 billion (2024 Rand value) and will create opportunities for local businesses. Due to the presence of the mining and energy sector, there are likely to suitably qualified companies in Ermelo that can provide the required services and products. 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 potential benefits for local communities are confirmed by the findings of the Overview of the IPPPP undertaken by the Department of Energy, National Treasury and DBSA (December 2021). The study found that to date, a total of 63 291 job years[17] have been created for South African citizens, of which 48 110 job years were in construction and 15 182 in operations. By the end of December 2021, 85 projects had successfully completed construction and moved into operation. These projects created 44 172 job years of employment, compared to the anticipated 30 488. This was 45% more than planned.

In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. For active projects, the expectation for local community participation was 13 284 job years. To date 25 272 job years have been realised (i.e. 90% more than initially planned), with 23 projects still in, or entering, construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 74%.

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 81%, 44% and 48% of total job opportunities created by IPPs to date. However, woman and disabled people could still be significantly empowered as they represent a mere 10% and 0.4% of total jobs created to date, respectively. Nonetheless, the fact that the REIPPPP has raised employment

[17] The equivalent of a full-time employment opportunity for one person for one year.

opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

The share of black citizens employed during construction (81%) and the early stages of operations (85%) has significantly exceeded the 50% target and the 30% minimum threshold. Likewise, the share of skilled black citizens (as a percentage of skilled employees) for both construction (71%) and operations (82%) has also exceeded the 30% target and minimum threshold of 18%. The share of local community members as a share of SA-based employees was 48% and 70% for construction and operations respectively – exceeding the minimum threshold of 12% and the target of 20%.

Table 4.1: Impact assessment of employment and business creation opportunities during the construction phase

Impact Phase: Construction		
Nature: Creation of employment and business opportunities during the construction phase		
	Without Enhancement	**With Enhancement**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Moderate (3)
Reversibility	N/A	N/A
Probability	Probable (3)	Highly probable (4)
Significance	Low (24)	Medium (32)
Status	Positive	Positive
Can impact be enhanced?	Yes	

Enhancement:

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, most skilled posts are likely to be filled by people from outside the area.
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
- 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 a 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.
- 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.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.
Residual impacts: Opportunity to up-grade and improve skills levels in the area.

4.3.2 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 way 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 partners 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. As indicated above, due to the presence of the mining and energy sectors, there are likely to suitably qualified personnel and companies in Ermelo that can provide the required services and products. Non-local workers are likely to be accommodated in Ermelo. Given the established energy and mining sectors the presence of contractors will not be unique to the area and Ermelo. The potential risk posed by non-local workers to the local community is therefore likely to be limited.

While the risks associated with construction workers at a community level are likely to be low with mitigation, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects, it is not possible to totally avoid these potential impacts at an individual or family level.

Table 4.2: Assessment of impact of the presence of construction workers in the area on local communities

Impact Phase: Construction		
Nature: Potential impacts on family structures and social networks associated with the presence of construction workers		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)
Reversibility	Recoverable (3)	Recoverable (3)
Probability	Probable (3)	Low Probable (2)
Significance	Medium (33)	Low (20)
Status	Negative	Negative
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be entirely eliminated	
Mitigation: • The proponent, in consultation with the MM should investigate the option of establishing a Monitoring Committee (MC) to monitor and identify potential problems that may arise during the construction phase. • 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 and 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 and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP. • The proponent and the contractor should implement an HIV/AIDS 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, except for security personnel, should be permitted to stay overnight on the site.		
Residual impacts: Impacts on family and community relations that may, in some cases, persist for a long period of time. Also, in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent residual/cumulative impacts on the affected individuals and/or their families and the community.		

4.3.3 Influx of job seekers

Large construction projects have the potential 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 in Section 4.3.2. Based on the findings of the SIA the potential for economically motivated in-migration and subsequent labour stranding is likely to be negligible. This is due to the relatively short duration of the construction phase. The risks associated with the influx of job seekers associated with the project are therefore likely to be low.

Table 4.3: Assessment of impact of job seekers on local communities

Impact Phase: Construction		
Nature: Potential impacts on family structures, social networks and community services associated with the influx of job seekers		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Very Low (1)	Very Low (1)
Reversibility	Recoverable (3)	Recoverable (3)
Probability	Probable (3)	Low Probable (2)
Significance	Low (27)	Low (18)
Status	Negative	Negative
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be entirely eliminated	
Mitigation: 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 should implement a "locals first" policy, specifically regarding unskilled and low skilled opportunities. • The proponent should implement a policy that no employment will be available at the gate.		

• 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.
Residual impacts: Impacts on family and community relations that may, in some cases, persist for a long period of time. Also, in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent residual/cumulative impacts on the affected individuals and/or their families and the community.

4.3.4 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 farm workers on the site.

Based on the comments from affected landowners stock theft, illegal hunting and arson were identified as key concerns. Security is therefore a key issue. The establishment of the WEF and the associated project related security (construction and operational phase) has the potential to improve security in the area and would represent a project benefit. This includes establishing a network of CCTV cameras along key access roads and intersections. Based on the interviews undertaken during the SIA the proponent has discussed security related matters with the affected landowners.

Table 4.4: Assessment of risk to safety, livestock, and damage to farm infrastructure

Impact Phase: Construction		
Nature: Potential risk to safety of farmers and farm workers, livestock and damage to farm infrastructure associated with the presence of construction workers on site		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)
Reversibility	Recoverable (3)	Recoverable (3)
Probability	Probable (3)	Low Probability (2)
Significance	Medium (30)	Low (16)
Status	Negative	Negative
Can impact be mitigated?	Yes	
Mitigation: • The proponent should liaise with the local landowners and security companies and install CCTV cameras along key access roads in the study area. • 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. • The developer(s) and local farming community should co-ordinate (and if necessary, upgrade) security arrangements, such as establishment of security cameras at strategic locations (see above).		

• 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 consider the option of establishing a MC (see above) that includes local farmers and develop a Code of Conduct for construction workers. The MC should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before construction activities commence. • 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 Environmental Management Programme (EMPr) 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 Code of Conduct. All dismissals must be in accordance with South African labour legislation. • It is recommended that no construction workers, except for security personnel, should be permitted to stay over-night on the site.
Residual impacts: No**,** provided losses are compensated for.

4.3.5 Nuisance impacts associated with construction related activities

The construction activities on site and movement of heavy construction vehicles during the construction phase has the potential to create noise and dust impacts, damage local roads and create safety impacts for other road users. The nuisance related impacts associated with the construction phase, including traffic related impacts associated with the transport of materials to the site, be effectively managed if the required mitigation measures are implemented. This includes ensuring that construction related activities are timed to minimise the impact on farming activities, specifically during the planting and harvesting season.

Table 4.5: **Assessment of nuisance impacts associated with construction related activities**

Impact Phase: Construction		
Nature: Potential noise, dust and safety impacts associated with movement of construction related activities and movement of traffic to and from the site		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)
Reversibility	Recoverable (3)	Recoverable (3)
Probability	Probable (3)	Low Probability (2)
Significance	Medium (30)	Low (16)
Status	Negative	Negative
Degree to which impact can be reversed	N/A for positive social/ socio-economic impacts	

Degree to which impact may cause irreplaceable loss of resources	N/A for positive social/ socio-economic impacts
Can impact be mitigated?	Yes
Mitigation: • Construction related activities should be timed to minimise the impact on farming activities, specifically during the planting and harvesting season. • The movement of construction vehicles on the site should be confined to agreed access road/s. • Establishment of 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. • Damage to internal farm roads should be repaired during and on completion of the construction phase (within 1 month). • The movement of heavy vehicles associated with the construction phase should be timed to avoid times and days of the week, such as weekends, when the volume of traffic travelling along the access roads may be higher. • Dust suppression measures should be implemented, such as wetting on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. • All vehicles must be road worthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.	
Residual impacts: No**,** provided losses are compensated for.	

4.3.6 Increased risk of grass fires

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 local landowners indicated that grass fires were a key risk given that the area is susceptible to grass fires during the winter months (May-October) and that the veld can take several years to recover to full productivity. Grass fires represent a key risk to livelihoods given the importance to livestock farming in the area. Grass fires also pose a risk to plantations.

Table 4.6: Assessment of impact of increased risk of grass fires

Impact Phase: Construction		
Nature: Potential loss of livestock and grazing and damage to farm infrastructure associated with increased incidence of grass fires		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)
Reversibility	Reversible with compensation (3)	Reversible with compensation (3)
Probability	Probable (3)	Low Probability (2)
Significance	Medium (30)	Low (16)
Status	Negative	Negative
Can impact be mitigated?	Yes	
Mitigation: • The proponent should become a member of the local firefighting association. • 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 winter months. • Contractor should provide adequate fire-fighting equipment on-site. • Contractor should provide fire-fighting training to selected construction staff. • No construction staff, except for security staff, to be accommodated on site overnight. • 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 should compensate farmers for damage caused to their farms.		
Residual impacts: No**,** provided losses are compensated for.		

4.3.7 Impact on farming operations and 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 crops and grazing. However, experience from other WEFs is that impact on farming operations can be effectively minimised and mitigated by careful planning in the final layout of the proposed WEF and associated components.

Based on the review of the proposed layout it appears that footprint impacts (long term and and/ or temporary) on productive farming areas are limited and associated with re relatively small number of wind turbines. The potential impacts on dryland cropping areas are associated with the three turbines, namely 2, 4, and 6. Two (2 and 4) are located on Schimmelhoek 272/2 (Cloete) and one (6) on 272/1 (De Villiers). Hardstand areas and access roads would further impact on these fields. In addition, a construction camp is proposed on a

further field on 272/1. A construction camp site is also proposed within a field on Schiedam 274/2. Turbine 17 is proposed immediately to the west of the field. The area has recently been cleared to allow expansion of the field. The owner indicated that the area should preferably be avoided, and that the relevant infrastructure could instead be repositioned further to the north-west, closer to the property's northern boundary (Randall, pers. comm). The laydown area, O&M sites and substations site would not impact on any cropping areas.

Mr Randall also indicated that the access road off the Bankplaas Road was the preferred option as it would enable better surveillance of traffic onto the site from the Vlakplaas farmstead (Randall, pers. comm). The potential issues raised by affected landowners can be addressed by micro re-siting of the identified turbines in consultation with owners. Mitigation measures would involve locating the relevant turbines closer to field borders and avoiding access roads that cut across cropping areas where possible.

The proponent should, in consultation with the owners of Schimmelhoek 272/1 (De Villiers), 274/2 and 274/5 (Cloete) and Schiedam 274/2 (Randall) investigate the opportunity to micro-site turbines 2, 4, 6, and 17 and associated construction camp sites on Schimmelhoek 272/1 and Schiedam 274/2.

The impact on farmland associated with the construction phase can also 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. Recommended mitigation measures are outlined below. The timing / phasing on construction activities should where possible also be planned to avoid and or minimise disruption to farming operations. Affected landowners should be involved in planning of timing of construction activities.

The Preferred Alignment is shorter than the alternative alignment (~6.5 km), affects fewer properties and follows an existing Eskom transmission line corridor. The Alternative Alignment is longer and affects four additional properties that are not affected by the Preferred Alternative and does not follow an existing Eskom transmission line corridor. The preferred alignment does however impact on cropped fields over a slightly longer distance (~1.5 km). These impacts affect a single owner, namely Mr Meyer.

Table 4.7: Assessment of impact on farming operations and farmland due to construction related activities

Impact Phase: Construction		
Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the project etc. will damage farmlands and result in a loss of farmlands for grazing.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)
Reversibility	Reversible with compensation and rehabilitation (3)	Reversible with compensation and rehabilitation (3)
Probability	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (24)

Status	Negative	Negative
Can impact be mitigated?	Yes	Yes
Mitigation: The potential impacts associated with damage to, and loss of farmland can be effectively mitigated. The aspects that should be covered include: • The proponent should, in consultation with the owners Schimmelhoek 272/1 (De Villiers), 274/2 and 274/5 (Cloete) and Schiedam 274/2 (Randall) investigate the opportunity to micro-site turbines 2, 4, 6, and 17 and associated construction camp sites on Schimmelhoek 272/1 and Schiedam 274/2. • An Environmental Control Officer (ECO) should be appointed to monitor the construction phase. • Existing internal roads should be used where possible. If new roads are required, these roads should be rehabilitated on completion of the construction phase. • The footprint associated with the construction related activities (access roads, construction camps, workshop etc.) should be minimised. • All areas disturbed by construction related activities, such as access roads on the site, construction camps 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 included in the EMPr. • The implementation of the Rehabilitation Programme should be monitored by the ECO.		
Residual impacts: If damage to and or loss of productive land is not avoided and or minimised can impact on viability of farming operations and livelihoods.		

4.4 OPERATIONAL PHASE SOCIAL IMPACTS

The following key social issues are of relevance to the operational phase:

Potential positive impacts
- The establishment of infrastructure to improve energy security and support renewable sector.
- Creation of employment opportunities.
- Benefits to the affected landowners.
- Benefits associated with the socio-economic contributions to community development.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Impact on property values.
- Impact on tourism.

4.4.1 Improve energy security and support the renewable energy sector

Improved energy security
South Africa's energy crisis, which started in 2007 and is ongoing, has resulted in widespread rolling blackouts (referred to as load shedding) due to supply shortfalls. The load shedding has had a significant impact on all sectors of the economy and on investor confidence. The mining and manufacturing sector have been severely impacted and will continue to be impacted until such time as there is a reliable supply to energy. The Minister of Mineral Resources and Energy, Gwede Mantashe, indicated in February 2023 that the cost of load shedding was estimated at R1 billion a day[18]. The South African Reserve Bank indicated in

[18] https://www.citizen.co.za/news/load-shedding-cost-economy-billion/

February 2023 that stage 3 and stage 6 loadshedding cost the South African economy between R204 million and R899 million a day.[19]

A survey of 3 984 small business owners in 2019 found that 44% said that they had been severely affected by load shedding with 85% stating that it had reduced their revenue, with 40% of small businesses losing 20% or more or revenue during due to load shedding period[20].

Impact of a coal powered economy

The Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus making the greening of the electricity mix a national imperative. The study notes that renewable energy provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa renewable energy is not as dependent on water compared to the massive water requirements of conventional power stations, has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The Greenpeace Report (powering the future: Renewable Energy Roll-out in South Africa, 2013), also notes that within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. These include acid mine drainage from abandoned mines in South Africa and the risk this poses on the country's limited water resources.

Benefits associated with REIPPPP

Through the competitive bidding process, the IPPPP has effectively leveraged rapid, global technology developments and price trends, buying clean energy at lower and lower rates with every bid cycle, resulting in SA getting the benefit of renewable energy at some of the lowest tariffs in the world. The price for wind power has dropped by 50% to R0.94/kWh, while solar PV has dropped with 75% to R1.14/kWh between BW1 and BW4. Prices contracted under the REIPPPP for all technologies are well below the published REFIT prices. The REIPPPP has effectively translated policy and planning into delivery of clean energy at very competitive prices. As such it is contributing to the national aspirations of secure, affordable energy, lower carbon intensity and a transformed 'green' economy.

Prices contracted under the REIPPPP for all technologies are well below the published REFIT prices. The REIPPPP has effectively translated policy and planning into delivery of clean energy at very competitive prices. As such it is contributing to the national aspirations of secure, affordable energy, lower carbon intensity and a transformed 'green' economy.

[19]https://businesstech.co.za/news/energy/662515/stage-6-load-shedding-costs-south-africa-r900-million-a-day-sarb/

[20]"How does load shedding affect small business in SA?". The Yoco Small Business Pulse (3: Q1 2019):

Table 4.8: Improve energy security and support renewable sector

Impact Phase: Operation		
Nature: Development of infrastructure to improve energy security and support renewable sector		
	Without Mitigation	**With Mitigation**
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (4)	High (4)
Reversibility	N/A	N/A
Probability	Highly Probable (4)	Definite (5)
Significance	Moderate (48)	High (60)
Status	Negative	Positive
Can impact be enhanced?	Yes	
Enhancement • Implement a skills development and training programme aimed at maximizing the number of employment opportunities for local community members. • Maximise opportunities for local content, procurement, and community shareholding.		
Residual impacts: Overall reduction in CO_2 emission, reduction in water consumption for energy generation, contribution to the development of the renewable energy sector in South Africa and benefit for economic development and investment.		

4.4.2 Creation of employment and business opportunities

The proposed development will create ~ 20-40 full-time employment opportunities during the operational phase. Based on similar projects the annual operating budget will be in the region of R 50 million (2024 Rand values), including wages. The operational phase will also train and employ ~ 20 local community members as bird monitors.

Table 4.9: Assessment of employment and business opportunities

Impact Phase: Operation		
Nature: Creation of employment, skills development and business opportunities associated with the operational phase		
	Without Mitigation	**With Enhancement**
Extent	Local and Regional (1)	Local and Regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Moderate (3)
Reversibility	N/A	N/A
Probability	Low Probability (2)	Highly Probable (4)
Significance	Low (14)	Medium (36)
Status	Positive	Positive
Can impact be enhanced?	Yes	

Enhancement: • Where reasonable and practical, the proponent should implement a 'locals first' policy, especially for semi and low-skilled job categories. • Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. • Where feasible, training and skills development programmes for locals should be initiated as part of the operational 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 for the operational phase. Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the operational phase.
Residual impacts: Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area.

4.4.3 Benefits for affected landowners

The proponent will be required to either purchase the land or enter into a rental agreement with the affected landowners for the use of the land for the establishment of the proposed WEF. Farming operations are impacted by droughts and market fluctuations. Any additional source of income therefore represents a significant benefit for the affected landowner(s). The additional income would assist to reduce the risks to their livelihoods posed by droughts and fluctuating market prices for outputs and farming inputs, such as fuel, feed etc. The additional income would improve economic security of farming operations, which in turn would improve job security of farm workers and benefit the local economy.

In addition to additional income, the establishment of the proposed WEF will also create an opportunity to improve local security in the study area associated with the security measures implemented by the operators of the wind farm, such as security cameras etc.

Table 4.10: Assessment of benefits for the affected landowners

Impact Phase: Operation		
Nature: The generation of additional income represents a significant benefit for the local affected farmer(s) and reduces the risks to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as feed etc. Security measures associated with the project will also benefit local landowners.		
	Without Mitigation	**With Enhancement**
Extent	Local and Regional (1)	Local and Regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Moderate (3)
Reversibility	N/A	N/A
Probability	Probability (3)	Definite (5)
Significance	Low (21)	Medium (45)
Status	Positive	Positive
Can impact be enhanced?	Yes	

Enhancement: • The proponent should liaise with the local landowners and security companies and install CCTV cameras along key access roads in the study area. • Implement agreements with affected landowners.
Residual impacts: Support for local agricultural sector and farming

4.4.4 Benefits associated with the socio-economic development contributions

The REIPPPP has been designed not only to procure energy but has also been structured to contribute to the broader national development objectives of job creation, social upliftment and broadening of economic ownership. Socio-economic development (SED) contributions are an important focus of the REIPPPP and are aimed at ensuring that local communities benefit directly from the investments attracted into the area. These contributions are linked to SED and accrue over the project operation life and, in so doing, create an opportunity to generate a steady revenue stream over an extended period. This revenue can be used to fund development initiatives in the area and support the local community. The long-term duration of the revenue stream also allows local municipalities and communities to undertake long term planning for the area. The revenue from the proposed SEF can be used to support a number of social and economic initiatives in the area, including:

- Creation of jobs.
- Education.
- Support for and provision of basic services.
- School feeding schemes.
- Training and skills development.
- Support for SMME's.

The minimum compliance threshold for SED contributions is 1% of the revenue with 1.5% the targeted level over the 20-year project operational life. For the current portfolio of projects, the average commitment level is 2%, which is 101% higher than the minimum threshold level. To date (across BW1-4) a total contribution of R22.8 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

As a percentage of revenue, SED obligations become effective only when operations commence, and revenue is generated. Of the 91 IPPs that have reached financial close (BW1–BW4), 85 are operational. The SED contributions associated with these 85 projects has amounted to R 1.8 billion to date.

In terms of ED and SED spend, education, social welfare, and health care initiatives have a SED focus. SED spend on education has been almost double the expenditure on enterprise development. In this regard IPPs have supported 1 388 education institutions with a total of R437 million in contributions, from 2015 to the end of June 2021. A total of 1 276 bursaries, amounting to R210.8 million, have been awarded by 67 IPPs from 2015 until the end of June 2021. The largest portion of the bursaries were awarded to African and Coloured students (97.4%), with women and girls receiving 56.3% of total bursaries. The Northern Cape province benefitted most from the bursaries awarded, with 57.2%, followed by the Eastern Cape (20.2%) and Western Cape (14.1%). Enterprise development and social welfare are the focus areas that have received the second highest share of the contributions to date.

The Green Jobs study (2011) found that the case for renewable energy is enhanced by the positive effect on rural or regional development. Renewable energy facilities located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues.

The SED contributions do therefore create significant benefits for local rural communities. However, the funds can be mismanaged. This is an issue that will need to be addressed when allocating SED funds.

Table 4.11: Assessment of benefits associated with socio-economic development contributions

Impact Phase: Operation		
Nature: Benefits associated with support for local community's form SED contributions		
	Without Mitigation	**With Enhancement**21
Extent	Regional (3)	National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (3)	High (4)
Reversibility	N/A	N/A
Probability	High Probability (4)	Definite (5)
Significance	Medium (40)	High (60)
Status	Positive	Positive
Reversibility	N/A	
Can impact be enhanced?	Yes	
Enhancement: • The proponents should liaise with the MM to identify projects that can be supported by SED contributions. • Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community. • Strict financial management controls, including annual audits, should be instituted to manage the SED contributions.		
Residual impacts: Promotion of social and economic development and improvement in the overall well-being of the community		

4.4.5 Visual impact and impact on sense of place

The proposed WEF will impact on the areas existing rural sense of place. However, the existing rural sense of place has been altered by coal mining in the general area. The findings of the Visual Impact Assessment (VIA) undertaken by GYLA (February 2025) indicate the visual environment during the operational phase is assessed to have a *high magnitude* over a *widespread area* and would occur over the *long-term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as High Negative. The significance of a high impact is that it could have an influence on the decision, and the impact would be unacceptable unless it is effectively mitigated. Mitigation measures are feasible (specifically with regards night lighting, the location of turbines to avoid flicker on affected residential locations and the lack of I&AP concern of the project) and can

21 Enhancement assumes effective management of the community trust

reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly to that of Moderate Negative.

Based on the findings of the SIA no concerns were raised by the affected landowners about the visual impacts on the areas sense of place.

Table 4.12: Visual impact and impact on sense of place (based on VIA)

Impact Phase: Operation		
Nature: Visual impact associated with the proposed facility and associated infrastructure and the potential impact on the areas rural sense of place.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (4)	Moderate (4)
Reversibility	Reversible with rehabilitation (3)	Reversible with rehabilitation (3)
Probability	Definite (5)	Highly Probable (5)
Significance	High (70)	Medium (56)
Status	Negative	Negative
Can impact be mitigated?	Yes, but opportunities are limited	
Mitigation: • The recommendations contained in the VIA should be implemented. • Install radar activated civil aviation light system.		
Residual impacts: Potential impact on current rural sense of place		

4.4.6 Potential impact on property values

A literature review was undertaken as part of the SIA. It should be noted that the review does not constitute a property evaluation study and merely seeks to comment on the potential impact of wind farms on property values based on the findings of studies undertaken overseas. The assessment rating is based on the findings of the review. In total five articles were identified and reviewed namely:

- Stephen Gibbons (April 2014): Gone with the wind: Valuing the Visual Impacts of Wind turbines through house prices. London School of Economics and Political Sciences & Spatial Economics Research Centre, SERC Discussion Paper 159.
- Review of the Impact of Wind Farms on Property Values, Urbis Pty Ltd (2016): Commissioned by the Office of Environment and Heritage, NSW, Australia.
- Yasin Sunak and Reinhard Madlener (May 2012): The Impact of Wind Farms on Property Values: A Geographically Weighted Hedonic Pricing. School of Business and Economics / E.ON Energy Research Centre, RWTH Aachen University. Model Working Paper No. 3/2012.
- Martin D. Heintzelman and Carrie M. Tuttle (March 3, 2011): Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Economics and Financial Studies School of Business, Clarkson University.
- Ben Hoen, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers (August 2013): A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on

Surrounding Property Values in the United States. Ernest Orlando Lawrence Berkeley National Laboratory.

Based on the findings of the literature review the potential impact of WEFs on rural property values is likely to be low, specifically for farms that are farmed as productive farms. Based on the findings of the SIA no concerns were raised regarding the potential impact on property values. As indicated above, the potential loss of productive land and the associated potential impact on property values can also be minimised by careful planning and siting of wind turbines.

Table 4.13: Assessment of potential impact on property values

Impact Phase: Operation		
Nature: Visual impact associated with the proposed facility and associated potential impact on property values.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)
Reversibility	N/A	N/A
Probability	Low Probability (2)	Low Probability (2)
Significance	Low (16)	Low (14)
Status	Negative	Negative
Can impact be mitigated?	Yes	
Mitigation: • The recommendations contained in the VIA should be implemented. • Install radar activated civil aviation light system.		
Residual impacts: Potential impact on current rural sense of place and property values		

4.4.7 Potential impact on tourism

A review of international literature in the impact of wind farms was undertaken as part of the SIA Three articles were reviewed, namely:

- Atchison, (April 2012). Tourism Impact of Wind Farms: Submitted to Renewables Inquiry Scottish Government. University of Edinburgh.
- Glasgow Caledonian University (2008). The economic impacts of wind farms on Scottish tourism. A report prepared for the Scottish Government.
- Regeneris Consulting (2014). Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector.

The research by Aitchison (2012) found that that previous research from other areas of the UK has demonstrated that wind farms are very unlikely to have any adverse impact on tourist numbers (volume), tourist expenditure (value) or tourism experience (satisfaction) (Glasgow Caledonian University, 2008; University of the West of England, 2004). In addition, to date, there is no evidence to demonstrate that any wind farm development in the UK or overseas

has resulted in any adverse impact on tourism. In conclusion, the findings from both primary and secondary research relating to the actual and potential tourism impact of wind farms indicate that there will be neither an overall decline in the number of tourists visiting an area nor any overall financial loss in tourism-related earnings as a result of a wind farm development.

In addition, all the studies that have sought to predict impact have demonstrated that any negative impact of wind farms on tourism will be more than outweighed by the increase in tourists that are attracted by wind farms, by the increase in employment brought about by the development of wind farms and/or by the continuing growth of tourism. The study by the Glasgow Caledonian University (2008) found that only a negligible fraction of tourists will change their decision whether to return to Scotland as a whole because they have seen a wind farm during their visit. The study also found that 51.0% of respondents indicated that they thought wind farms could be tourist attractions. In this regard the visitor centre at the Whitelee Wind Farm in east Ayrshire Scotland run by ScottishPower Renewables has become one of the most popular 'eco-attractions' in Scotland, receiving 200 000 visitors since it opened in 2009.

The study by Regeneris Consulting (2014) found that there was no evidence that wind farms would deter tourists from traveling along designated visitor or tourists' routes. The study indicated that small minorities of visitors would be encouraged, whilst others would be discouraged. Overall, however, there was no evidence to suggest that there would be any significant change in visitor numbers using these routes to reach destination elsewhere.

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 MM at a local and regional level. Based on the findings of the SIA no tourist facilities are likely to be impacted by the proposed WEF. Only one receptor, Foxhill Cottage, is located within 5 km of a proposed turbine (4.7 km). The Smitsfield wedding venue along the Lothair Road, is located 15 km from the nearest turbine, i.e., not in significant proximity. The broader area has also been impacted by mining, the Camden Power Station and associated transmission lines. The impact on tourism both locally and within the region will therefore be negligible.

Table 4.14: Impact on tourism in the region

Impact Phase: Operation		
Nature: Potential impact of the WEF on local tourism operations and activities		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Very Low (1)	Very Low (1)
Reversibility	N/A	N/A
Probability	Low Probability (2)	Low Probability (2)
Significance	Low (14)	Low (14)
Status	Negative	Negative
Can impact be mitigated?	Yes	

Mitigation: • The recommendations contained in the VIA should be implemented. • Install radar activated civil aviation light system.
Residual impacts: Potential impact on current rural sense of place and future tourism opportunities in the area.

4.5 CUMULATIVE IMPACT ON SENSE OF PLACE

The potential cumulative impacts on the area's sense of place will be largely linked to potential visual impacts. In this regard the Scottish Natural Heritage study (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. 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 National Wind Farm Development Guidelines, DRAFT - July 2010, Environment Protection and Heritage Council (EPHC), Commonwealth of Australia and each Australian State and Territory) 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

The establishment of the WEF and other WEFs in the area will create the potential for combined and sequential visibility impacts. However, as indicated above, the area has been impacted by the Camden Power Station and associated transmission lines and large-scale coal mining.

The findings of the Visual Impact Assessment (VIA) undertaken by GYLA (February 2025) indicate the significance of the cumulative impact of these projects on the visual environment during their operational phase is assessed to have a *high magnitude* and over the *long-term.* The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as High Negative. The implementation of mitigation measures and that receptor sensitivity to the project is low could reduce the anticipated impact, to Medium Negative. Based on the findings of the VIA, the author notes that the project is deemed acceptable from a visual perspective.

Table 4.15: Cumulative impacts on sense of place and the landscape

Impact Phase: Operation		
Nature: 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	**Cumulative impact of the project and other projects in the area**
Extent	Regional (3)	National (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (4)	High (4)
Reversibility	Reversible with rehabilitation (3)	Reversible with rehabilitation (3)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Medium (56)	High (60)
Status (positive/negative)	Negative	Negative
Can impacts be mitigated?	Limited potential	
Mitigation: • The recommendations contained in the VIA should be implemented. • Install radar activated civil aviation light system.		

4.6 CUMULATIVE IMPACT ON LOCAL SERVICES AND ACCOMMODATION

The objective will be to source as many low and semi-skilled workers for the construction phase from the MM, specifically Ermelo. This will reduce the pressure on local services and accommodation in Ermelo. For a single WEF project ~ 200-250 workers may require accommodation. In the event of the construction phase for overlapping projects overlapping (2 or more), the total number of workers requiring accommodation would be between 500 and 600. The potential pressure on local services will depend on the number of locally based contractors and workers that are employed during the construction phase.

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 MM. These benefits will create opportunities for investment in the MM, including the opportunity to up-grade and expand existing services and the construction of new houses. Socio-economic development (SED) contributions also represent an important focus of the REIPPPP and is aimed at ensuring that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. The proposed WEF is also required to contribute a percentage of projected revenues accrued over the 20-year period to SED. This will provide revenue that can be used by the MM to invest in up-grading local services where required. In should also be noted that it is the function of national, provincial, and local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of development renewable energy projects should therefore be addressed in the Integrated Development Planning process undertaken by the MM.

Table 4.16: Cumulative impacts on local services

Impact Phase: Operation		
Nature: The establishment of several renewable energy facilities and associated projects, such as the proposed WEF, in the MM has the potential to place pressure on local services, specifically medical, education and accommodation		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (2)	Local and regional (3)
Duration	Short term (2)	Medium term (3)
Magnitude	Low (2)	Medium (3)
Reversibility	N/A	N/A
Probability	Low Probability (2)	Low Probability (2)
Significance	Low (12)	Low (18)
Status (positive/negative)	Negative	Negative
Can impacts be mitigated?	Yes	
Mitigation: • The proponent should liaise with the MM to address potential impacts on accommodation and local services.		

4.7 CUMULATIVE IMPACT ON 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 MM. The positive cumulative opportunities include creation of employment, skills development and training opportunities, and downstream business opportunities.

The review of the REIPPPP (December 2021) indicates that to date (across BW1-4) a total contribution of R22.8 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase. The potential cumulative benefits for the local and regional economy are therefore 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.

Table 4.17: Cumulative impacts on local economy

Impact Phase: Operation		
Nature: The establishment of renewable energy facilities and associated projects, such as the WEF, in the MM will create employment, skills development and training opportunities, creation of downstream business opportunities.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Regional (3)	National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	High (4)
Reversibility	N/A	N/A
Probability	Highly Probable (4)	Definite (5)
Significance	Medium (32)	High (60)
Status (positive/negative)	Positive	Positive
Can impacts be enhanced?	Yes	

4.8 ASSESSMENT OF 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[22]. The decommissioning phase is therefore likely to create additional construction type jobs, as opposed to the jobs losses typically associated with decommissioning. The number of people employed during the operational phase will be in the region of 20. Given the low number of people employed during the operational phase the decommissioning of the facility will not have a significant negative social impact on the local community. The potential impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. The decommissioning phase will also create employment opportunities. This will represent a positive impact. These jobs will, however, be temporary.

Table 4.18: Social impacts associated with decommissioning

Impact Phase: Decommissioning		
Nature: Social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (3)	Low (2)

[22] There is also a possibility that the existing wind turbines may be replaced with new, more efficient turbines at the end of the first 20-year contract period. This would create additional employment opportunities and ensure that the existing operational phase jobs are maintained.

Reversibility	Recoverable (3)	Recoverable (3)
Probability	Highly Probable (4)	Probable (3)
Significance	Medium (36)	Moderate (24)
Status	Negative	Negative
Can impact be mitigated?	Yes	
Mitigation: • The proponent should ensure that retrenchment packages are provided for all staff retrenched when the WEF is decommissioned.		
Residual impacts: Loss of income and employment.		

4.9 ASSESSMENT OF NO-DEVELOPMENT OPTION

The primary goal of the project is to generate additional renewable energy and improve energy security. 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-Development option would represent a lost opportunity for South Africa to improve energy security and supplement is 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.

Table 4.19: Assessment of no-development option

Impact Phase: Operation		
Nature: No-development option would result in the lost opportunity for South Africa to improve energy security and assist to support with the development of clean, renewable energy		
	Without Mitigation[23]	**With Enhancement**[24]
Extent	Local-International (5)	Local-International (5)
Duration	Long term (4)	Long term (4)
Magnitude	Medium (3)	Medium (3)
Reversibility	N/A	N/A
Probability	High Probability (4)	High Probability (4)
Significance	Moderate (48)	Moderate (48)
Status	Negative	Positive
Can impact be mitigated/enhanced?	Yes	
Enhancement:		

23 Assumes project is not developed
24 Assumes project is developed

The proposed WEF should be developed, and the mitigation and enhancement measures identified in the SIA and other specialist studies should be implemented.
Residual impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.

SECTION 5: KEY FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

Section 5 lists the key findings of the SIA. These findings are based on:

- A review of key planning and policy documents pertaining to the area.
- A review of social and economic issues associated with similar developments.
- The experience of the authors with other renewable energy projects.
- Site visit and interviews with key stakeholders.

5.2 SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning.
- Construction phase impacts.
- Operational phase impacts.
- Cumulative impacts.
- Decommissioning phase impacts.
- No-development option.

5.2.1 Policy and planning issues

The development of renewable energy is strongly supported at a national, provincial, and local level. The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The development of renewable energy is also supported by the MMSDF. In this regard the SDF acknowledges the importance of the mining sector and notes that it will need to be accommodated over the short to medium term. However, of relevance to the proposed development the SDF refers to green industries and indicates that the existing site of the Camden Power Station and surrounds should be made available for new industrial development in the long term, to manage the long-term impact of the Power Station being decommissioned.

5.2.2 Construction phase impacts

Potential positive impacts

- Creation of employment and business opportunities.

The construction phase will extend over a period of approximately 18-24 months and create in the region of 200-250 employment opportunities. Members from the local communities in Ermelo and the MM would qualify for the majority of low skilled and semi-skilled employment opportunities and a number of skilled opportunities. The Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members from the local community. Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. The total wage bill will be in the region of R 40 million (2024 Rand values). A percentage of the wage bill will be spent

in the local economy which will also create opportunities for local businesses in Ermelo and the MM. The capital expenditure associated with the construction phase will be approximately R 6.5 billion (2024 Rand value). This will create opportunities for local companies and the regional and local economy. Due to the presence of the mining and energy sector, there are likely to suitably qualified companies in Ermelo that can provide the required services and products. 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.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of jobseekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles.
- Impact on productive farmland.

The findings of the SIA indicate that the significance of the potential negative impacts with mitigation will be **Low Negative**. The potential negative impacts associated with the proposed construction phase can therefore be effectively mitigated if the recommended mitigation measures are implemented. Table 5.1 summarises the significance of the impacts associated with the construction phase.

Table 5.1: Summary of social impacts during construction phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Medium (Positive)	Medium (Positive)
Presence of construction workers and potential impacts on family structures and social networks	Medium (Negative)	Low (Negative)
Influx of job seekers	Low (Negative)	Low (Negative)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Medium (Negative)	Low (Negative)
Increased risk of grass fires	Medium (Negative)	Low (Negative)
Impact of heavy vehicles and construction activities	Medium (Negative)	Low (Negative)
Loss of farmland	Medium (Negative)	Low (Negative)

5.2.3 Operational phase impacts

Potential positive impacts

- Establishment of infrastructure to improve energy security and support renewable sector.
- Creation of employment opportunities.
- Benefits for local landowners.
- Benefits associated with socio-economic contributions to community development.

The proposed project will 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.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Potential impact on property values.
- Potential impact on tourism.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation will be **Low Negative**. The potential negative impacts can therefore be effectively mitigated. The significance of the impacts associated with the operational phase are summarised in Table 5.2.

Table 5.2: Summary of social impacts during operational phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Establishment of infrastructure to improve energy security and support renewable sector	High (Positive)	High (Positive)
Creation of employment and business opportunities during maintenance	Low (Positive)	Medium (Positive)
Benefits associated with socio-economic contributions to community development	Medium (Positive)	High (Positive)
Benefits for landowners	Low (Positive)	Medium (Positive)
Visual impact and impact on sense of place	High (Negative)	Moderate (Negative)
Impact on property values	Low (Negative)	Low (Negative)
Impact on tourism	Low (Negative)	Low (Negative)

5.2.4 Assessment of cumulative impacts

Cumulative impact on sense of place
The establishment of the WEF and other wind energy facilities in the area will create the potential for combined and sequential visibility impacts. The significance is rated as **Medium Negative** without and with mitigation.

Cumulative impact on local services and accommodation
The potential cumulative impact on local services and accommodation will depend on the timing construction phases for the different renewable energy projects in the area. With effective planning the significance of the potential impact is rated as **Low Negative** with mitigation.

Cumulative impact on local economy
The significance of this impact with enhancement is rated as **High Positive** with enhancement.

5.2.5 Decommissioning phase

Given the relatively small number of people employed during the operational phase (~ 20-30), the potential negative social impact on the local economy associated with decommissioning will be limited. In addition, the potential impacts associated with the decommissioning phase can also 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. The significance of this impact was assessed to be **Low Positive**.

5.2.6 Assessment of no-development option

The No-Development option 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. The No-Development option is not supported by the findings of the SIA.

5.3 ASSESSMENT OF TRANSMISSION LINE ALTERNATIVES

The Preferred Alignment is shorter than the alternative alignment (~6.5 km), affects fewer properties and follows an existing Eskom transmission line corridor along the central 16 km section. The impact on cropped fields is greater than the Alternative Alignment and largely impacts a single owner, Mr Meyer.

The Alternative Alignment is longer and affects four additional properties that are not affected by the Preferred Alternative and does not follow an existing Eskom transmission line corridor. The Alternative Alignment also impacts on cropped fields. However, the impact lower.

Based on the findings of the SIA the social impacts associated with the Preferred and Alternative Alignments are similar as most of the alignment is shared. While the Alternative Alignment avoids the impacts on a single landowner, it impacts on four additional properties. From a social perspective the Preferred Alternative is therefore more socially acceptable. However, Mr Meyer has indicated that he does not support the establishment of a transmission line over his property.

5.4 CONCLUSION AND RECOMMENDATIONS

The findings of the SIA study indicate that the proposed Emvelo WEF and associated components, including the grid infrastructure, will create several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phase.

The project will create economic development opportunities for the local community. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole.

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.

In terms of the grid infrastructure, the social impacts associated with the Preferred and Alternative Alignment are similar for most of the alignment. While the Alternative Alignment avoids concentrating the impacts on a single landowner, it impacts on four additional landowners. From a social perspective the Preferred Alternative is therefore more socially acceptable. However, Mr Meyer has indicated that he does not support the establishment of a transmission line over his property.

Recommendations

- The proponent should, in consultation with the owners of Schimmelhoek 272/1 (De Villiers), 274/2 and 274/5 (Cloete) and Schiedam 274/2 (Randall) investigate the opportunity to micro-site turbines 2, 4, 6, and 17 and associated access roads, and the construction camp sites on Schimmelhoek 272/1 and Schiedam 274/2.
- The proponent should, in consultation with the owner of Schiedam 274/2 discuss the impact on wind turbines on the Vlakplaas landing strip on Schiedam 274/2.
- Install radar activated civil aviation light system on wind turbines where technically feasible.

Statement and reasoned opinion

The establishment of the proposed Emvelo WEF and associated infrastructure and grid connection is supported by the findings of the SIA.

ANNEXURE A

INTERVIEWS

- De Villiers, Me Ina (telephonic 2024-12-10). Schimmelhoek 272/01.
- Geldenhuys, Mr Henry (telephonic 2025-02-10). Schiedam 274/6.
- Langenhoven, Mr Pieter (telephonic 2025-02-10). Windhoek 291/1, 291/8.
- Meyer, Mr Josua (2024-12-14, telephonic 2025-02-10). Waaihoek 286/3, 286/4. 286/12, 286/14, Onverwacht 287/5, 287/6, Windhoek 291/7.
- Randall, Mr Philip (2024-12-12, telephonic 2025-02-10, e-mail 2025-02-11). Onverwacht 273/9/RE, 273/10, 273/12, Schiedam 274/2.
- Roberts, Mr Jan (2024-12-14, telephonic 2025-02-10). Onverwacht 273/2, 273/3, 273/8.
- Robberts, Mr Johannes (telephonic 2025-02-11). Waaihoek 286/2/RE, 286/6/RE, 286/13/RE.
- Saaiman, Mr Johan (2024-12-12). Onverwacht 273/3, 273/4, 273/7, 273/13.
- Swart, Antoinette & Jan (telephonic 2024-12-10). Schiedam 274/1.
- Van der Spuy, Mr Riaan (telephonic 2024-12-10; e-mail 2025-02-10). Schiedam 274/2.
- Vorster, Mr Pikkie (WhatsApp, voice message 2024-12-10, telephonic 2025-02-10). Klipfontein 283/RE.

REFERENCES

- The National Energy Act (2008).
- The White Paper on the Energy Policy of the Republic of South Africa (December 1998).
- The White Paper on Renewable Energy (November 2003).
- Integrated Resource Plan (IRP) for South Africa (2010-2030).
- The National Development Plan (2011).
- Mpumalanga Spatial Development Framework (2019).
- Msukaligwa Municipality Integrated Development Plan (2022-2027).
- Msukaligwa Spatial Development Framework (2019).
- Barbour, T and van der Merwe, S (2023). Social Impact Assessment: Zephyr Wind Energy Facility, Mpumalanga Province. Prepared for SIVEST.
- Barbour, T and van der Merwe, S (2022). Social Impact Assessment: Camden 1 Wind Energy Facility, Mpumalanga Province. Prepared for WSP on behalf of Enertrag.
- Barbour, T and van der Merwe, S (2022). Social Impact Assessment: Camden 2 Wind Energy Facility, Mpumalanga Province. Prepared for WSP on behalf of Enertrag.

INTERNET

- https://egis.environment.gov.za/renewable_energy.
- https://seritiza.com/news-media/announcements/2023/seriti-to-construct-155-mw-wind-farm-in-mpumalanga/
- https://www.esi-africa.com/news/wind-farm-construction-starts-for-energy-cluster-in-mpumalanga/
- https://www.eskom.co.za/sites/heritage/Pages/Camden.aspx

MAPS

- Chief Directorate National Geo-Spatial Information (2009). 2629BD Breyten, Ed 4.
- Chief Directorate National Geo-Spatial Information (2009). 2629DB Ermelo, Ed 4.
- Chief Directorate National Geo-Spatial Information (2009). 2630AC Chrissiesmeer, Ed 3.
- Chief Directorate National Geo-Spatial Information (2009). 2630AD Silindile, Ed 3.

- Chief Directorate National Geo-Spatial Information (2009). 2630CA Camden, Ed 3.
- Chief Directorate National Geo-Spatial Information (2009). 2630CB Sheepmoor, Ed 3.

ANNEXURE B

METHODOLOGY FOR THE ASSESSMENT OF POTENTIAL IMPACTS

The purpose of the assessment of impacts in an EIA is to evaluate the likely extent and overall significance that a potential impact may have on an identified receptor or resource. Another important aspect of the assessment of impacts is to quantify those impacts that are not scientific-based or evidence-based and include the opinions of others (i.e., the involvement and comment from I&APs).

A successful assessment of the potential significance of impacts will include the description and development of 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.

A 7-step approach for the determination of significance of potential impacts was developed by Arcus to align with the requirements of Appendix 3 of the EIA Regulations, 2014 (as amended). The approach is both objective and scientific based to allow appointed specialists and EAPs to retain independence throughout the assessment process.

Arcus has adapted this 7-step approach from standard ranking metrics such as the Hacking Method, Crawford Method etc. The Arcus 7-step approach complies with the method provided in the EIA guideline document (GN 654 of 2010) and considers international EIA Regulatory reporting standards such as the newly amended European Environmental Impact Assessment (EIA) Directive (2014/52/EU).

The 7-Step approach for determining the significance of impacts pre, and post mitigation, is described below:

Step 1: Predict potential impacts by means of an appraisal of:

- Site Surveys,
- Project-related components and infrastructure,
- Activities related with the project life-cycle,
- The nature and profile of the receiving environment and potential sensitive environmental features and attributes,
- Input received during public participation from all stakeholders, and
- The relevant legal framework applicable to the proposed development

Step 2:

Determination of whether the potential impacts identified in **Step 1** will be *direct* (caused by construction, operation, decommissioning or maintenance activities on the proposed development site or immediate surroundings of the site), *indirect* (not immediately observable or do not occur on the proposed development site or immediate surroundings of the site), *residual* (those impacts which remain after post mitigation) and *cumulative* (the combined impact of the project when considered in conjunction with similar projects in proximity).

Step 3:

Description and determination of the significance of the predicted impacts in terms of the criteria below to ensure a consistent and systematic basis for the decision-making process. Significance is numerically quantified on the basis score of the following impact parameters:

1. ***Extent*** **(E)** of the impact: The geographical extent of the impact on a given environmental receptor.
2. ***Duration*** **(D)** of the impact: The length of permanence of the impact on the environmental receptor.
3. ***Reversibility*** **(R) of the impact**: The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change
4. ***Magnitude*** **(M)** of the impact: The degree of alteration of the affected environmental receptor.
5. ***Probability*** **(P)** of the impact: The likelihood of the impact actually occurring.

A widely accepted numerical quantification of significance is the formula:

S=(E+D+R+M)*P

Where: *Significance=(Extent+Duration+Reversibility+Magnitude) * Probability*

The following has also been considered when determining the significance of a potential impact.

1. **Nature (N)** of the impact: A description of what causes the effect, what will be affected, and how it will be affected.
2. **Status (S)** of the impact: described as either positive, negative or neutral
3. **Cumulative impacts**.
4. Inclusion of **Public comment.**

The significance of environmental impacts is determined and ranked by considering the criteria presented in **Table 1** below. All criteria are rank according to 'Very Low', 'Low', 'Moderate', 'High' and 'Very High' and are assigned scores of 1 to 5 respectively.

Table 1: Defining the significant in terms of the impact criteria.

Impact Criteria	Definition	Score	Criteria Description
Extent (E)	Site	1	Impact is on the site only
	Local	2	Impact is localized inside the activity area
	Regional	3	Impact is localized outside the activity area
	National	4	Widespread impact beyond site boundary. May be defined in various ways, e.g. cadastral, catchment, topographic
	International	5	Impact widespread far beyond site boundary. Nationally or beyond
Duration (D)	Immediate	1	On impact only
	Short term	2	Quickly reversible, less than project life. Usually up to 5 years.
	Medium term	3	Reversible over time. Usually between 5 and 15 years.
	Long term	4	Longer than 10 years. Usually for the project life.
	Permanent	5	Indefinite
Magnitude (M)	Very Low	1	No impact on processes
	Low	2	Qualitative: Minor deterioration, nuisance or irritation, minor change in species/habitat/diversity or resource, no or very little quality deterioration. Quantitative: No measurable change; Recommended level will never be exceeded.
	Moderate	3	Qualitative: Moderate deterioration, discomfort, Partial loss of habitat /biodiversity /resource or slight or alteration. Quantitative: Measurable deterioration; Recommended level will occasionally be exceeded.

Impact Criteria	Definition	Score	Criteria Description
	High	4	Qualitative: Substantial deterioration death, illness or injury, loss of habitat /diversity or resource, severe alteration or disturbance of important processes. Quantitative: Measurable deterioration; Recommended level will often be exceeded(e.g. pollution)
	Very High	5	Permanent cessation of processes
Reversibility (R)	Reversible	1	Recovery which does not require rehabilitation and/or mitigation.
	Recoverable	3	Recovery which does require rehabilitation and/or mitigation.
	Irreversible	5	Not possible, despite action. The impact will still persist, and no mitigation will remedy or reverse the impact.
Probability (P)	Improbable	1	Not likely at all. No known risk or vulnerability to natural or induced hazards
	Low Probability	2	Unlikely; low likelihood; Seldom; low risk or vulnerability to natural or induced hazards
	Probable	3	Possible, distinct possibility, frequent; medium risk or vulnerability to natural or induced hazards.
	Highly Probable	4	Highly likely that there will be a continuous impact. High risk or vulnerability to natural or induced hazards
	Definite	5	Definite, regardless of prevention measures.

The *significance* (s) of potential impacts identified according to the criteria above has been colour coded for the purpose of comparison. This colour coding will be used in impact tables.

Significance is deemed Negative (-)			Significance is deemed Positive (+)		
0 - 30	**31 - 60**	**61 - 100**	**0 - 30**	**31 - 60**	**61 - 100**
Low	**Moderate**	**High**	**Low**	**Moderate**	**High**

- **Step 4:** Determination of practical and reasonable mitigation measures based on specialists' inputs and field observations following the mitigation hierarchy (avoid, minimise, manage, mitigate, or rehabilitate).
- **Step 5:** Evaluation of predicted residual impacts after implementation of mitigation measures.
- **Step 6:** Determination of the significance of the impact taking into consideration the predicted residual impacts after implementation of mitigation measures.
- **Step 7:** Based on an acceptable significance of the impact, determination of the need and desirability of the proposed development and an opinion as to whether the development should proceed or not.

The Assessment of the significance of potential impacts is then populated in an Impact Summary Table.

ANNEXURE C

Tony Barbour
ENVIRONMENTAL CONSULTING

10 Firs Avenue, Claremont, 7708, South Africa
(Cell) 082 600 8266
(E-Mail) tony@tonybarbour.co.za

Tony Barbour's has 30 years' experience in the field of environmental consulting and management. His experience includes working for ten years as a consultant in the private sector followed by four years at the University of Cape Town's Environmental Evaluation Unit. He has worked as an independent consultant since 2004, with a key focus on Social Impact Assessment. His other areas of interest include Strategic Environmental Assessment and review work.

EDUCATION

- BSc (Geology and Economics) Rhodes (1984);
- B Economics (Honours) Rhodes (1985);
- MSc (Environmental Science), University of Cape Town (1992)

EMPLOYMENT RECORD

- Independent Consultant: November 2004 – current;
- University of Cape Town: August 1996-October 2004**:** Environmental Evaluation Unit (EEU), University of Cape Town. Senior Environmental Consultant and Researcher;
- Private sector: 1991-August 2000: 1991-1996**:** Ninham Shand Consulting (Now Aurecon, Cape Town). Senior Environmental Scientist; 1996-August 2000: Steffen, Robertson and Kirsten (SRK Consulting) – Associate Director, Manager Environmental Section, SRK Cape Town.

LECTURING

- University of Cape Town: Resource Economics; SEA and EIA (1991-2004);
- University of Cape Town: Social Impact Assessment (2004-current);
- Cape Technikon: Resource Economics and Waste Management (1994-1998);
- Peninsula Technikon: Resource Economics and Waste Management (1996-1998).

RELEVANT EXPERIENCE AND EXPERTISE

Tony Barbour has undertaken in the region of 300 SIA's, including SIA's for infrastructure projects, dams, pipelines, and roads. In addition, he is the author of the Guidelines for undertaking SIA's as part of the EIA process commissioned by the Western Cape Provincial Environmental Authorities in 2007. These guidelines have been used throughout South Africa.

Tony was also the project manager for a study commissioned in 2005 by the then South African Department of Water Affairs and Forestry for the development of a Social Assessment and Development Framework. The aim of the framework was to enable the Department of Water Affairs and Forestry to identify, assess and manage social impacts associated with large infrastructure projects, such as dams. The study also included the development of guidelines for Social Impact Assessment, Conflict Management, Relocation and Resettlement and Monitoring and Evaluation.

Countries with work experience include South Africa, Namibia, Angola, Botswana, Zambia, Lesotho, Swaziland, Ghana, Senegal, Nigeria, Mozambique, Mauritius, Kenya, Rwanda, Ethiopia, Oman, South Sudan, Sudan, Rwanda, and Armenia.

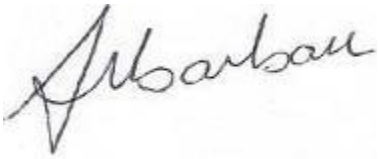
ANNEXURE D

The specialist declaration of independence in terms of the Regulations_

I, Tony Barbour , declare that -- General

declaration:

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



Signature of the specialist:

Tony Barbour Environmental Consulting and Research

Name of company (if applicable):

23 May 2025

ANNEXURE E

EMPR RECOMMENDATIONS

Impact	Mitigation / Enhancement Action	Responsibility	Mitigation / Enhancement Objective	Frequency
Employment and Business Opportunities	**Employment** • Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi- and low-skilled job categories. • Where feasible, efforts should be made to employ local contractors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. • The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. **Business** • Where possible, the proponent should assist local BBBEE companies to complete and submit the required tender forms and associated information.	Developer	Enhance local employment and business opportunities	Once off during construction phase
Risk to local communities posed by construction workers	• Prepare and implement Stakeholder Engagement Plan (SEP). • Prepare and implement Community Health, Safety and Security Plan (CHSSP) • SEP and CHSSP should include a Grievance Mechanism • Implement 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories. • Investigate option of establishing a Monitoring Forum (MF) • Develop Code of Conduct for construction workers and contractor. • Implement an HIV/AIDS awareness programme for construction workers • Provide transport for workers to and from the site daily. • Ensure 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, except for security personnel, permitted to stay over-night on the site.	Developer and appointed contractor	Reduce risk posed by construction workers to local communities	Prior to and throughout construction phase

Safety and security risks posed by construction workers to local landowners	**Mitigation:** • Prepare and implement Community Health, Safety and Security Plan (CHSSP). • Investigate option of establishing a Monitoring Forum (MF) • Establish Grievance Mechanism. • Develop Code of Conduct for construction workers and contractor. • Manage and monitor movement of construction workers on and off the site. • Avoid the establishment of a public link between the Transvalia Road and N11. • Install security cameras at strategic locations and key access points. • Ensure all farm gates are closed after use. • Provide transport for low and semi-skilled workers to and from the site. • Establish code of conduct for workers and Inform construction workers of site rules, including consequences of stock theft and trespassing on adjacent farms. • No construction workers, except for security personnel, permitted to stay over-night on the site.	Contractor appointed by developer	Avoid and or minimise safety and security risks posed by construction workers on local landowners	Prior to and throughout construction phase
Nuisance impacts associated with construction activities (noise, dust, safety etc.)	• Prepare and implement Community Health, Safety and Security Plan (CHSSP). • Establish Grievance Mechanism. • Develop Code of Conduct for construction workers and contractor. • Restrict movement of construction vehicles to agreed access road/s. • Repair damage to farm infrastructure, including damage to local gravel farm roads. • Plan movement of heavy vehicles to avoid impact on farming activities, such as planting and harvesting. • Implement dust suppression measures.	Contractor appointed by developer	Avoid and or minimise nuisance impacts to local landowners associated with construction related activities	Prior to and throughout construction phase
Risk of grass fires	**Mitigation:** • No open fires on the site for cooking or heating except in designated areas. • Smoking on site to be confined to designated areas. • All construction related activities that pose a potential fire risk, such as welding, to be effectively managed and confined to areas where the risk of fires has been reduced. • Avoid working in high wind conditions. • Provide adequate fire-fighting equipment on-site	Contractor appointed by developer	Avoid and or minimise risk of grass fires developing and spreading	Throughout construction phase

	• Provide fire-fighting training to selected construction staff. • No construction staff to be accommodated on site overnight.			
Impact on farmland and farming activities	• The proponent should, in consultation with the owners of Schimmelhoek 272/1 (De Villiers), 274/2 and 274/5 (Cloete) and Schiedam 274/2 (Randall) investigate the opportunity to micro-site turbines 2, 4, 6, and 17 and associated access roads, and the construction camp sites on Schimmelhoek 272/1 and Schiedam 274/2. • The proponent should, in consultation with the owner of Schiedam 274/2 discuss the impact on wind turbines on the Vlakplaas landing strip on Schiedam 274/2. • Establish Grievance Mechanism. • Plan movement of heavy vehicles to avoid impact on farming activities, such as planting and harvesting. • Preparate and implement Stakeholder Engagement Plan (SEP) prior to and during the construction phase. This should include informing affected landowners of type and timing of activities. • Implement dust suppression measures. • Maximise use of existing internal roads. • Minimise footprint associated with the construction related activities (access roads, construction camps, workshop etc.) • Rehabilitate areas disturbed by temporary construction related activities, such as access roads on the site, construction camps etc., at the end of the construction phase. • Appoint Environmental Control Officer (ECO) should be appointed to monitor construction phase and implementation of rehabilitation plan.	Developer and contractor appointed by developer	Avoid and or minimise impact on farmland and farming activities	Throughout construction phase
Employment and Business Opportunities	**Employment** • Implement skills development and training program. • Where reasonable and practical, appoint members from the local community and local contractors. • Promote gender equality and the employment of women wherever possible. **Business** • Where possible, appoint local BBBEE companies to provide services.	Developer	Enhance local employment and business opportunities	Throughout operational phase

Generate benefits for affected landowners	• Implement agreements with affected landowner. • Investigate opportunities to contribute to and improve security in the area.	Developer	Compensate landowners for use of land	Throughout operational phase
Support local SED initiatives	• Liaise with the MM to identify projects that can be supported by SED contributions. • Establish criteria for identifying and funding community projects. Criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community. • Develop and implement financial management controls, including annual audits, to manage the SED contributions.	Developer	Enhance SED opportunities	Throughout operational phase
Visual impact on sense of place	• Implement recommendations contained in the VIA. • Install radar activated civil aviation light system on wind turbines where technically feasible.	Developer	Reduce visual impact on sense of place	Once off at outset of operational phase



VISUAL IMPACT REPORT

EMVELO WIND ENERGY FACILITY AND OVERHEAD POWERLINES

May 2025



PROPOSED MULILO CLUSTER WEF, NEAR ERMELO, MPUMALANGA PROVINCE

VISUAL IMPACT REPORT

EMVELO WEF AND OVERHEAD POWERLINE

Submitted to:

Environmental Resource Management Southern Africa (Pty) Ltd (ERM)

Prepared by:

Graham A Young Landscape Architect

PO Box 331

Groenkloof

0027

+27 (0)82 462 1491

Report Revision No:	*05 – Addendum Added*
Date Issued:	13 May 2025
Prepared By:	Menno Klapwijk PrLArch, FILASA
Reviewed By:	Graham Young PrLArch, FILASA
Signed:	
Reference:	0106_2023: Mulilo Cluster VIA

EXPERTISE OF SPECIALIST

Name:	**GRAHAM A YOUNG**
Qualification:	BL (Toronto) ML (Pretoria)
Professional Registration:	South African Council for the Landscape Architectural Profession (SACLAP) Reg. No. 87001 Fellow Institute of Landscape Architects of South Africa (FILASA)
Experience in Years:	45 years
Experience	Graham Young is a registered landscape architect with an interest and experience in landscape architecture, urban design, and environmental planning. He holds a degree in landscape architecture from the Universities of Toronto (BL) and Pretoria (ML). He has conducted visual impact assessments in Canada and Africa, where he has spent most of his working life. He has served as President of the Institute of Landscape Architects of South Africa (ILASA) and vice president of the Board of Control for Landscape Architects. He is a Fellow of the ILASA and a professionally registered landscape architect in South Africa (SACLAP). He is Secretary-General for the International Federation of Landscape Architects, Africa Region (IFLA Africa) and Vice President of IFLA (world). He runs his practice, Graham A Young Landscape Architect (GYLA). A speciality is Visual Impact Assessments, for which he has been cited with an Institute of Landscape Architects of South Africa (ILASA) Merit Award (1999). This work also includes landscape characterisation studies, end-use studies for quarries, and computer modelling and visualisation. He has completed over three hundred specialist reports for projects and conducted VIA reviews. He has served as a specialist witness in legal cases involving visual impact issues. Mr Young helped develop the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* (Oberholzer 2005) and produced a research document for Eskom, *The Visual Impacts of Power Lines* (2009). In 2011 he produced '*Guidelines for involving visual and aesthetic specialists'* for the Aapravasi Ghat Trust Fund Technical Committee, which manages a World Heritage Site in Mauritius, along with the *Visual Impact Assessment Training Module Guideline Document* for the same client.

Consultant:	**Bapela Cave Klapwijk**
Contact person:	**Mr Menno Klapwijk**
Physical address:	168 Nicolson Street, Brooklyn, Pretoria
Postal address:	P O Box 95702, Waterkloof, Pretoria, 0045
Telephone:	012-346 2324
	0832558127
E-mail:	menno@bcksa.co.za

Menno Klapwijk has specialised for 41 years in environmental planning, construction rehabilitation and control, visual impact assessment, and landscape site design. Significant visual impact projects include: N3 De Beers Pass, Mzimvubu Government Water Scheme, Aggeneys Solar Park Moatize Power Plant (Mozambique), Transnet Multi-purpose Pipeline, Saldanha Steel, Mozal (Alusaf – Mozambique), Letsibogo Dam (Botswana), Blue Circle Cement Factory (East London), Phlogopite Factory (Phalaborwa), Iscor Heavy Minerals Smelter (Empangeni), many VIA's for Eskom 765 kV and 400kV transmission lines and substations, Mmamabula 400kV Transmission Line, Mine and Power Plant (Botswana), West Coast Combined Cycle Gas Turbine Power Plant (CCGT), De Hoop Dam and Pipeline (Sekhukuneland), Tugela Water Project (KwaZulu-Natal), Delportshoop Tower Mast (Delportshoop, Northern Cape), N3 Toll Road, Cedara (KwaZulu-Natal) to Heidelberg (Gauteng), Maputo Steel Project (Maputo, Mozambique), Ga-Pila Village (Potgietersrus, Limpopo Province) and Pom Pom Camp (Okavango, Botswana).

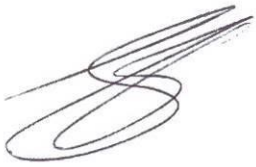
He has more than 100 publications and reports dealing mostly with environmental planning, environmental rehabilitations and control specification, environmental impact assessment and visual impact assessment.

1983:	BL. (Land Arch), Texas A & M
1986:	Environmental Impact Assessment, Graduate School of Business, UCT
Registered:	South African Council for Landscape Architecture Practitioners (SACLAP)
Fellow:	Institute of Landscape Architects of South Africa (ILASA)
Member:	International Association of Impact Assessors (SA)
Past Council Member:	Council for the Built Environment (CBE)

DECLARATION OF INDEPENDENCE

I, Graham Young, declare that –

- I am contracted as the Visual Impact Assessment Specialist for the EMVELO WIND ENERGY FACILITY and ASSOCIATED POWERLINE, Mpumalanga Province South Africa
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct; and



Graham A. Young FILASA PrLArch SACLAP Reg. No. 87001

7 February 2025

COPYRIGHT

Copyright to the text and other matters, including the manner of presentation, is exclusively the property of GRAHAM YOUNG LANDSCAPE ARCHITECT (GYLA). The content of this report is exclusively for the EMVELO WIND ENERGY FACILITY AND ASSOCIATED POWERLINE (WEF) and can also be used by Environmental Resource Management Southern Africa (Pty) Ltd who are preparing the Environmental and Social Impact Assessment (ESIA) report for the Project. It is a criminal offence to reproduce and/or use, without written consent, any matter, technical procedure, and/or technique contained in this document. Criminal and civil proceedings will be taken as a matter of strict routine against any person and/or institution infringing the copyright of the author and/or proprietors.

.

ACRONYMS, ABBREVIATIONS & GLOSSARY

Acronyms & Abbreviations	
BAR	Basic Assessment Report
BID	Background Information Document
DS	Distribution Substation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GYLA	Graham Young Landscape Architect
kV	Kilovolt
MTS	Main Transmission Substation
MW	Megawatt
OHPL	Overhead Power Transmission Line
SACLAP	South African Council for the Landscape Architectural Profession
WEF	Wind Energy Facility
WTG	Wind Turbine Generator
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment

Glossary	
Aesthetic Value	Aesthetic value is the emotional response derived from the experience of the environment with its natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings, and attitudes (Ramsay, 1993). Thus, aesthetic value encompasses more than the seen view, visual quality, or scenery, and includes atmosphere, landscape character and sense of place (Schapper, 1993).
Aesthetically significant place	A formally designated place visited by recreationists and others for the express purpose of enjoying its beauty. For example, tens of thousands of people visit Table Mountain on an annual basis. They come from around the country and even from around the world. By these measurements, one can make the case that Table Mountain (a designated National Park) is an aesthetic resource of national significance. Similarly, a resource that is visited by large numbers who come from across the region has regional

	significance. A place visited primarily by people whose place of origin is local is of local significance. Unvisited places either have no significance or are "no trespass" places. (After New York, Department of Environment 2000).
Aesthetic impact	Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Mere visibility, even startling visibility of a project proposal, should not be a threshold for decision making. Instead, a project, by its visibility, must clearly interfere with or reduce (i.e. visual impact) the public's enjoyment and/or appreciation of the appearance of a valued resource e.g. cooling tower blocks a view from a National Park overlook (after New York, Department of Environment 2000).
Cumulative Effects	The summation of effects that result from changes caused by a development in conjunction with the other past, present, or reasonably foreseeable actions.
Glare	The sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which. the eyes are adapted, which causes annoyance, discomfort, or loss in visual performance and visibility. *See* Glint. (USDI 2013:314)
Glint	A momentary flash of light resulting from a spatially localised reflection of sunlight. *See* Glare. (USDI 2013:314)
Landscape Character	The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings, and roads. They are generally quantifiable and can be easily described.
Landscape Impact	Landscape effects derive from changes in the physical landscape, which may give rise to changes in its character and how this is experienced (Institute of Environmental Assessment & The Landscape Institute 1996).
Study area	For the purposes of this report this Project the study area refers to the proposed project footprint / project site as well as the 'zone of potential influence' (the area defined as the radius about the centre point of the Project beyond which the visual impact of the most visible features will be insignificant) which is a 5,0km radius surrounding the proposed project footprint / site.
Project Footprint / Site	For the purposes of this report the Project *site* / *footprint* refers to the actual layout of the Project as described.
Sense of Place (genius loci)	Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. *A genius locus literally means* 'spirit of the place'.

Sensitive Receptors	Sensitivity of visual receptors (viewers) to a proposed development.
Viewshed analysis	The two-dimensional spatial pattern created by an analysis that defines areas, which contain all possible observation sites from which an object would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1,8m above ground level.
Visibility	The area from which project components would potentially be visible. Visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation, and distance.
Visual Exposure	Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion and visual acuity, which is also influenced by weather and light conditions.
Visual Impact	Visual effects relate to the changes that arise in the composition of available views because of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity.
Visual Intrusion	The nature of intrusion of an object on the visual quality of the environment resulting in its compatibility (absorbed into the landscape elements) or discord (contrasts with the landscape elements) with the landscape and surrounding land uses.
Visual absorption capacity	Visual absorption capacity is defined as the landscape's ability to absorb physical changes without transformation in its visual character and quality. The landscape's ability to absorb change ranges from low-capacity areas, in which the location of an activity is likely to cause visual change in the character of the area, to high-capacity areas, in which the visual impact of development will be minimal (Amir & Gidalizon 1990).
Worst-case Scenario	Principle applied where the environmental effects may vary, for example, seasonally to ensure the most severe potential effect is assessed.
Zone of Potential Visual Influence	By determining the zone of potential visual influence, it is possible to identify the extent of potential visibility and views which could be affected by the proposed development. Its maximum extent is the radius around an object beyond which the visual impact of its most visible features will be insignificant primarily due to distance.

EXECUTIVE SUMMARY

INTRODUCTION

Respective Special Purpose Vehicles (SPVs) are proposing the development of a commercial wind farm cluster that is expected to comprise two separate (up to 360 MW) Wind Energy Facilities (WEFs). Each WEF will apply for its own grid connection route to connect to the existing Eskom UItkoms Substation, via approximately 20 – 32 km long 132 kV overhead transmission line. The powerline is proposed and is assessed within a 300 m assessment corridor. The proposed development sites are located near Ermelo and fall within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province.

PROJECT SITE AND STUDY AREA

The Project site is approximately 28km east of Ermelo and 37km west of Amsterdam in Mpumalanga. The study area was determined as the site provided by the Developer, and a 30 km buffer zone around it determined by the visual specialist as the maximum area of potential impact. The visibility of the turbines would be insignificant beyond this point. Refer to **Figure 1 Locality** – Emvelo WEF Site, which identifies the study area. The 40 km buffer zone has also been established for the study, as it may be possible, that when viewed from an elevated position or when the turbines are silhouetted on a ridgeline, the structures could be visible depending on light and atmospheric conditions. The other consideration is the effect of flashing red lights on top of the turbines at night, which would be visible from great distances against what is currently a dark rural sky.

It is anticipated that the potential visual impact of the overhead power line (OHPL) should not extend beyond 5km and for this reason the visual specialist has limited the study area to 5km either side of the centre line of the proposed corridor.

AIM OF THE SPECIALIST STUDY

The study's main aim is to document the baseline and ensure that the visual/aesthetic risks of the proposed Project are understood.

TERMS AND REFERENCE

A specialist study is required to establish the visual baseline and to identify and assess the visual impacts arising from the Project based on the general requirements for a comprehensive VIA. The following terms of reference was established:

- Undertake a site survey to determine the nature of the receiving environment and the extent of visual influence.
- Describe the landscape character and quality and assess the visual resource of the study area.
- Describe the visual characteristics of the components of the Project.
- Qualitatively assess the potential for shadow flicker.
- Rate the significance of the impact of the Project.
- Rate the potential cumulative effect of the Project.
- Propose mitigation measures to reduce the potential impact of the Project.

ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations have been made in the study:

- The description of project components is limited to what has been supplied to the author prior to the date of completion of this report.
- The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. GYLA have interpolated these down to 1m intervals to get better accuracy. However, these types of viewshed investigations (using readily available GIS software and terrain contours only) are limited in their accuracy due to their inability to incorporate vegetation information. To be more accurate at predicting absolute visibility, the analysis would require “a 3D model of a tree/plant and a layer indicating the spatial distribution and density of vegetation on the landscape” (Llobera 2007:799) and buffering all existing buildings, structures and infrastructure. The possibility of indicating both the spatial and density distribution of tree/plants, and the three-dimensional model representing vegetation and all structures, is currently not available to the author. Therefore, on-site observations are critical.
- Site photos taken in early winter (when the site visit was conducted) do not necessarily reflect the complete landscape character of the area as experienced through all seasons i.e. atmospheric conditions can vary considerably (i.e. mist, haze, smoke from grass fires in winter etc. The weather was sunny with some cloud and haze conditions and showers later in the day.
- The report used the worst-case scenario for the technical details of the proposed turbines (i.e. height 150m to the hub and 110m rotors) as the final design was not available when compiling the document.

FINDINGS

The existing visual condition of the landscape that may be affected by the proposed Emvelo WEF and associated OHPL has been described. The study area's scenic quality has been rated *high* to *low* within the context of the sub-region. The Project site is in a *moderate* rated landscape type. Sensitive viewing areas and landscape types have been identified and mapped, indicating potential sensitivity to the Project, for users of the farmsteads, settlements, and towns and the R65 and the N2 roads.

Impacts on views are the highest when viewers are sensitive to change in the landscape, and the view is focused on and dominated by the change. The Project's visual impact will cause significant changes in the landscape that are noticeable to people viewing the Project.

Construction activities include the removal of vegetation, earthworks required to create building terraces for turbines and the preparation of the internal roads. Construction activities would negatively affect the landscape's visual quality and sense of place relative to its baseline. They would contrast with the patterns that define the structure of the immediate landscape and cause a significant change over a local to regional area, resulting in a moderate high change to key views. Mitigation measures are minimal with the greatest effect only at night.

Operational activities include the regular cleaning and maintenance, vegetation management under and around the turbines and powerline servitudes as well as maintenance of all other infrastructural components.

Security lighting and other lighting associated with the movement of security vehicles at night. These activities along with the physical presence of the Project components day and night, constitute the visual impact.

Decommissioning and closure activities include the dismantling and removal of all infrastructure and the rehabilitation of the site back to its current, mostly natural, state.

Significance of Visual Impact

The significance of impact is based on the worst-case scenario and all project components taken together, i.e. WEF and OHPL.

Construction phase

The impact on the visual environment during the construction phase is assessed to have a potential *medium severity* over a *regional* area (but extend beyond the site boundary to at least at 10,0km) and would occur over the *short-term* (less than five years) resulting in a moderate *consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as moderate. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain moderate

Operational Phase

The visual environment during the operational phase is assessed to have a *high magnitude* over a *widespread area* and would occur over the *long-term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The significance of a high impact is that it could have an influence on the decision, and the impact would be unacceptable unless it is effectively mitigated. Mitigation measures are feasible (specifically with regards night lighting, the location of turbines to avoid flicker on affected residential locations and the lack of I&AP concern of the project) and can reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly to that of MODERATE.

Decommissioning Phase

The impact on the visual environment during the decommissioning phase is assessed to have a *medium magnitude* over a *local area* and would occur over the *short-term* (less than five years) resulting in a *low consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as MEDIUM. The implementation of mitigation measures would reduce the anticipated impact, but it would remain MEDIUM.

CUMULATIVE EFFECTS

The significance of the cumulative impact of these projects on the visual environment during their operational phase is assessed to have a *high magnitude* and over the *long-term.* The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The implementation of mitigation measures and that receptor sensitivity to the project is low could reduce the anticipated impact, to MEDIUM.

AUTHOR'S OPINION

It is the opinion of GYLA that the visual impacts associated with the proposed Project are of a nature, scale and duration that will require mitigation to slightly reduce the impact during the operational phase. It must also be noted that the I&APs did not consider visual and aesthetic concerns as an issue. GYLA believes that the impacts associated with the construction, operation and decommissioning phases can be mitigated from HIGH

to MODERATE provided the recommended measures are effectively implemented in the short term and managed in the long term and that the site is effectively rehabilitated during decommissioning. The project is deemed acceptable from a visual perspective.

ADDENDUM TO THE REPORT

*** GYLA ***

TABLE OF CONTENT

	EXECUTIVE SUMMARY	x
	INTRODUCTION	x
	PROJECT SITE AND STUDY AREA	x
	AIM OF THE SPECIALIST STUDY	x
	TERMS AND REFERENCE	x
	ASSUMPTIONS AND LIMITATIONS	xi
	FINDINGS - VISUAL IMPACT	xi
	AUTHOR'S OPINION	xii
1.	**INTRODUCTION**	**1**
1.1	Project Overview and Background	1
1.2	Project site and Study Area	1
1.3	Aim of the Specialist Study	1
1.4	Terms and Reference	1
1.5	Assumption, Uncertainties and Limitations	2
2.	**NATIONAL ENVIROMENTAL GUIDELINES**	**6**
3.	**APPROACH AND METHODOLOGY**	**7**
3.1	Approach	7
3.2	Methodology	7
4.	**DESCRIPTION OF THE PROJECT**	**9**
4.1	Description	9
4.2	WEF Location Alternatives	10
4.3	WEF Technology Alternatives	10
4.4	Overhead Powerlines Alternatives	10
4.5	No-Go Alternative	10
5.	**POTENTIAL VISUAL ISSUES**	**11**
5.1	Context	11
5.2	Sequential visibility	12
5.3	Night Lighting	13
5.4	Shadow Flicker	13
5.5	Overhead Powerlines	14
6.	**THE ENVIRONMENTAL SETTING**	**15**
6.1	Landscape Character and nature of the Study Area	15
6.2	Sense of Place	16
7.	**VISUAL RESOURCE**	**24**
7.1	Visual Resource Value, Scenic Quality and Landscape Sensitivity	24
8.	**LANDSCAPE IMPACT**	**27**
9.	***MAGNITUDE* OF VISUAL IMPACT**	**28**
9.1	Visual Receptors	28
9.2	Sensitive Viewers and locations	28

9.3 Visibility 30
9.4 Effects of Shadow Flicker 31
9.5 Visual Intrusion and Exposure 36
9.6 Effects of Night Lighting (WEF) 42
9.7 *Magnitude* of Visual Impact 42
10. MANAGEMENT MEASURES 44
10.1 Planning and site development 44
10.2 Earthworks and vegetation 44
10.3 Structures and associated infrastructure 45
10.4 Good housekeeping 45
10.5 Lighting 45
10.6 Shadow Flicker 46
11. SIGNIFICANCE OF VISUAL IMPACT 52
11.1.1 Construction Phase 52
11.1.1.1 WEF 52
11.1.1.2 OHPL 53
11.1.2 Operational Phase 54
11.1.2.1 WEF 54
11.1.1.2 OHPL 55
11.1.3 Decommissioning Phase 56
11.1.3.1 WEF 56
11.1.3.2 OHPL 57
10 CUMULATIVE EFFECT 59
10.1 The cumulative effect of the Project 59
11 CONCLUSION 64
11.1 Significance of Visual Impact 64
11.1.1 Construction phase 64
11.1.2 Operational Phase 64
11.1.3 Decommissioning Phase 65
11.2 Cumulative Effects 65
11.3 Authors' opinion 65
12 REFERENCES 66
APPENDIX A: DETERMINING THE VISUAL RESOURCE VALUE OF A LANDSCAPE 72
APPENDIX B: METHOD FOR DETERMINING THE *MAGNITUDE / INTESITY* OF LANDSCAPE AND VISUAL IMPACT 76
APPENDIX C: CRITERIA FOR ASSESSMENT METHODOLOGY (ERM) 84
APPENDIX D: CRITERIA FOR PHOTO / COMPUTER SIMULATION 88
APPENDIX E: CURRICULUM VITAE 89
APPENDIX F: SPECIALIST DECLARATION 90

LIST OF FIGURES

Figure 1	Locality
Figure 2	Layout Plan – Location of Proposed Turbines
Figure 3	Viewpoints
Figure 4-1	Landscape Character View 1, 2 and 3
Figure 4-2	Landscape Character Views 4, 5 and 6
Figure 4-3	Landscape Character Views 7, 8 and 9
Figure 4-4	Landscape Character Views 10, 11 and 12
Figure 4-5	Landscape Character Views 13, 14 and 15
Figure 5	Landscape Character and Sensitivities
Figure 6	Receptor Sensitivities
Figure 7-1	Sequential Visibility
Figure 7-2	Viewshed Analysis
Figure 8	Shadow Flicker Analysis
Figure 9-1	Simulation View 2
Figure 9-2	Simulation View 3
Figure 9-3	Simulation View 5
Figure 9-4	Simulation View 6
Figure 9-5	Simulation View 9
Figure 10-1	Cumulative – Sequential Visibility
Figure 10-2	Cumulative – Viewshed
Figure 10-3	Cumulative – Shadon Flicker

LIST OF TABLES

Table 1	Project Technical Details
Table 2	Value of the Visual Resource
Table 3	Potential Sensitivity of Visual Receptors
Table 4	Magnitude of Visual Impact
Table 5	Mitigation – WEF
Table 6	Mitigation – OHPL
Table 7-1:	WEF Visual Impact - CONSTRUCTION PHASE
Table 7-2:	OHPL Visual Impact - CONSTRUCTION PHASE
Table 8-1:	WEF Visual Impact - OPERATIONAL PHASE
Table 8-2:	OHPL Visual Impact - OPERATIONAL PHASE
Table 9-1:	WEF Visual Impact – DECOMMISSIONING PHASE
Table 9-2:	OHPL Visual Impact - DECOMMISSIONING PHASE
Table 10	Cumulative Impact

1. INTRODUCTION

1.1 Project Overview and Background

Respective Special Purpose Vehicles (SPVs) are proposing the development of a commercial wind farm cluster that is expected to comprise two separate (up to 360 MW) Wind Energy Facilities (WEFs). Each WEF will apply for its own grid connection route to connect to the existing Eskom UItkoms Substation, via approximately 20 – 32 km long 132 kV overhead transmission line. The powerline is proposed and is assessed within a 300 m assessment corridor. Te proposed development sites are located near Ermelo and fall within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province.

1.2 Project site and Study Area

The Project site is approximately 28km east of Ermelo and 37km west of Amsterdam in Mpumalanga. The study area was determined as the site provided by the Developer, and a 30 km buffer zone around it determined by the visual specialist as the maximum area of potential impact. The visibility of the turbines would be insignificant beyond this point. Refer to **Figure 1 Locality** – Emvelo WEF Site, which identifies the study area. The 30 km buffer zone has also been established for the study, as it may be possible, that when viewed from an elevated position or when the turbines are silhouetted on a ridgeline, the structures could be visible depending on light and atmospheric conditions. The other consideration is the effect of flashing red lights on top of the turbines at night, which would be visible from great distances against what is currently a dark rural sky.

It is anticipated that the potential visual impact of the overhead power line (OHPL) should not extend beyond 5km and for this reason the visual specialist has limited the study area to 5km either side of the centre line of the proposed corridor. Refer to **Figure 1** for the OHPL route.

1.3 Aim of the Specialist Study

The study's main aim is to document the baseline and ensure that the visual/aesthetic risks of the proposed Project are understood.

1.4 Terms and Reference

A specialist study is required to establish the visual baseline and to identify and assess the visual impacts arising from the Project based on the general requirements for a comprehensive VIA. The following terms of reference was established:

- Undertake a site survey to determine the nature of the receiving environment and the extent of visual influence.
- Describe the landscape character and quality and assess the visual resource of the study area.
- Describe the visual characteristics of the components of the Project.
- Qualitatively assess the potential for shadow flicker.
- Rate the significance of the impact of the Project.
- Rate the potential cumulative effect of the Project.
- Propose mitigation measures to reduce the potential impact of the Project.

1.5 Assumption, Uncertainties and Limitations

The following assumptions limitations have been made in the study:

- The description of project components is limited to what has been supplied to the author prior to the date of completion of this report.
- The accuracy of the viewshed analysis depends on the quality of the input digital surface model (DSM). Readily available digital contours for the area are limited to 20m contours. GYLA have interpolated these down to 1m intervals to get better accuracy. However, these types of viewshed investigations (using readily available GIS software and terrain contours only) are limited in their accuracy due to their inability to incorporate vegetation information. To be more accurate at predicting absolute visibility, the analysis would require “a 3D model of a tree/plant and a layer indicating the spatial distribution and density of vegetation on the landscape” (Llobera 2007:799) and buffering all existing buildings, structures and infrastructure. The possibility of indicating both the spatial and density distribution of tree/plants, and the three-dimensional model representing vegetation and all structures, is currently not available to the author. Therefore, on-site observations are critical.
- Site photos taken in early winter (when the site visit was conducted) do not necessarily reflect the complete landscape character of the area as experienced through all seasons i.e. the density of the bush in the summer would further restrict visual access to the site. The weather was sunny with some cloud and haze conditions.

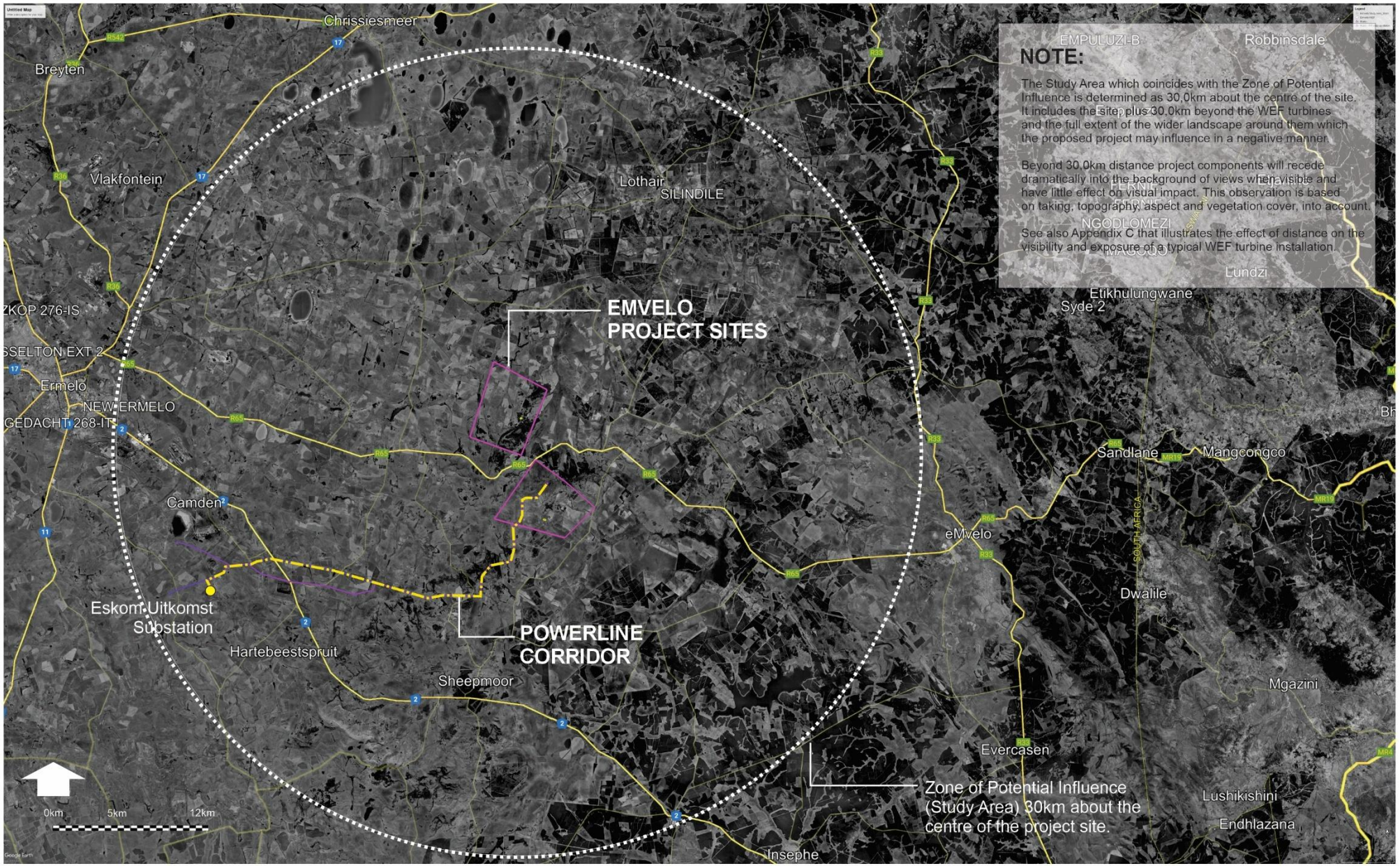


Figure 1: LOCALITY - Emvelo WEF Site

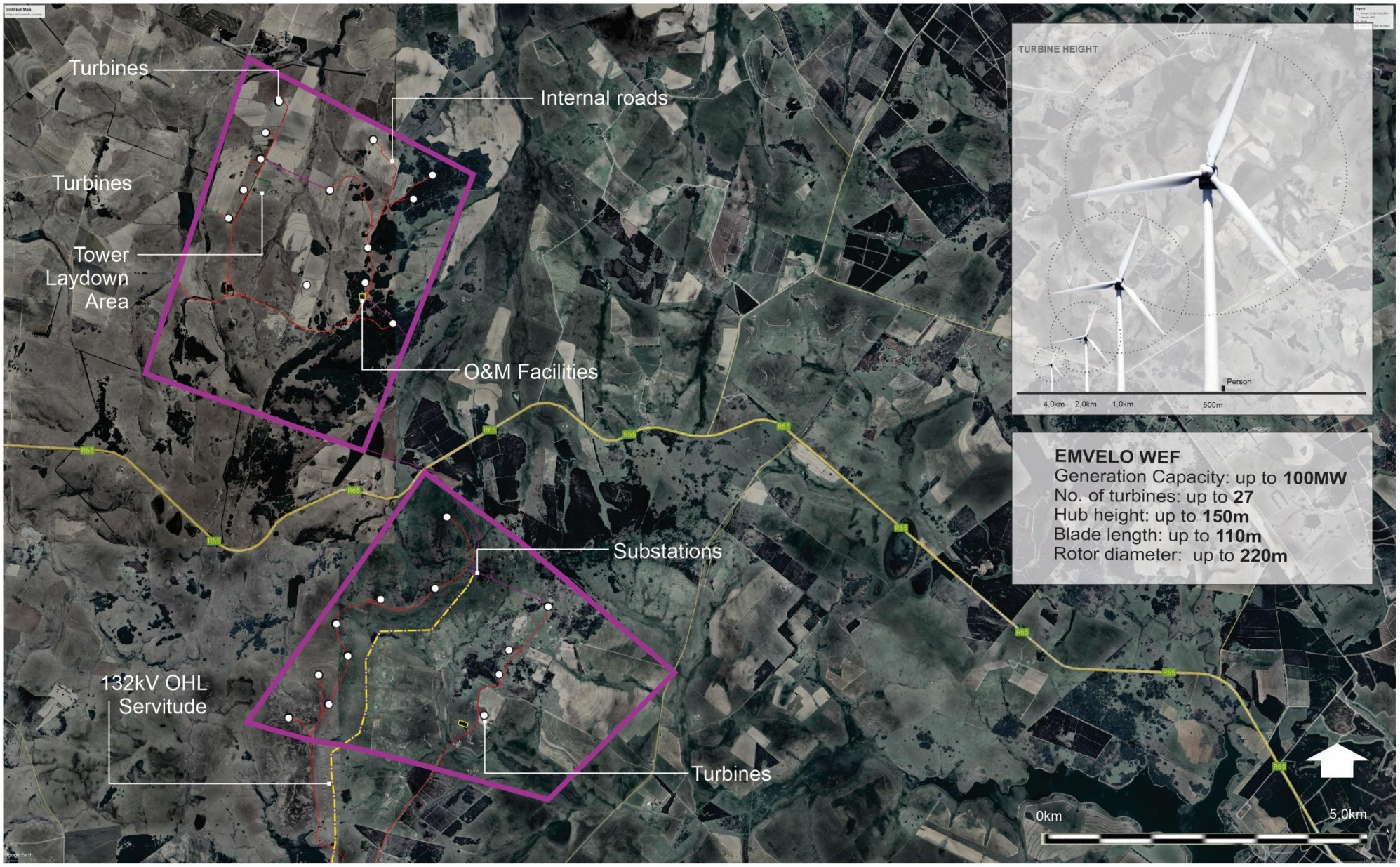


Figure 2: LAYOUT EMVELO - Wind Turbine Generator Areas

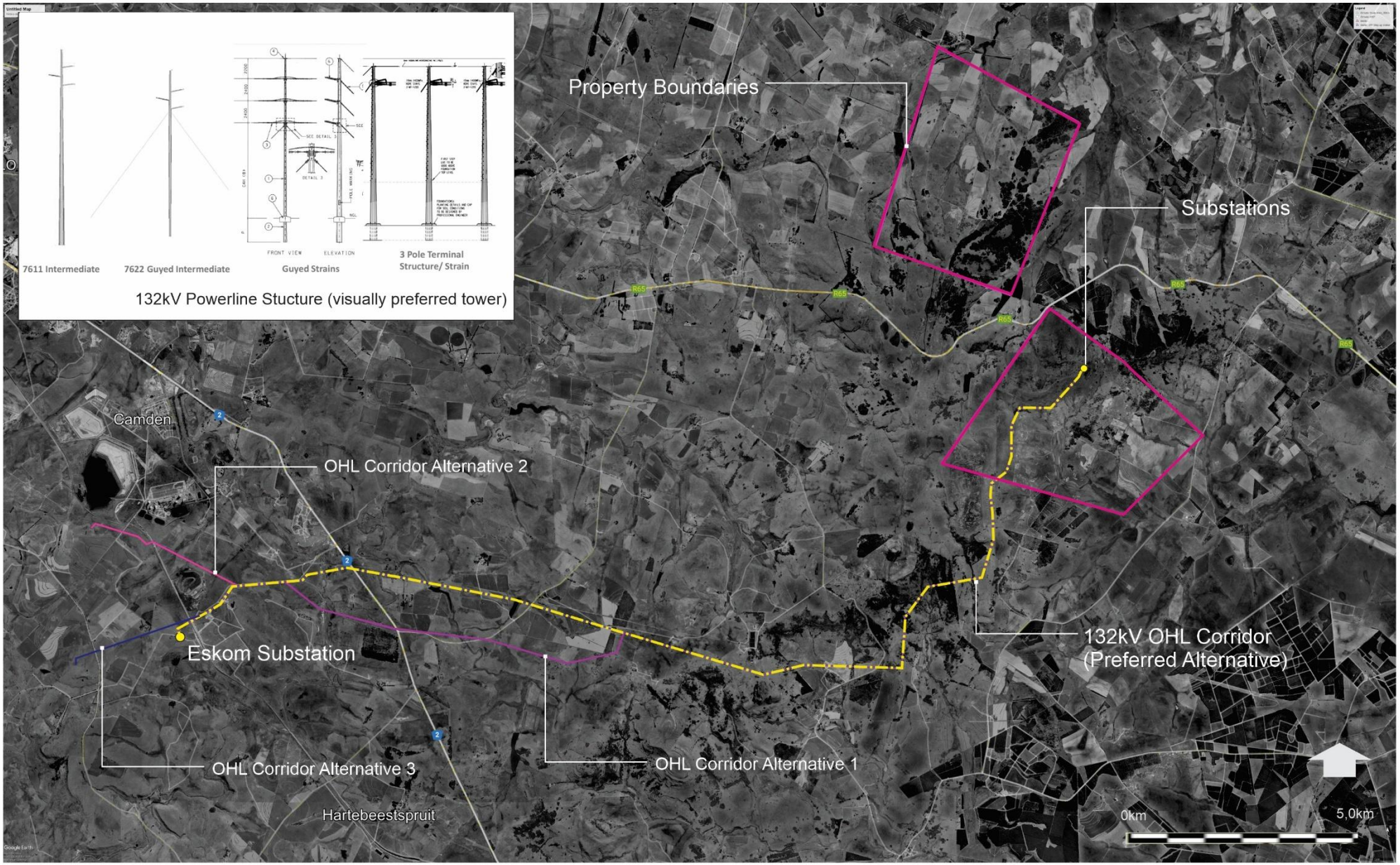


Figure 2-1: LAYOUT EMVELO - 132kV Overhead Powelines

2. NATIONAL ENVIROMENTAL GUIDELINES

There are no specific legal requirements nor is there any direct reference to the visual environment in the legislation. General legislation pertaining to the environment is contained in the National Environmental Management Act (NEMA) (Act No. 107 of 1998) as well as the National Heritage Resources Act No. 25, 1999 and the associated provincial regulations provide legislative protection for listed or proclaimed site, such as urban conservation areas, nature reserves and proclaimed scenic routes.

National Environmental Management Act (Act 107 of 1998), EIA Regulations

The specialist report is in accordance with the specification on conducting specialist studies as per Government Gazette (GN) R 982 (as amended) of the National Environmental Management Act (NEMA) Act 107 of 1998. The mitigation measures as stipulated in the specialist report can be used as part of the Environmental Management Programme Report (EMPR) and will be in support of the Environmental Impact Assessment (EIA) and Appendix 6 of the EIA Regulations 2014 (as amended).

Western Cape Department of Environmental Affairs & Development Planning: Guideline for Involving Visual and Aesthetic Specialists in EIA Processes Edition 1 (CSIR, 2005)

Although the guidelines were specifically compiled for the Province of the Western Cape, they provide guidance that is appropriate for any EIA process. The Guideline document also seeks to clarify instances when a visual specialist should get involved in the EIA process.[1]

The National Heritage Resources Act refers, under Part 1 General Principles, to the National Estate:

> 3.(2)(d) Landscapes and natural features of cultural significance

Visual pollution is controlled to a limited extent, by the Advertising on Roads and Ribbons Act (Act No. 21 of 1940) which deals with signage on public roads.

The Protected Areas Act (NEMA) (Act 57 of 2003, Section 17) is also intended to protect natural landscapes.

[1] The Western Cape Guidelines are the only official guidelines for visual impact assessment reports in South Africa and can be regarded as best practice throughout the country.

3. APPROACH AND METHODOLOGY

3.1 Approach

The assessment of likely effects on a landscape resource and visual amenity is complex since it is determined through quantitative and qualitative evaluations. When assessing visual impact, the worst-case scenario is considered. Landscape and visual assessments are separate, although linked, procedures. The landscape, its analysis, and the assessment of impacts on the landscape all contribute to the visual impact assessment studies baseline. The potential impact on the landscape is assessed as an impact on an environmental resource, i.e. the physical landscape. On the other hand, visual impacts are assessed as one of the interrelated effects on people (i.e. the viewers and the result of an introduced object into a view or scene).

For a detailed description of the methodology to determine the value of a visual resource, refer to **Appendix A**. Appendices B and C list the criteria for determining the severity and significance of visual impact. **Plate 1** below graphically illustrates the visual impact process used in this Project.

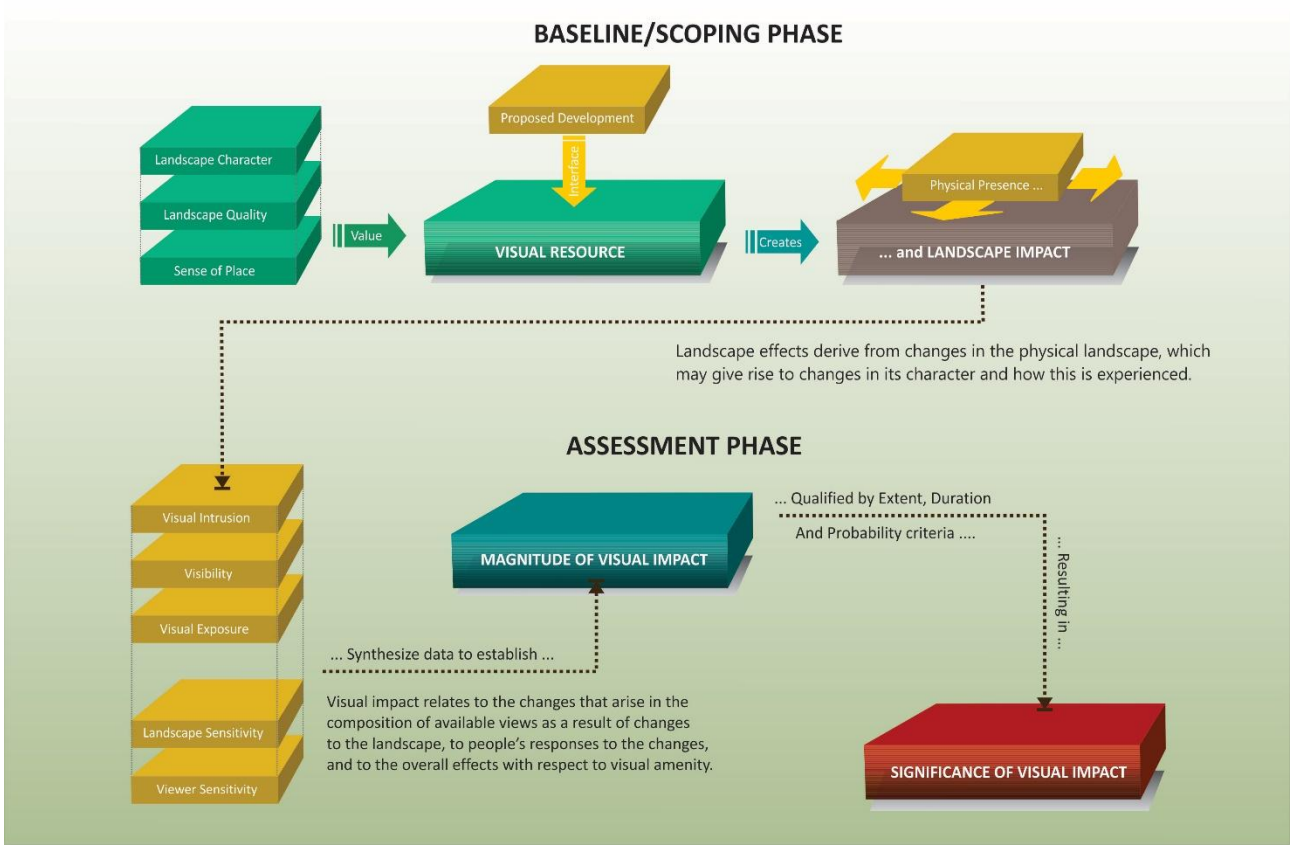


Plate 1: Visual Impact Process

3.2 Methodology

The following method was used:

- Site visit was undertaken on the 31 May and 13 June 2023.
- The method used for the study was both a desk top study using Google Earth and a site inspection. Google Earth, the Surveyor General, SANBI, the South African protected and Conservation Areas Database – DFFE, and Environment Geographic Information Systems were used to identify homesteads and structures that may be visually impacted. This information was

referenced during the site inspection, which took place on 31 May and 13 June 2023. The field study entailed travelling along public roads that surrounded and crossed the study area to determine the potential visibility from these areas. The route followed the R65 towards Amsterdam. The route turned off to the north following a route around the northern section of the Emvelo WEF section re-joining the R65 further east. The route then continued southwards past Sheepmoor where it linked up with the N2. From here the route followed the N2 back past the Camden power station to Ermelo.

- Project components: The physical characteristics of the project components were described and illustrated based on information supplied by the EAP.
- The landscape's character was described and rated in terms of its aesthetic appeal using recognised contemporary research in perceptual psychology as the basis, and its sensitivity as a landscape receptor.
- The sense of place of the study area was described as to its uniqueness and distinctiveness. The primary informant of these qualities was the spatial form and character of the natural landscape together with the cultural transformations associated with the historical/current use of the land.
- The visibility of the proposed Project was determined using on-site observations and a viewshed assessment.
- Illustrations, in basic simulations, of the proposed WEF and the proposed 132kV powerlines were overlaid onto panoramas of the landscape, as seen from nearby sensitive viewing points, to give the reviewer an idea of the scale and location of the proposed Project within its landscape context.
- Visual intrusion (contrast) of the proposed Project was determined by simulating its physical appearance from these sensitive viewing areas.
- The severity and significance of the visual impact of the proposed Project were rated based on the method described above and as detailed in **Appendices B** and **C**; and
- Measures to mitigate the negative impacts of the proposed Project were recommended.

4. DESCRIPTION OF THE PROJECT

4.1 Description

The scope of this report is the Emvelo Wind Energy Facility (WEF) and associated OHPL application. The proposed technical details are presented in the table below:

Table 1: Project Technical Details[2]

Developer / Applicant	Emvelo Wind Energy Facility (Pty) LTD
DFFE Reference	To be confirmed
WEF Generation Capacity	Up to 260 MW
Site Access	Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3m width for underground 33 kV reticulation.
Number of Turbines	24
Hub Height from ground level	Up to 150 m
Blade Length	Up to 110 m
Rotor Diameter	Up to 220 m
Length of internal roads	Unknown at this point.
Width of internal roads	Up to 12 m to be rehabilitated to up to 9 m.
On-site substation capacity	Up to 132 kV
Proximity to grid connection	Approximately 30 km
Grid Connection Capacity	Up to 132 kV
Temporary turbine construction laydown and storage areas.	Crane platforms and hardstand laydown area up to 40 ha (Up to 1 ha per turbine)
Permanent footprint area dimensions, including roads, turbine hardstand areas, O&M buildings, and battery pad.	O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha
Operations and maintenance buildings (O&M building) with parking area	Up to 1 ha
Height of fencing	2.8 m
Type of fencing	Where site offices are required, temporary screen fencing used to screen offices from the wider landscape.

It is intended that the Ermelo WEF be bid in the seventh bidding window of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the aim of evacuating the generated power from

[2] Supplied by the EAP.

the WEF into the National Eskom Grid. This will aid in the diversification and stabilisation of the country's electricity supply in line with the objectives of the Integrated Resource Plan (IRP).

Emvelo WEF is proposed to comprise up to 25 turbines with a maximum output capacity of up to 260 MW. The WEF will have an anticipated lifespan of 20 – 25 years. The final design which will be requested for approval in the EA, was determined based on the outcome of the specialist studies undertaken for the Scoping phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation.

It is proposed that an on-site substation with a capacity up to 132 kV and an up to 132 kV OHPL of approximately 30 km (300 m corridor), traversing several land parcels, be constructed to connect the proposed WEF to the Eskom Uitkoms Substation.

The expected operational life of a WEF is estimated up to 25 years. The construction and the commissioning of a WEF are expected to last 18 to 24 months. Refer to **Figure 2** for the layout and typical examples of wind turbines.

4.2 WEF Location Alternatives

No other location (development areas) alternatives are being considered. Renewable Energy (RE) development in South Africa (SA) is highly desirable from a social, environmental and development point of view and a wind energy installation is more suitable for the site due to the high wind resource. However, the number of turbines was reduced from 45 to 25 based on comment received during the scoping phase of the study.

Reason for the location chosen: This site is preferred due to the suitable climate, conditions, and topography. Based on the above site- specific attributes, the study area is considered highly preferred in terms of the development of a wind energy facility. As such, no property/ location alternatives have been considered.

4.3 WEF Technology Alternatives

No other technological alternatives are being considered.

4.4 Overhead Powerlines Alternatives

Four OHPL alternatives were considered in the Scoping Phase. The preferred option is one overhead 132kV OHPL route, within a 300m servitude, is being proposed. The route connects the Emvelo substation to the Sheepmoor substation and then to the Eskom Uitkoms Substation at Camden. Refer to **Figures 1** and **3**.

4.5 No-Go Alternative

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

.

5. POTENTIAL VISUAL ISSUES

WEF projects typically consist of large-scale infrastructure that can cause change to the fabric and character of an area and possible visual intrusion in sensitive landscapes due to their physical presence.

Typical issues associated with WEF projects are:

- Who will be able to see the new development?
- What will it look like, and will it contrast with the receiving environment?
- Will the development affect sensitive views in the area, and if so, how?
- What will be the impact of the development during the day and at night?
- What will the cumulative impact be, if any?
- What Shadow Flicker nuisance could be to nearby residents.

During the public participation process the public and government agencies raised concerns mostly relating to the ecology and biodiversity. Visual issues were not the focus of concern[3]. However, the public usually indicate a sensitivity to visual and aesthetic concerns. It is assumed, based on the generic sensitivity criteria listed in **Appendix B** that receptor sensitivity could potentially be high. However, during the I&AP process no visual or aesthetic concerns were raised.

5.1 Context

The WEF study area is located on the Highveld which is prone to cold winter temperature inversions. As it is a summer rainfall area and a grassland, winter fires are common as is thick mist. In addition, airborne pollution is supplemented by industrial discharges from mines and power stations in the area. These atmospheric conditions can significantly influence the visual impact, as they affect visibility, contrast, and the overall perception of the structures. Atmospheric conditions like mist, rain, and smoke can make turbines appear farther away, reducing their perceived size and impact. In clear conditions, wind farms can be accentuated by bright lighting, whereas overcast or polluted conditions can diminish their brightness and contrast. Public perception of wind farms might change based on weather conditions. On clear days, people might notice turbines more sharply, while on foggy or rainy days, they might overlook them. Overall, atmospheric conditions can either reduce or accentuate the visual presence of wind farms, making them appear less obtrusive in some situations or drawing more attention in others.

Mist

- **Visibility**: Mist reduces visibility by scattering light and creating a hazy atmosphere, making distant objects like wind turbines appear blurry or even invisible.
- **Perception**: When partially obscured, wind turbines may seem less intrusive or more ethereal. However, during intermittent mist, the sudden appearance and disappearance of the turbines can draw more attention.
- **Impact on scale**: Mist can also distort the perception of scale, making the wind farm appear smaller or more integrated into the landscape.

[3] Mpumalanga Tourism and Parks Agency, Office of Biodiversity Conservation, Letter to ERM dated 18 September 2024 and Mpumalanga Agriculture, Rural Development, Land and Environmental Affairs, Letter to ERM dated 19 September 2024.

- **Cloud Cover**
- **Contrast**: Low cloud cover can reduce the contrast between the turbines and the sky, particularly if the clouds are grey or heavy. This can make the turbines blend in more with the background.
- **Skyline interruption**: On days with scattered clouds, the turbines may stand out more prominently against patches of blue sky, making them more visually noticeable.
- **Shadows**: With thick cloud cover, shadows from turbines on the ground are minimized, reducing their visual footprint.

Rain

- **Clarity**: Rain can significantly reduce visibility, much like mist, by blurring the landscape. This can diminish the visual dominance of wind turbines.
- **Reflections and glare**: Wet surfaces, both on the ground and on the turbines, may reflect light, particularly if the sun breaks through. However, heavy rain usually dulls the overall appearance of the landscape.
- **Movement perception**: Rain can also affect the perception of movement, making the rotating blades harder to distinguish, thus lessening their visual prominence.

Smoke

- **Visual clutter**: Smoke from wildfires, agricultural burning, or industrial activities can dramatically alter visibility. A hazy or smoke-filled atmosphere diffuses light and reduces clarity, often making turbines fade into the background or appear ghostly.
- **Coloration**: Depending on the source of the smoke, the colour of the air may change, causing the turbines to appear more muted or, conversely, stand out against an unusual sky (e.g., reddish, or orange tones).
- **Horizon line**: Smoke can obscure the horizon, which might make it harder to gauge the height and scale of the wind turbines.

Industrial Air Pollution

- **Haze and smog**: Pollution from industrial activities can create a persistent haze or smog that lowers air quality and visibility. In urban areas, this haze might reduce the contrast between the turbines and the skyline, making them harder to distinguish from their surroundings.
- **Colour distortion**: Airborne pollutants often alter the natural colours of the sky, particularly during sunrise or sunset, when wind turbines might stand out due to altered light. This can exaggerate or reduce the contrast between the turbines and the environment.
- **Public perception**: The presence of pollution may shift public focus onto the wind farm as a symbol of renewable energy and contrast with the industrial pollution, which could heighten their perceived importance or value.

5.2 Sequential Visibility

Sequential visibility, in the context of wind farms, refers to the phenomenon where multiple turbines or clusters of turbines come into view one after another as the observer moves through the landscape, such as driving along a road. In this case it would be the R65, N2 and local farm access roads in the vicinity of the WEF sites.

5.3 Night Lighting

The negative effect of night lighting caused by the Project would be seen against a dark night sky that has, however been impacted by lights from urban areas such as Ermelo and Sheepmoor. Security lighting could, however, be detrimental to people living in the immediately vicinity. It is a requirement by Civil Aviation that a red hazard flashing navigation light be installed on top of each turbine. These lights can be seen over extended distances of at least 40km and when viewed against a dark sky they become very visible.

5.4 Shadow Flicker

Farmsteads and other housing near the wind turbines could experience the effect of shadow flicker. A wind turbine's moving blades can cast a moving shadow on locations within a certain distance of a turbine. These moving shadows are called shadow flicker and can be a temporary phenomenon experienced by people at nearby residences or public gathering places. The impact area depends on the time of year and day (which determines the sun's azimuth and altitude angles) and the wind turbine's physical characteristics (height, rotor diameter, blade width, and orientation of the rotor blades). Shadow flicker occurs during low angle sunlight conditions, typically during sunrise and sunset times of the day. However, when the sun angle gets very low (less than 3 degrees), the light must pass through more atmosphere and becomes too diffused to form a coherent shadow. Shadow flicker will not occur when the sun is obscured by clouds or fog, at night, or when the source turbine(s) are not operating (Green Rhino Energy[4]). Not only can shadow flicker be a nuisance to nearby residents but, it has been suggested, could aggravate medical problems such as migraine and epilepsy.

Shadow flicker magnitude is defined as the difference in brightness at a given location in the presence and absence of a shadow. Shadow flicker magnitude diminishes with greater receptor-to-turbine separation distance. Shadow flicker magnitude for receptor-to-turbine distances beyond 1,500 meters is very low and considered imperceptible. Shadow flicker magnitude for receptor-to-turbine distances between 1,000 and 1,500 meters is also low and considered barely noticeable. At this distance shadow flicker magnitude would only tend to be noticed under conditions that would enhance the magnitude difference, such as observing from a dark room with a single window directly facing the turbine casting the shadow during sunny conditions. At distances less than 1,000 meters, shadow flicker may be more noticeable. In general, the largest number of shadow flicker hours, along with greatest shadow flicker magnitude, occurs nearest the wind turbines (Green Rhino Energy[5]).

A shadow flicker analysis calculates for each point of interest, in this case for each turbine:

- Number of hours per year that the flickering occurs,
- Maximum length (in minutes) that flickering occurs on the worst day in the year, and
- Number of days in the year that shadow flickering appears at all.

All the above are calculated for both the worst case.

Following German regulation, shadow flickering cannot be perceived by the human eye if the angle of the sun over the horizon is less than 3°. Plus, the blades of the turbines must cover at least 20% of the sun.

[4] https://www.greenrhinoenergy.com/renewable/wind/wind_flicker.php
[5] https://www.greenrhinoenergy.com/renewable/wind/wind_flicker.php

While guidelines differ, the ones in Germany are most widely adopted. Accordingly, the maximum impact allowed by shadow flickering is:

- 30 hours per annum of flickering in the worst case
- 30 minutes maximum on the worst day in the year

5.5 Overhead Powerlines

The 132kV OHP pylons are approximately 28m tall and are readily visible within a grassland open and rolling landscape, which is typical of most of the study area. Various potential visual impact issues have been identified. The following general risks are associated with the visual intrusion in the landscape:

- Excessive clearing for preparing the area for the pylon structures as well as for the construction of temporary access roads.
- The random and disorganised lay down of building materials and vehicles,
- Dust from construction activities.
- High seed bank of alien species in the topsoil can lead to the uncontrolled spread of exotic invader plant species. This could create a vegetated linear area that is visually contrary to the surrounding landscape.
- Areas and /or specific sites of aesthetic value may be disfigured by the introduction of a power line within the viewshed resulting in a permanent change to the existing visual quality of visually sensitive areas.
- The compromising of views from or the alteration of the ambience of natural areas.
- Need to keep certain areas such as road reserves and servitudes clear of vegetation which will result in visual scarring.

6. THE ENVIRONMENTAL SETTING

6.1 Landscape Character and nature of the Study Area

The study area consists of a landscape that varies from flat with wide open grasslands and agricultural lands, to rolling with low ridges, valleys, ridges, escarpments, and flat-topped hills. Refer to Figure panoramas in **Figures 4-1** to **4-4** and the distribution of landscape character types in **Figure 5**. **Figure 3** gives the location of the panoramas. In the east the landscape drops down to the edge of the Mpumalanga escarpment with steeper valleys and ridges. The study area comprises gently undulating land originally covered with Eastern Highland Grassveld with Wakkerstroom Montane Grassland on the eastern edge (Mucina and Rutherford 2006:460) (refer to **Figure 4-1** to **4-4**). Most of the area is not often ploughed due to the clay soils. However, the very nature of the original vegetation in this area is low growing and visually uniform which does not provide much visual screening. Although the grassland vegetation is not overly sensitive to the development it does not assist in reducing the visual expose of the turbines. The vegetation is typical of the Highveld ambience, and it is this together with the topography which provides the Highveld sense of place.

The area in the northern sector of the study area exhibits a high aesthetic appeal imparted by the rolling topography, farmsteads, streams and rivers, dams and lakes, and farmlands.

The area further to the east forms the edge of the upper reaches of the escarpment and is well forested with timber plantations which may assist in screening the visibility of the turbines (i.e., visual absorption capacity (VAC) is high for the eastern sections of the study area.

The landscape in the west and south western parts of the study area are visually intruded by existing power lines, views of the Camden Power Station and settlements such as Sheepmoor, which do not have the aesthetic appeal of the north (refer to **Figure 5**). Although the hills to the far south of the N2 exert a powerful sense of place.

The study area is well populated (refer to **Figure 6** which illustrates potential receptor locations)[6], especially in the central/south which was borne out by the site visit.

The study area's visual quality (resource) can be categorised into five landscape character zones as illustrated in **Figure 5**. The area north of the R65 exhibits a high visual quality due to the rural agricultural ambience. The area to the east is more diverse with a mixture of grasslands, hills and valleys and timber production. The area to the south of the R65 to the N2 is a mix of farming, grazing settlements roads, power lines and game farms. In the far south and southwest are grassland covered rolling hills that reach elevations of over 1700m above sea level. The area north of the R65 exhibits a high visual quality due to the rural agricultural ambience and presence of water bodies (dams, vleis, pans and rivers) and the Chrissiesmeer Protected Environment (refer to Figure 6).

[6] It is noted that the potential receptor locations have been identified by building locations on the Surveyor General data base. Not all these building would necessary be of a residential (sensitive viewing location) nature. .

Implication for the Project

> The project will alter the visual ambience of the area and will have a potentially substantial negative effect on the visual quality of the landscape. The industrial nature of the turbines will contrast with the rural agricultural ambience. The turbine structures will visually stand out and contrast with the low and uniformly textured vegetation of the grassland landscape and agricultural lands. These landscape character types combine to present a low VAC (Visual Absorption Capacity) which does not assist in screening the proposed development, nor does it assist in blending it with the landscape.

The area to the east of the project site is more diverse with a mixture of grasslands, hills and valleys and timber production (refer to **Figure 5**).

Implication for the Project

> This area is visually more diverse and presents a medium VAC which allows for some visual screening and blending with the visual environment. However, the magnitude and scale of the turbines will always be dominant in the visual environment.

The area to the west and south of the N2 is a mix of farming, grazing settlements roads, power lines and game farms.

Implication for the Project

> This area exhibits a mixed landscape which is a combination of both agricultural and industrial images. As with the previous zone, the diversity allows for some visual screening and blending with the visual environment. However, the magnitude and scale of the turbines will tend to be visually dominant.

In the far south and south-west are grassland covered rolling hills that reach elevations of over 1700m above sea level.

Implication for the Project

> The low and uniformly textured vegetation of the grassland landscape type and the agricultural lands visually contrast with the turbine structures making them visible in the landscape. These features combine to present a low Visual Absorption Capacity (VAC) which does not assist in screening the proposed development, nor does it assist in blending it with the landscape. The industrial nature of the turbines will contrast with the rural agricultural ambience.

The visual resource value of these landscape types is summarized in **Table 2 Section 7**, along with the relative landscape receptor sensitivities.

6.2 Sense of Place

According to Lynch (1992), a sense of place is the extent to which a person can recognise or recall a place as being distinct from other places - as having a vivid, unique, or at least particular, character of its own. The sense of place for the study area derives from the local landscape types described above and their impact on the senses.

The landscape character types in the study area (**Figure 5**) are common within this region. The sense of place for the area is overwhelmingly rural agricultural in nature as illustrated in **Figures 4-1** to **4-5**. The original vegetation type for this area was mainly undisturbed grasslands which have now been modified to that of grazing and in patches to that of ploughed lands for maize crop production. The rural nature of the study area continues further to the east where that grassland ambience is replaced with that of extensive timber plantations. Refer to **Figure 4-3**. The area to the west and south of the study area has a mixed industrial/agricultural nature created by the presence of transmission powerlines, the Camden power station, the N2, settlements such as Sheepmoor (**Figure 4-4**) and the eastern edges of Ermelo.

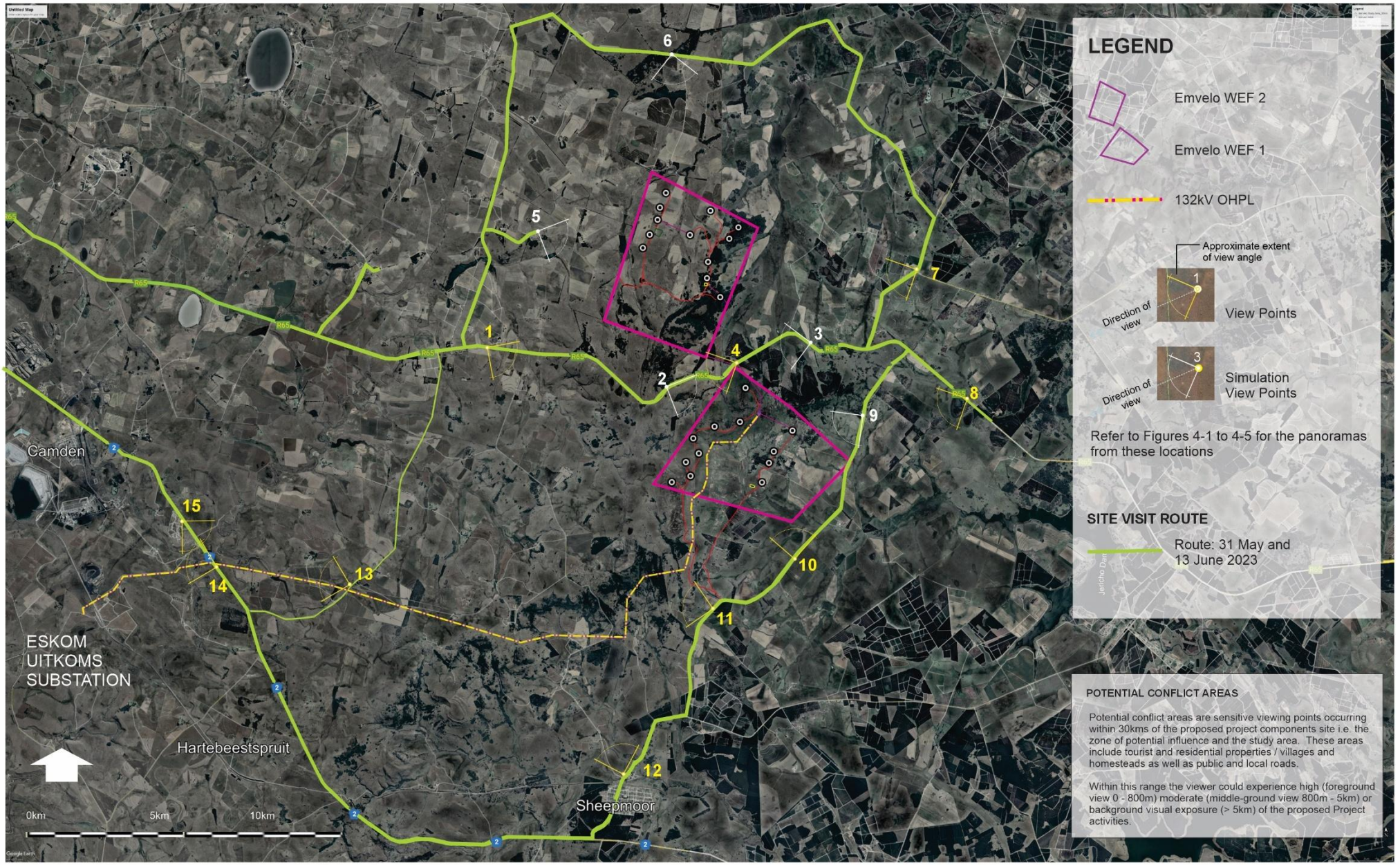


Figure 3: PANORAMA VIEW POINT LOCATIONS - Emvelo WEF Site



View 1: looking east from the R65 towards the project site beyond the crest of the ridge line



View 2: looking east to the project site along the middle distant ridgelines



View 3: looking south west from the R65 regional road towards the site evident along the horizon line

Figure 04-1: LANDSCAPE CHARACTER - Views 1, 2 and 3

Refer to Figure 3 for location of viewing points



View 4: looking south west from the R65 towards the project site in the valley and along the hozison line along the left side of the image



View 5: looking south east to the project site beyond the horizon line



View 6: looking south from a local district road towards the project site along the distant horizon line

Figure 04-2: LANDSCAPE CHARACTER - Views 4, 5 and 6

Refer to Figure 3 for location of viewing points



View 7: looking south west from a local district road north of the R65 to the project site beyond the high horizon line.



View 8: looking west from the R65 towards the site located along the horizon line to the left of the immediate high ridge line



View 9: looking south west from a local district road towards the site along the distant horizon line and down onto the lower plains

Figure 04-3: LANDSCAPE CHARACTER - Views 7, 8 and 9

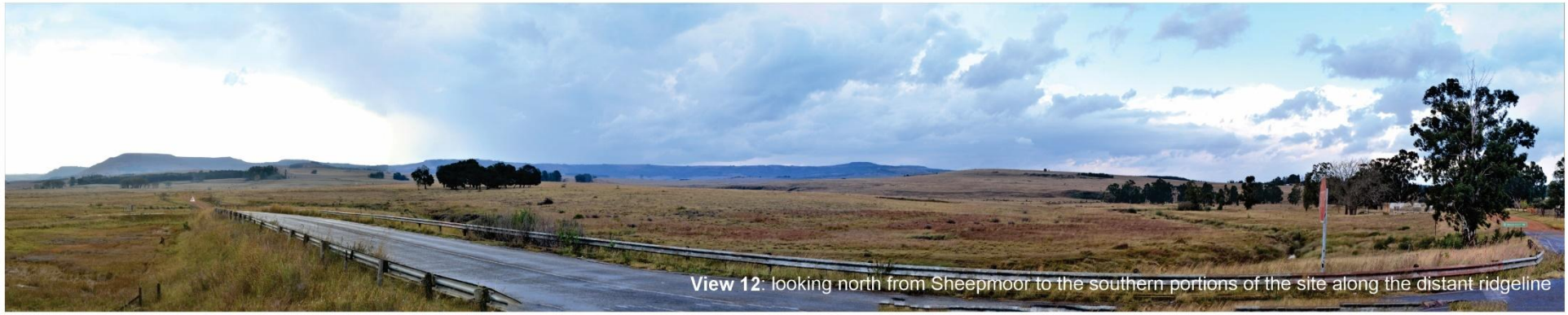
Refer to Figure 3 for location of viewing points



View 10: looking north from a local district road towards the eastern sections of the project site along the ridge line left to the left and down into the plains



View 11: looking south west from a local district road to the western sections of the project site



View 12: looking north from Sheepmoor to the southern portions of the site along the distant ridgeline

Figure 04-4: LANDSCAPE CHARACTER - Views 10, 11 and 12

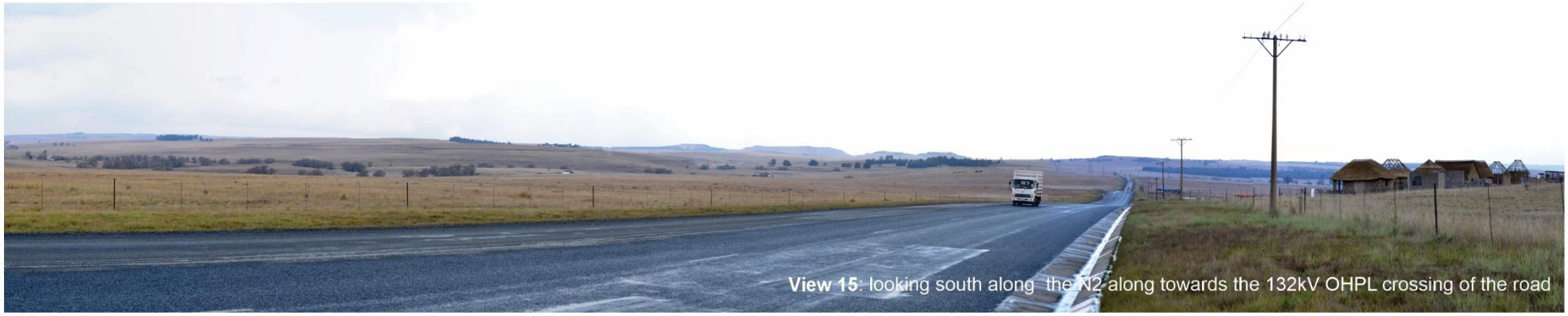
Refer to Figure 3 for location of viewing points



View 13: looking west from a local district road along the proposed 132kV OHPL powerline servitude adjacent to existing powerlines, towards the Camden Power Station



View 14: looking north along the N2 towards existing powerlines and the proposed the 132kV OHPL powerline crossing of the N2



View 15: looking south along the N2 along towards the 132kV OHPL crossing of the road

Figure 04-5: LANDSCAPE CHARACTER - Views 13, 14 and 15

Refer to Figure 3 for location of viewing points

7. VISUAL RESOURCE

7.1 Visual Resource Value, Scenic Quality and Landscape Sensitivity

The value of the study area's visual resource and its associated scenic quality (using the scenic quality rating criteria described in Appendix A) are derived from the landscape types described above. The sensitivity of the study area's landscape (as a scenic resource) can be defined as *moderate* to *low* (as indicated in Table 1 below), within the context of the sub-region. These ratings are dependent on the landscape character:

- Does it contribute to the area's sense of place and distinctiveness?
- Quality? – in what condition is the existing landscape?
- Value – is the landscape valued by people, local community, visitors, and is the landscape recognised, locally, regionally, or nationally? and
- Capacity – what scope is there for positive change in the existing landscape character?

When the criteria listed in **Appendix A** are considered and understood within the context of the sub-region. A visual resource value of moderate to high is assigned to the grasslands associated with grazing and maize production. The transformed natural grasslands associated with timber production in the east of the site have a moderate resource value. The landscape character type with the highest visual quality and consequently the most sensitive to development is the dams, vleis, pans and streams associated with the Chrissiesmeer Protected Area. The landscape character type with the lowest value is the power infrastructure and mines.

A summary of these values is provided in **Table 2**, which categorises the various local landscape character types and sensitivity to development, within the context of the sub-region.

Table 2: Value of the Visual Resource
(After: LiEMA 2013)

High Dams, vleis, pans and rivers (Chrissiesmeer Protected Area) and grassland on natural hills and ridgelines	**Moderate** Partially degraded and natural grassland associated with grazing, maize production, and timber production	**Low** Power generation and distribution infrastructure
This landscape type is considered to have a *high* value because it is a: Distinct landscape that exhibits a positive character with valued features that combine to give the experience of unity, richness, and harmony. It is a landscape that may be of particular importance to conserve, and which has an intense sense of place.	This landscape type is considered to have a *moderate* value because it is a: Common landscape that exhibits some positive character, but which has evidence of alteration / degradation/ erosion of features resulting in areas of more mixed character.	This landscape type is considered to have a *low* value because it is a: Minimal landscape generally negative in character with few, if any, valued features.

Sensitivity: It is sensitive to change in general and will be detrimentally affected if change is inappropriately dealt with. The Project site is partially located in this landscape type	Sensitivity: It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with. **The Project site is located primarily across these landscape types**	Sensitivity: It is not sensitive to change in general and change.

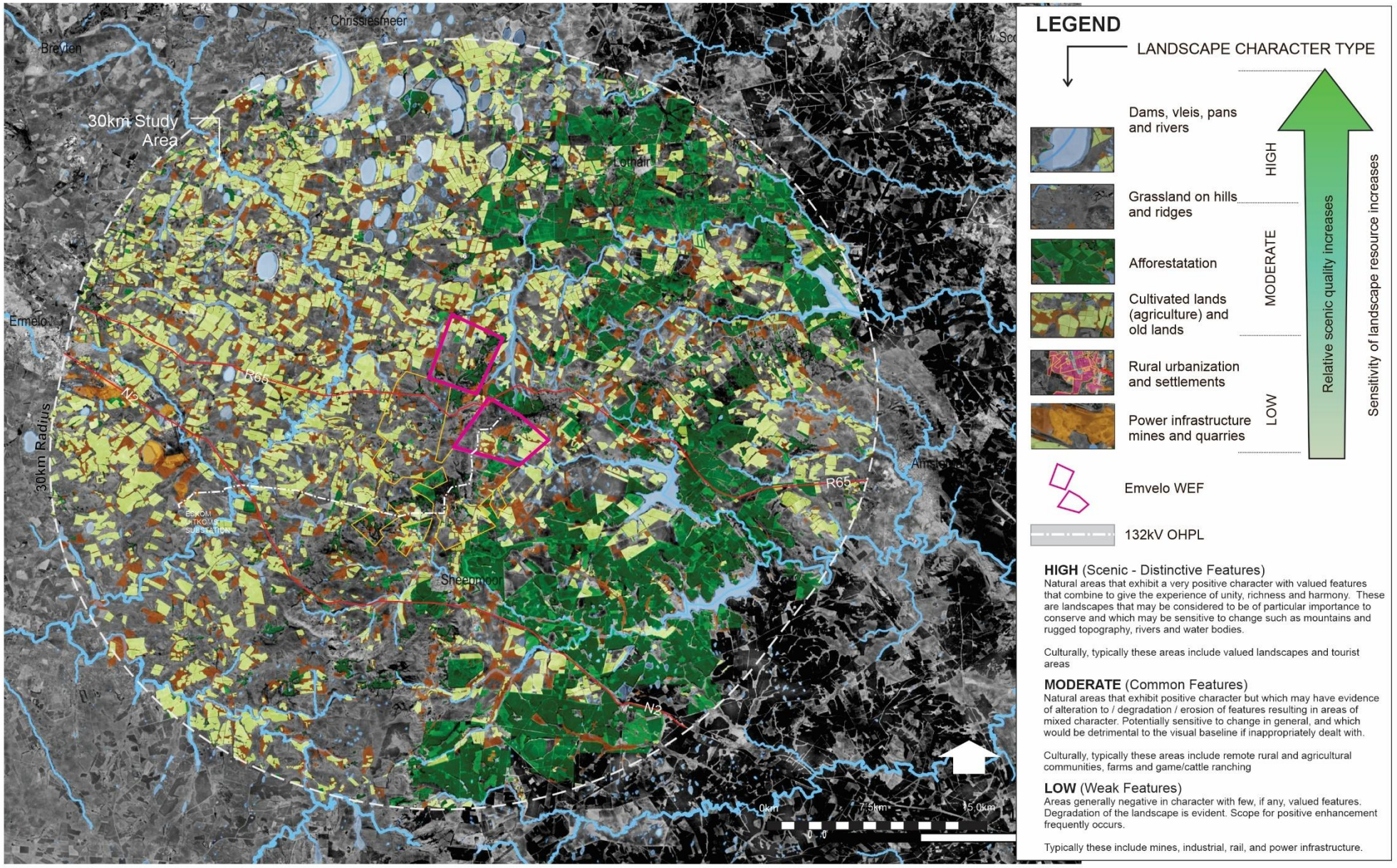


Figure 05: LANDSCAPE CHARACTER and SENSITIVITIES - Emvelo WEF

8. LANDSCAPE IMPACT

The development of the proposed WEF and powerline will occupy 180ha (development footprint) as illustrated in Figure 5.

The preparation/construction activities (earthworks and infrastructure development) will contrast with the existing agricultural and grass lands as soil is exposed to create service roads, trenches, erecting structures for the turbines, distribution lines and sub-stations etc. Once the turbines have been installed, they will also contrast, significantly, with the immediate landscape as illustrated in the simulations in **Figures 8-1** to **8-4**. The *landscape impact* (i.e. the change to the fabric and character of the landscape caused by the physical presence of the Project) is considered ***moderate*** particularly during the construction and operational phases**.** The combined effects of the changes described above, have a medium negative affect the overall character of the landscape, give the context of the sub-region.

9. *MAGNITUDE* OF VISUAL IMPACT

Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape (as described in **Section 8**), to people's responses to the changes, and to the overall effects with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the area.

To assess the potential magnitude of visual impact of the Project four main factors are considered.

Sensitivity:	Sensitivity of visual receptors to the proposed development
Visual Intrusion:	The nature of intrusion or contrast (physical characteristics) of a Project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use.
Visibility:	The area/points from which Project components will be visible.
Visual exposure:	Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion.

9.1 Visual Receptors

Visual receptors include people living in, visiting, or travelling through or adjacent to the study area and other local public roads (specifically the R65 road that connects Ermelo with Amsterdam to the east and the N2 which connects Ermelo with Piet Retief to the south-east).

The towns of Ermelo and Amsterdam and smaller settlements such as Sheepmoor and Lothar are within the study area. As the area is predominantly a farming community there are several farmsteads that fall within the study area. Activities and businesses that rely of the visual environment such as lodges, bed and breakfast establishments were not specifically observed in the study area although a game farm was noted on the eastern edge of the site.

9.2 Sensitive Viewers and locations

Although not all homesteads may be occupied fulltime, many of these will be in direct line of sight and within the 0-1km zone for the OHPL and a 0-5km zone for the turbines, where the magnitude of impact could be high. Other potential sensitive receptors include local towns and villages such as Ermelo, Sheepmoor, Lothair, Amsterdam and Camden, travellers on the main roads such as the N2, N11, R65 and secondary public roads, activities and institutions that rely on the aesthetic environment such as game farms, nature reserves, lodges, and B&B's

These receptors and viewing areas are listed in **Table 3** below and their locations illustrated in **Figure 6**.

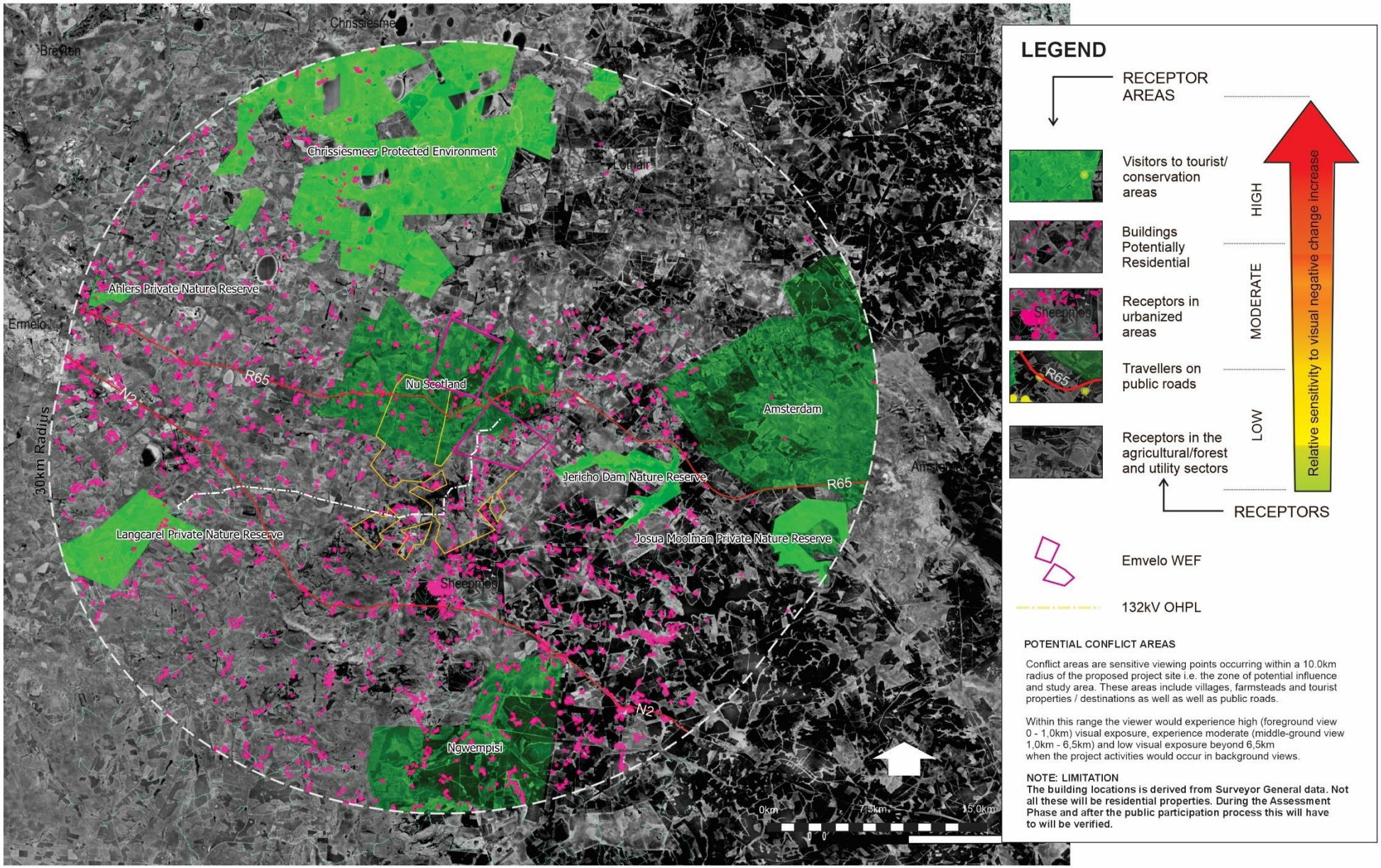


Figure 06: RECEPTOR SENSITIVITIES - Emvelo WEF

Graham A Young
Landscape Architect
082 462 1491

Table 3: Visual Receptor Sensitivities

High	Moderate	Low
Receptors at residential units across the study area. Primarily east and south of the project site and in the site as well as nature reserves, lodges, and B&B's	Locals travelling along the R65 and N2, and on the local connector roads that bisect the site	People working or travelling to work in the study area and related to the power production and transmission
Typical receptors -Visitors of tourist attractions and travelling along local routes, whose intention or interest may be focused on the landscape. -Communities where the development results in changes in the landscape setting or valued views enjoyed by the community. -Occupiers of residential properties with views affected by the development.	**Typical receptors** -People travelling through or past the affected landscape in cars or other transport routes.	**Typical receptors** Visitors and people working within the study area and travelling along local roads whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

9.3 Visibility

Visibility is described in terms of the areas that theoretically have direct line of sight in relation to distance the viewer is away from the object.

The visibility is dependent on the topography. The existing topography is gently rolling which does not assist significantly in limiting the views. Visibility of the structures, due to the tall and imposing scale of the turbines, would potentially be continuous and uninterrupted. Under optimal viewing conditions, up to 30km and beyond. It is considered that beyond 30 km views of the development, though still visible, are considered insignificant in the landscape due to the exponential diminishing effect of distance. Refer to **Figure 7-1** which illustrates sequential visibility (the number of turbines viewed from any given location) and **Figure 7-2**, which illustrates the viewshed for the project along with exposure, relative to distance from a turbine.

In a study sponsored by the United States Department of the Interior Bureau of Land Management, 377 observations of five wind facilities in Wyoming and Colorado were made under various lighting and weather conditions. The facilities were found to be visible to the unaided eye at >58 km under optimal viewing conditions, with turbine blade movement often visible at 39 km. Under favourable viewing conditions, the wind facilities were judged to be major foci of visual attention at up to 19 km (12 mi) and likely to be noticed by casual observers at >37 km. A conservative interpretation suggests that for such facilities, an appropriate radius for visual impact analyses would be 48 km that the facilities would be unlikely to be missed by casual observers at up to 32 km, and that the facilities could be major sources of visual contrast at up to 16 km (Sullivan, *et. al*, 2011).

Activities associated with the Project will be visible to varying degrees and distances from the sensitive viewing areas described above and as indicated in **Figure 6**. During the construction phase, the Project's visibility will be influenced due to the preparatory activities, primarily earthworks and building works. During the operational phase, the visibility of the Project will be caused by the established wind turbines and associated infrastructure as well as the proposed new 132kV powerline (Preferred Alternative), which connect the Project site substation to the Uitkoms substation near the Camden power-station to the west of the site.

All Project components (WEF and OHPL) are planned within a landscape which has a low visual absorption capacity (grassland and along the ridgelines).

Although, due to the nature of land (topography, grassland vegetation, agriculture, timber, and settlements) immediately adjacent and in the general vicinity of the site, the landscape, although reasonably flat to undulating, provides a low visual absorption capacity (VAC). This is due to the substantial height of the turbines (maximum 250m to tip of rotor blade), the nature of the vegetation cover. The landscape is therefore not readily able to 'absorb' the visual change.

The visibility of the site, theoretically, extends (without taking the effect of vegetation screening into account) in a general northwest – southeast direction. Views to the south are intermittent with sections of the n2 exposed. The Sheepmoor community is exposed to the turbines due to the higher elevation of the turbines. The most intense views are those from the R65 where it runs east – west between the northern and southern portions. The site is most exposed along the N2 that runs east -west south of the site, where the OHPL cross the national road.

9.4 Effects of Shadow Flicker

The shadow flicker exercise was done for each of the turbine towers. The area of flicker influence was determined by the areas receiving 30 or more hours of flickering (See **Figure 8** Shadow Flicker Analysis). The area bounded by the yellow (30-99 hours per annum) is the extent of shadow flicker impact. The areas in red reflect those areas that will receive at least 100 hours per annum while the green areas will receive 10-29 hours per annum. The areas unshaded will receive less than 10 hours per annum. Furthermore, zone of influence does not extend more than 2 km beyond any of the towers.

The greatest impact is within the 2 km zone. There is little that topography and vegetation can help to mitigate this impact. This will have a high impact on the critical visual receptors such as the farmsteads and occupied buildings. There are farmsteads that will be directly impacted as well as some of the main roads that service the area such as the one that transects the study area which connects Ermelo with eMvelo (Amsterdam) via the R65 (refer to **Figure 8** for the potentially affected farm/homesteads). These roads are within the zone of flicker influence. There are relatively few visual receptors, such as those that rely on the visual quality of the visual environment, such as game farms, national parks, lodges, and guesthouses, within the 2km zone of influence that will be affected.

The analysis of potential shadow flicker impacts from the development on the visual receptors indicates that the impacts are expected to be minor. It is not expected that the zone of influence will extend further that 2 km

from any of the turbines. The impacts beyond 1 km will be very low intensity. Also, shadow flicker is not expected to be a significant environmental impact for any extended period.

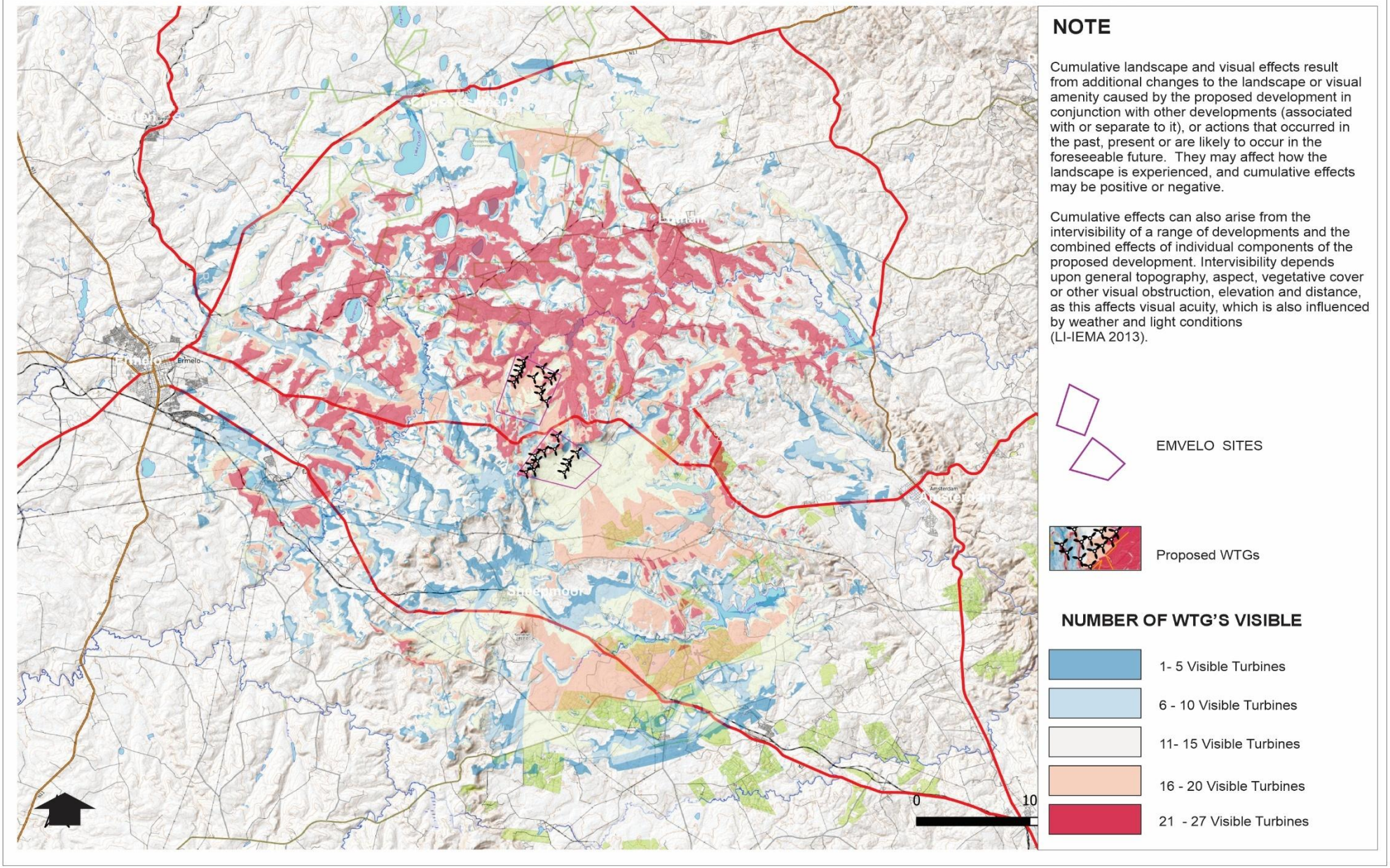


Figure 7-1: SEQUENTIAL VISIBILITY- Emvelo WEF

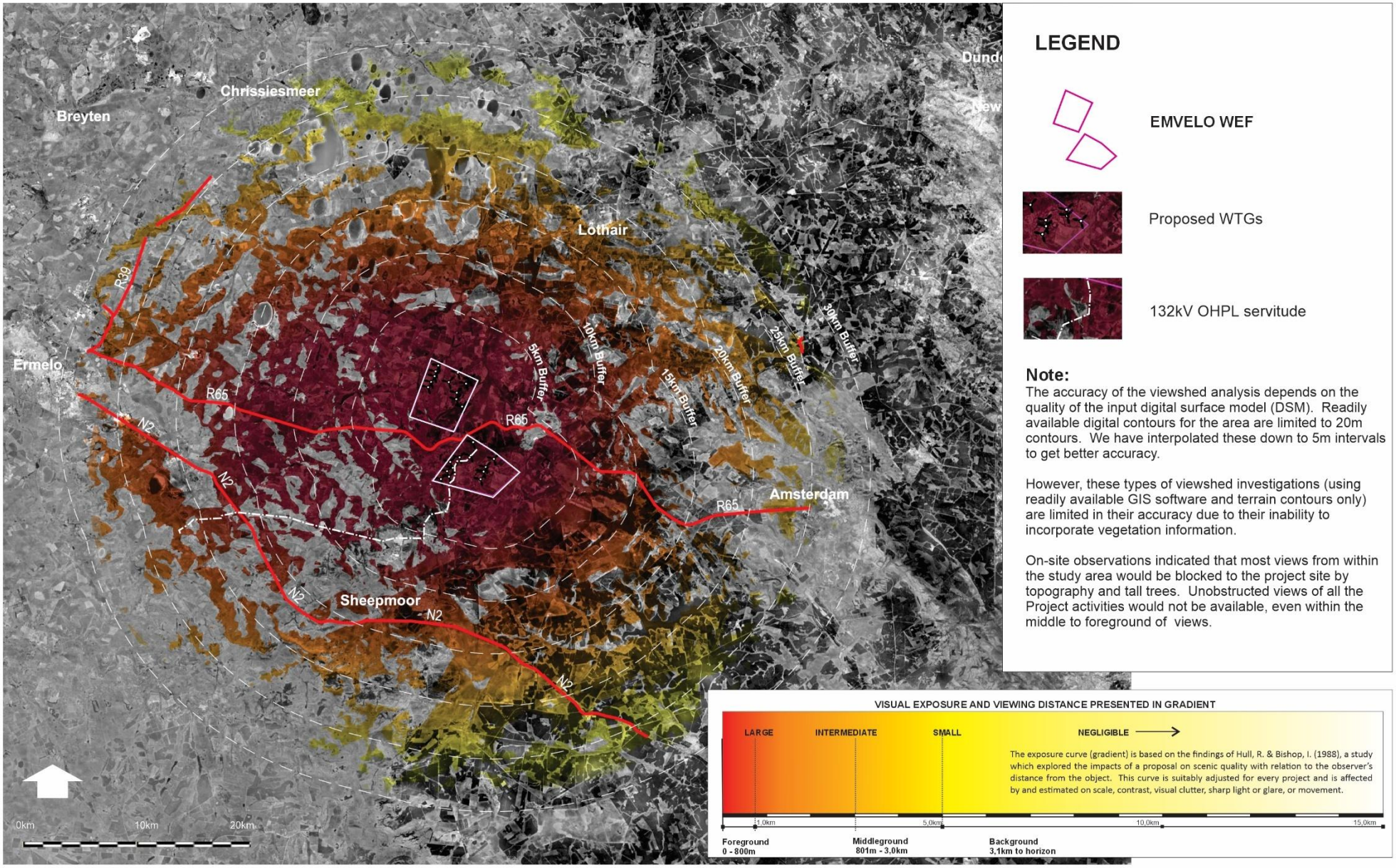


Figure 7-2: VISIBILITY AND VIEWSHED EXPOSURE - Emvelo WEF

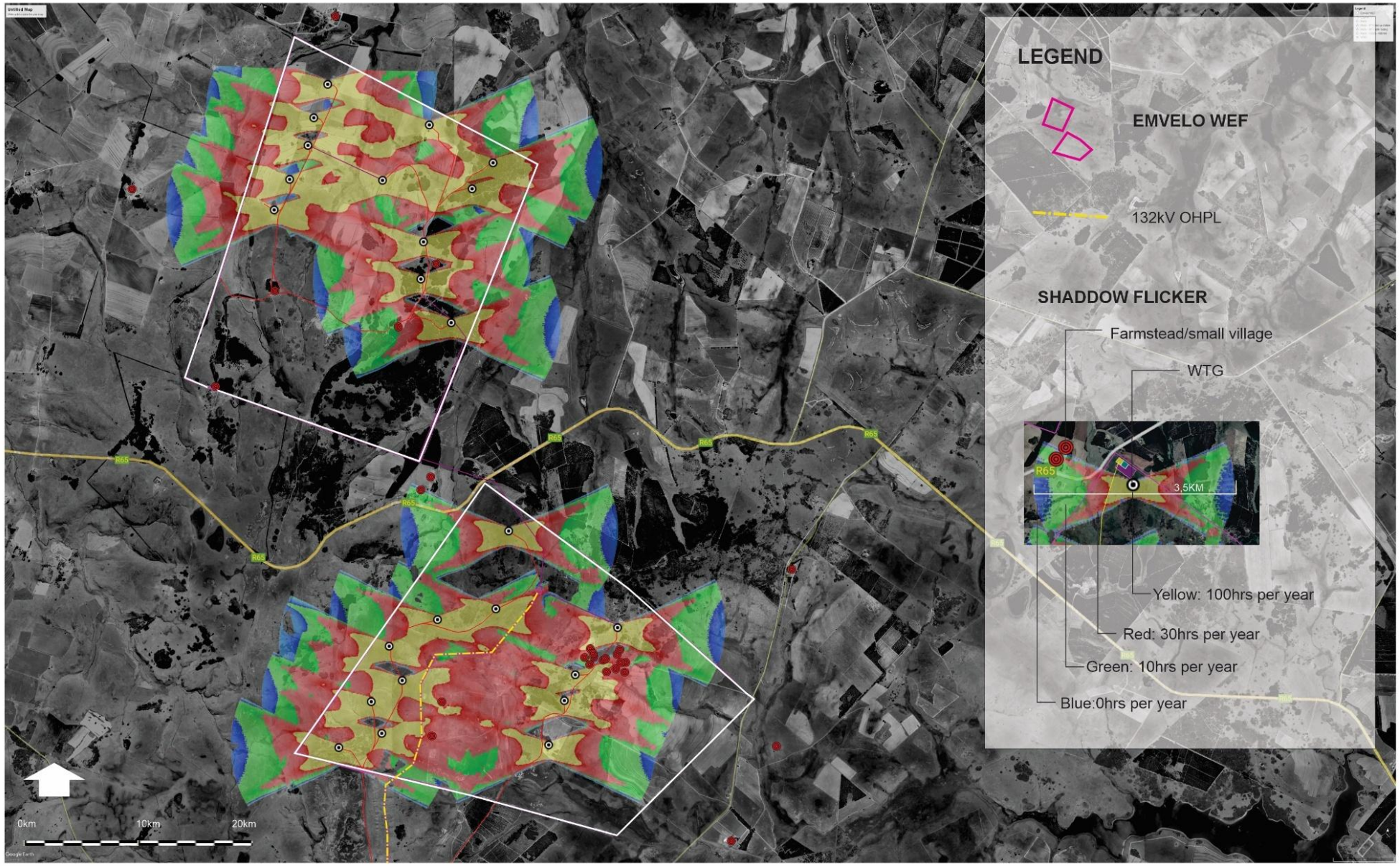


Figure 8: FLICKER ANALYSIS - Emvelo WEF

9.5 Visual Intrusion and Exposure

Visual intrusion deals with contextualism, i.e. how well does a project component fit with or disrupt/enhance the ecological and cultural aesthetic of the landscape as a whole? And ties in with the concept of VAC which for the study area is considered *low* and is dependent on where the viewer is located relative to the development areas.

The simulations in **Figures 9-1** to **9-5** illustrate the worst-case effect that the WEFs would have on the most exposed views experienced from the surrounding public areas. Project components will appear in moderately sensitive views from the local arterial and national roads with the potential for high visual intrusion for short sections of the R65 (**Figures 9-2** and **9-3**) and from farmsteads to the north and west of the northern site and east of the southern site. Visual exposure and intrusion from the N2 would be moderate to low for the OHPL, for a short section of the road east of the Eskom Uitkoms substation. as illustrated in **Figure 9-4**.

For the remainder of the study area, visual intrusion is considered low to negligible, i.e. has a minimal to no effect on the visual quality and sense of place of the landscape and contrasts minimally with the patterns or cultural elements (mining infrastructure) that define the structure of the landscape.





Figure 9-1: SIMULATION VIEW 2 - Emvelo WEF





Figure 9-2: SIMULATION VIEW 3 - Emvelo WEF





Figure 9-3: SIMULATION VIEW 5 - Emvelo WEF



Figure 9-4: SIMULATION VIEW 6 - Emvelo WEF



Figure 9-5: SIMULATION VIEW 9 - Emvelo WEF

9.6 Effects of Night Lighting (WEF)

I&APs consistently raise the impact of night lighting, specifically when they can be seen from tourist or residential sites and when the effect would continue for the Project's life. The negative effect of night lighting caused by the Project would be seen against a night sky already impacted by lights from surrounding urban areas such as Ermelo and Sheepmoor. Security lighting could, however, potentially be detrimental to people living in the immediate vicinity. As proposed in Section 10, management measures should be implemented to limit light spillage beyond the Project's site boundaries.

Civil aviation requires installing a red hazard flashing navigation light on top of each turbine. These lights can be seen over extended distances of at least 40km, and when viewed against a dark sky, they become very visible. To minimise this visual intrusion, the use of AVWS (Audio Visual Warning System) technology should be investigated. AVWS is a radar-based obstacle avoidance system that activates obstruction lighting and audio signals only when an aircraft is near an obstruction on which an AVWS unit is mounted, such as a wind turbine. The obstruction lights and audio warnings are inactive when aircraft are not in proximity to the obstruction (BML 2013[7]).

9.7 *Magnitude* of Visual Impact

With reference to the sections above, the potential impact ratings are based on the worst-case scenario and when the impacts of all aspects of the Project, i.e., the WEF and the OHPL, are taken together. It is anticipated that visual impacts could result from the activities and infrastructure in all the Project phases, i.e., construction, operational, and closure.

The method used for the assessment of potential impacts is set out in **Appendix C**. This assessment methodology enables the assessment of environmental impacts including cumulative impacts. Referring to the discussions in previous sections, a high-level identification of potential visual impacts is predicted. The estimated time frame for the construction phase is eighteen months and the operational phase is approximately 20 – 25 years. The construction and decommissioning phases are estimated to be eighteen months. **Table 3** below summarise the magnitude of visual impact for all phases of the project.

Table 4: *Magnitude* of visual impact without mitigation during the Construction and Operational Phases on Sensitive Viewing Areas

High	**Moderate**	**Low**	**Negligible**
For receptors using the R65 and local access road and living in or visiting farmsteads, where turbines occur within the fore and middle ground of views (i.e. up to 8km from the viewer)	For receptors using the R65, local access and farm/homesteads where turbines are seen in the background of views (i.e. greater than 8km to 20km from the viewer)	For all receptors where turbines are seen in the background or horizon (i.e. greater than 20km) and were the OHPL crosses the N2	For all other sensitive receptor areas
Major loss of or alteration to key elements / features / characteristics of the baseline in the immediate vicinity of the site.	Partial loss of or alteration to key elements / features / characteristics of the baseline.	Minor loss of or alteration to key elements / features / characteristics of the baseline.	Very minor or no loss or alteration to key elements/features/characteristics of the baseline.

[7] United States Department of the Interior. 2013. Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands. Bureau of Land Management. Cheyenne, Wyoming. 342 pp, First Edition 2013.

i.e. Pre-development landscape or view and / or introduction of elements considered to be uncharacteristic when set within the attributes of the receiving landscape. Result: **A *high* scenic quality impact would result.**	i.e. Pre-development landscape or view and / or introduction of elements that may be prominent but may not necessarily be substantially problematic when set within the attributes of the receiving landscape. Result: **A *moderate* scenic quality impact would result over an intense by localized area.**	i.e. Pre-development landscape or view and / or introduction of elements that may not be problematic when set within the attributes of the receiving landscape. Result: **A *low* scenic quality impact would result.**	i.e. Pre-development landscape or view and / or introduction of elements that is not problematic with the surrounding landscape – approximating the 'no change' situation. Result: ***Negligible* to *no* scenic quality impacts would result.**

10. MANAGEMENT MEASURES

In considering mitigating measures, three rules are considered - the measures should be feasible (economically), effective (how long will it take to implement and what provision is made for management/maintenance) and acceptable (within the framework of the existing landscape and land use policies for the area).

The following generic mitigation measures are suggested for the Project and should be included in the Environmental Management Plan Report (EMPr). The following general actions are recommended:

10.1 Planning and site development

- With the preparation of the land within the full extent of the Project site(s) onto which activities will take place, the minimum amount of existing vegetation and topsoil should be removed.
- Specifications with regards to the placement of construction camps (if required), as well as a site plan of the construction camp, indicating waste areas, storage areas and placement of ablution facilities, should be included in the EMPr. These areas should either be screened or positioned in areas where they would be less visible from the public road north of the Project site.
- When possible, construction activities should be limited to between 06:00 and 18:00 or in conjunction with the ECO and neighbours of the Project site.
- Adopt responsible construction practices that strictly contain the construction/establishment activities to demarcated areas.
- Building or waste material discarded should be undertaken at an authorised location, which should not be within any sensitive areas.

10.2 Earthworks and vegetation

- The mitigation measures during operation will need to focus on effective rehabilitation of the construction area. These specifications must be explicit and detailed and included in the contract documentation (Environmental Management Plan) so that the tasks can be costed and monitored for compliance and result.
- It is recommended that that a suitably qualified person, such as a landscape architect, is appointed to give attention to the concept and design of the aesthetic aspects of the project during the detailed design phase of the project prior to construction to integrate the design especially the shape of the cut and fill slopes with the surrounding landscape to ensure that the project blends in physically and aesthetically with the environment. The cut and fill slopes should not be steeper than 1:2.5 vertical to horizontal as this allows vegetation to establish more easily. This will also reduce erosion of the soil surface.
- Earthworks should be executed so that only the footprint and a small 'construction buffer zone' around the proposed activities are exposed. In all other areas, the naturally occurring vegetation should be retained.

- All cut and fill slopes (if any) and areas affected by construction work should be progressively top soiled and re-vegetated as soon as possible.
- Disturbed soil must be exposed for the minimum time possible once cleared of vegetation to avoid prolonged exposure to wind and water erosion and to minimise dust generation.

10.3 Structures and associated infrastructure

- Paint all structures with colours that reflect and compliment the colours of the surrounding landscape – avoid shiny materials.
- The colour of the components of the project components will make a difference to the visual fit of the project into the landscape and setting.
- Subdued and complimentary natural shades and tints blend easily into a landscape setting.
- Vivid primary or bright or reflective colours or surfaces will accentuate the visual presence of the development and should be avoided.

10.4 Good housekeeping

- "Housekeeping" procedures should be developed for the Project to ensure that the project site and lands adjacent to it are kept clean of debris, garbage, graffiti, fugitive trash, or waste generated on-site; procedures should extend to control of "track out" of dirt on vehicles leaving the active construction site and controlling sediment in stormwater runoff.
- During construction, temporary fences surrounding the material storage yards and laydown areas should be covered with 'shack' cloth (khaki coloured) or shade cloth.
- Operating facilities should be actively maintained during operation.

10.5 Lighting

- As night lighting during both construction and operation is one of the more objectionable forms of visual impact, it is important that selective and sensitive location and design of the lighting requirements for the construction camp and the sub-stations are developed. For instance, reduce the height from which floodlights are fixed and identify zones of high and low lighting requirements with the focus of the lights being inward, rather than outward.
- Light pollution is the result of bad lighting design, which allows artificial light to shine outward and upward into the sky, where it is not wanted, instead of focusing the light downward, where it is needed. Ill designed lighting washes out the darkness of the night sky and radically alters the light levels in rural areas where light sources shine as 'beacons' against the dark sky and are not wanted.
- Of all the pollutions faced, light pollution is the most easily remedied. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere. The following are measures that must be considered in the lighting design of the Project, particularly at the management and service platforms.

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site i.e. lights are to be aimed away from adjacent roads and residential areas.
- Minimize the number of light fixtures to the bare minimum, including security lighting.
- Avoid high pole top security lighting along the periphery of the site and at the substations , and use only lights activated on illegal entry to the site.
- It is a requirement by Civil Aviation that a red hazard flashing navigation light be installed on top of each turbine. To minimise this visual intrusion, the use of AVWS (Audio Visual Warning System) technology should be investigated.

10.6 Shadow Flicker

- Avoid locating any of the turbines within 2km of a residence to limit the effect of shadow flicker.

Table 5: Emvelo WEF Environmental Mitigation Monitoring Measures

Impact/Aspect	Mitigation/Management Actions	*Responsibility*	*Methodology*	Mitigation/Management Objectives and Outcomes	*Frequency*
Planning and Design					
Visual intrusion and potential flicker effect by wind turbines and associated structures and infrastructure on visual receptors	● Site turbines at least 2 km from any occupied homestead or hospitality/tourism facility, where possible to limit effect of shadow flicker. (This has already been done during the Scoping phase)	Client	Determine location of sensitive viewers	Avoid impact on sensitive viewers	once
Visual intrusion by wind turbines and associated structures and infrastructure on visual and landscape receptors	● Site turbines at least 2 km from any occupied homestead hospitality/tourism facility, where possible. ● Locate construction camps and all related facilities such as stockpiles, lay-down areas, batching plants in areas already impacted such as existing farmyards or in unobtrusive locations away from the main visual receptors (These has already been done during the Scoping phase)	Client Client	Determine location of sensitive landscape receptors such as rivers, hills, ridges, natural areas, pans, nature reserves, cultural sites and structures	Avoid impact on landscape receptors	Once once
Visual intrusion by Access Road, Substations and Associated	● Locate construction camps and all related facilities such as stockpiles, lay-down areas, batching plants in	Client	Determine location of sensitive viewers and	Avoid impact on sensitive viewers and landscape receptors	once

structures and infrastructure on visual and landscape receptors	areas already impacted such as existing farmyards or in unobtrusive locations away from the main visual and landscape receptors		landscape receptors		
Construction					
Visual intrusion by wind turbines and associated structures and infrastructure on visual and landscape receptors	● Limit area of disturbance for access roads, substations and construction camp sites ● Limit access tracks for construction and maintenance vehicles to existing roads where possible. Once established do not allow random access through the veld ● Suppress dust during construction. Blend edges of road and platforms with surrounding landscape Rehabilitate exposed disturbed areas ● Avoid vegetation stripping in straight lines but rather non-geometric shapes that blend with the landscape ● Limit need for security lighting Use non-reflective materials ● Paint ,where possible, all other project infrastructure elements such as operational buildings, support poles etc. a dark colour ● Avoid bright colour/patterns and logos	Client/Contractor Client/contractor Contractor/ Client/Contractor Client/Contractor Client/Contractor Client	Prepare a site layout plan for construction	To limit visual intrusion of turbine installation	Once Continuously Regularly/Daily Once Once Once Once
Visual intrusion by Access Road, Substations and Associated structures and infrastructure on visual and landscape receptors	● Limit area of disturbance for footprint, access roads and construction camp or sites ● Suppress dust during construction ● Limit area of disturbance for access roads, substations and construction camp sites ● Limit access tracks for construction and maintenance vehicles to existing roads where possible. Once established do not allow random access through the veld Suppress dust during	Client/Contractor Contractor Client/Contractor Client/Contractor	Prepare a site layout plan for construction	To limit visual intrusion of infrastructure	Once Regularly /daily Once Once

	construction. ● Blend edges of road and platforms with surrounding landscape Rehabilitate exposed disturbed areas ● Avoid vegetation stripping in straight lines but rather non-geometric shapes that blend with the landscape ● Limit need for security lighting Use non-reflective materials ● Paint, where possible, all other project infrastructure elements such as operational buildings, support poles etc. a dark colour ● Avoid bright colour/patterns and logos	Client/Contractor Client/Contractor Client/Contractor Client Client/Contractor Client			Once Once Once Once Once Once
Operation					
Visual intrusion and potential flicker effect by wind turbines and associated structures and infrastructure on visual receptors	● Mitigation will already have been implemented by the placement of turbines according to distance from visual receptors. Additional mitigation if still required: • Screening the affected receptor by, for example, applying blinds or shutters to the affected window; closing curtains during the period of the day when flicker could occur; planting a vegetation screen such as a row of trees between the receptor and the turbine or reconfiguring the building so that views from it are limited. • Consider compensation • Shutdown the turbine/s during the time of the day for those calendar days when flicker will occur. ● Investigate the possibility to manage for the top of turbine red hazard lighting to only operate when a plane enters the affected airspace rather than be permanently lit ● Limit need for security lighting	Client Client Client Client Client Client	Site turbines 2 km from visual receptors. This has already been done	To limit the effect of shadow flicker on the visual receptors	Done Once Once As and when required during affected times during the year Once Once

Visual intrusion by wind turbines and associated structures and infrastructure on landscape receptors	● Mitigation will already have been implemented by the placement of turbines according to distance from landscape receptors ● Limit need for security lighting. ● Use non-reflective materials ● Paint, where possible, all other project infrastructure elements such as operational buildings, support poles etc. a dark colour ● Avoid bright colour/patterns and logos	Client	Done Use unobtrusive security lighting Select matt colours Select darker tones of colours	To limit the visual impact on the landscape receptors	Done
Decommissioning					
Visual intrusion and potential flicker effect by wind turbines and associated structures and infrastructure on visual receptors Visual intrusion by wind turbines and associated structures and infrastructure on visual and landscape receptors Visual intrusion by Access Road, Substations and Associated structures and infrastructure on visual and landscape receptors	● Remove all project components from site ● Rip all compacted hard surfaces such as platforms, words areas, access and service roads etc. and reshape to blend with the surrounding landscape ● Rehabilitate/revegetate all disturbed areas to visually the original state by shaping and planting	Contractor Contractor Contractor	Disassemble and or demolish component Use a ripper or by hand and loosen all compacted material Fertilise ripped areas, add organic matter where necessary and hydroseed with indigenous plant seed	To re-instate the area to approximately the original state	Once Once Once and then monitor growth succession. Redo where necessary
Cumulative					
The introduction of a WEF into a landscape that is devoid of any such similar structures	Locate the WEF in areas where there is already existing industrial infrastructure such as other powerlines, roads, rail and industry	Client	During the planning stage (already done) locate the proposed WEF as close to existing large-scale infrastructure	Concentrating infrastructure minimises the visual cumulative impact	Once

Table 6: Emvelo OHPL Environmental Mitigation Monitoring Measures

Impact/Aspect	Mitigation/Management Actions	*Responsibility*	*Methodology*	Mitigation/Management Objectives and Outcomes	*Frequency*
Planning and Design					
Visual intrusion by 132kV overhead transmission Powerline and its Associated Electrical Grid Infrastructure on visual and landscape receptors	Limit transmission alignment to the planned corridor	Client	Select the optimal routing	Minimise area of impact	Once
Construction					
Visual intrusion by 132kV overhead transmission Powerline and its Associated Electrical Grid Infrastructure on visual and landscape receptors	● Limit area of disturbance for access roads pylon placement. sites ● Suppress dust during construction ● Limit area of disturbance for access roads. ● Locate stockpiles, in areas already impacted such as existing farmyards or in unobtrusive locations away from the main visual receptors. ● Limit access tracks for construction and maintenance vehicles to existing roads where possible. Once established do not allow random access through the veld Suppress dust during construction. ● Blend edges of road and platforms with surrounding landscape ● Avoid vegetation stripping in straight lines but rather non-geometric shapes that blend with the landscape ● Limit need for security lighting ● Use non-reflective materials ● Paint , where possible, all other project infrastructure elements	Client/Contractor Contractor Client/Contractor Client/Contractor Contractor Contractor Client/Contractor Client Client Client Client	Break up straight edges where possible Use unobtrusive security lighting Select matt colours Select darker tones of colours		

	such as operational buildings, support poles etc. a dark colour ● Avoid bright colour/patterns and logos		Use mono-tone colours		
Operation					
Visual intrusion by Access Road, Substations and Associated structures and infrastructure on visual and landscape receptors	● Maintain rehabilitated disturbed areas	Contractor	Remove invasive species and general weeds. Cut back vegetation where overgrown. Revegetate where rehabilitation has not taken	To avoid unnecessary landscape degeneration and rehabilitation	Weekly basis
Decommissioning					
Visual intrusion by 132kV overhead transmission Powerline and its Associated Electrical Grid Infrastructure on visual and landscape receptors	● Remove all project components from site ● Rip all compacted hard surfaces and reshape to blend with the surrounding landscape ● Rehabilitate/ revegetate all disturbed areas to visually the original state by shaping and planting	Contractor	Disassemble and or demolish component Use a ripper or by hand and loosen all compacted material Fertilise ripped areas, add organic matter where necessary and hydroseed with indigenous plant seed	To re-instate the area to approximately the original state	Once Once Once and then monitor growth succession. Redo where necessary
Cumulative					
The introduction of a powerline into a landscape where similar structures already exist	Locate the powerlines in areas where there is already existing industrial infrastructure such as other powerlines, roads, rail and industry	Client	During the planning stage (already done) locate the prosed lines as close to existing large-scale infrastructure	Concentrating infrastructure minimises the visual cumulative impact	Once

11. SIGNIFICANCE OF VISUAL IMPACT

The significance ratings[8], are based on the worst-case scenario for the WEF project along with its associated 132kV OHPL infrastructure, when the impacts of all aspects of the Project are taken together using the impact criteria in **Appendix C**. The sensitive receptors and areas of concern are (refer to **Figure 6)**:

- Users of the R65 arterial road and the local access roads to the west, north and east of the project sites.
- Residents of farm/homesteads surrounding the project sites.

The *magnitude* of impact, derived from **Table 3,** is further qualified with *extent*, *duration, reversibility,* and *probability* to establish the *significance* of the impact. The worst-case scenario is assessed below in series of tables. Visual impact on all other areas within the study area would be less that the assessed worst-case scenario.

11.1.1 Construction Phase

11.1.1.1 WEF

Construction activities include the removal of vegetation, earthworks required to create building terraces for internal substations and preparation of the internal roads as well as excavations for the turbine structures foundations associated infrastructure and the clearing of vegetation for access roads. Construction activities would potentially negatively affect the landscape's visual quality and sense of place relative to its baseline. They would contrast with the patterns that define the structure of the landscape. The duration of the construction phase is approximately, twenty-four months.

Table 7-1: WEF Visual Impact - *CONSTRUCTION PHASE*

Impact Phase: Construction					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Short Term	Irreversible	Moderate	High
Score	3	2	5	3	4
With Mitigation	Regional	Short Term	Irreversible	Moderate	High
Score	3	2	5	3	4
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M) *P	Moderate Negative Impact (52)		Moderate Negative Impact (52)		
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.				
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities were considered as visual issues were not listed as a concern.				

[8] Where: *Significance=(Extent + Duration + Reversibility + Magnitude) * Probability*

Mitigation measures to reduce residual risk or enhance opportunities: • Limit area of disturbance for turbine footprint, access roads and construction camp or sites • Suppress dust during construction. • Site turbines at least 2 km from any occupied homestead hospitality/tourism facility, where possible. • Mitigation will already have been implemented by the placement of turbines according to distance from visual receptors. And the effect of shadow flicker. • Limit area of disturbance for access roads, substations, and construction camp sites • Locate construction camps and all related facilities such as stockpiles, lay-down areas, batching plants in areas already impacted such as existing farmyards or in unobtrusive locations away from the main visual receptors. • Limit access tracks for construction and maintenance vehicles to existing roads where possible. Once established do not allow random access through the veld. • Blend edges of road and platforms with surrounding landscape • Rehabilitate exposed disturbed areas. • Avoid vegetation stripping in straight lines but non-geometric shapes that blend with the landscape. • Limit need for security lighting. • Use non-reflective materials. • Paint all other project infrastructure elements such as operational buildings, support poles etc. a dark colour. • Avoid bright colour/patterns and logos.

Residual impact	Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place

The impact on the visual environment during the construction phase is assessed to have a potential *medium severity* over a *regional* area (but extend beyond the site boundary to at least at 10,0km) and would occur over the *short-term* (less than five years) resulting in a moderate *consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as moderate. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain moderate.

11.1.1.2 OHPL

Construction activities include the removal of vegetation, earthworks required for tower foundations and preparation for temporary access roads. Construction activities would potentially negatively affect the landscape's visual quality and sense of place relative to its baseline. They would contrast with the patterns that define the structure of the landscape. The construction is approximately twenty-four months.

Table 7-2: OHPL Visual Impact - *CONSTRUCTION PHASE*

Impact Phase: Construction					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Short Term	Irreversible	Moderate	Probable
Score	3	2	5	3	3
With Mitigation	Regional	Short Term	Irreversible	Moderate	Probable
Score	3	2	5	3	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		

S=(E+D+R+M)*P	Moderate Negative (39)	Moderate Negative Impact (39)
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.	
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities were considered as visual issues were not listed as a concern.	
• Limit area of disturbance for access roads, and construction camp sites • Locate construction camps and all related facilities such as stockpiles, lay-down areas, batching plants in areas already impacted such as existing farmyards or in unobtrusive locations away from the main visual receptors. • Limit access tracks for construction and maintenance vehicles to existing roads where possible. Once established do not allow random access through the veld • Suppress dust during construction. • Blend edges of road and platforms with surrounding landscape • Rehabilitate exposed disturbed areas • Avoid vegetation stripping in straight lines but rather non-geometric shapes that blend with the landscape • Limit need for security lighting • Use non-reflective materials • Paint all other project infrastructure elements such as operational buildings, support poles etc. a dark colour • Avoid bright colour/patterns and logos		
Residual impact	Change of the landscape characteristics and key views (visual intrusion) and change to the sense of place.	

The impact on the visual environment during the construction phase is assessed to have a potential *medium severity* over a *regional* (but extend beyond the site boundary to at least at 5,0km) and would occur over the *short-term* (less than five years) resulting in a moderate *consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as moderate. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain moderate

11.1.2 Operational Phase

11.1.2.1 WEF

Operational activities include the regular maintenance of the wind turbines, vegetation management under and around the structures and maintenance of all other infrastructural components. Security lighting, aviation hazard flashing lights, and other lighting associated with the movement of security vehicles at night. These activities along with the physical presence of the Project components day and night, constitute the visual impact.

Table 8-1: WEF Visual Impact Table - *OPERATIONAL PHASE*

Impact Phase: Operation					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Long Term	Irreversible	High	Highly Probable
Score	3	4	5	4	4
With Mitigation	Regional	Long Term	Irreversible	Moderate	Probable

Score	3	4	5	3	3
Significance Calculation	**Without Mitigation**			**With Mitigation**	
S=(E+D+R+M)*P	High Negative Impact (64)			Moderate Negative Impact (45)	
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.				
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities where considered as visual issues were not listed as a concern				
Mitigation measures to reduce residual risk or enhance opportunities: • Mitigation will already have been implemented by the placement of turbines according to distance from visual receptors. • Manage need for top of turbine red hazard lighting to only when a plane enters the affected airspace rather than be permanently lit. • Limit need for security lighting. • Use non-reflective materials. • Paint all other project infrastructure elements such as operational buildings, support poles etc. a dark colour. • Avoid bright colour/patterns and logos. • Maintain rehabilitated disturbed areas.					
Residual impact	Change of the landscape characteristics and key views (visual intrusion, shadow flicker and blinking aviation light effects) and change to the sense of place.				

The worst-case impact on the visual environment during the operational phase is assessed to have a *high magnitude* over a *widespread area* and would occur over the *long-term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The significance of a high impact is that it could have an influence on the decision, and the impact would be unacceptable unless it is effectively mitigated. Mitigation measures are feasible (specifically with regards night lighting, the location of turbines to avoid flicker on affected residential locations and the lack of I&AP concern of the project) and can reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly to that of MODERATE.

11.1.1.2 OHPL

Operational activities include the maintenance of the access roads and pylons, and vegetation management and maintenance under and around the transmission lines and other infrastructural components such as substations. These activities along with the physical presence of the Project components, constitute the visual impact.

Table 8-2: OHPL Visual Impact - *OPERATIONAL PHASE*

Impact Phase: Operational					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Long Term	Irreversible	Moderate	Probable
Score	3	4	5	3	3

With Mitigation	Regional	Long Term	Irreversible	Moderate	Probable
Score	3	4	5	3	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (45)		Moderate Negative Impact (45)		
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.				
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities where considered as visual issues were not listed as a concern				
Mitigation measures to reduce residual risk or enhance opportunities: • Maintain rehabilitated disturbed areas					
Residual impact	Change of the landscape characteristics and key views (visual intrusion) and change to the sense of place				

The worst-case impact on the visual environment during the operational phase is assessed to have a moderate *magnitude* over a *widespread area* and would occur over the *long-term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *moderate* resulting in a predicted significance of impact as MODERATE. The significance of a moderate impact is that it could have an influence on the decision, and the impact will not be avoided unless it is mitigated. Mitigation measures are feasible and can reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly but would remain MODERATE.

11.1.3 Decommissioning Phase

11.1.3.1 WEF

Decommissioning and closure activities include the dismantling and removal of infrastructure and the rehabilitation of the site back to its current, mostly natural, state.

Table 9-1: WEF Visual Impact – *DECOMMISSIONING PHASE*

Impact Phase: Decommissioning					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Short Term	Recoverable	Moderate	High
Score	3	2	3	3	4
With Mitigation	Regional	Short Term	Recoverable	Moderate	High
Score	3	2	3	3	4
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (44)		Moderate Negative Impact (44)		
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.				
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities where considered as visual issues were not listed as a concern				

Mitigation measures to reduce residual risk or enhance opportunities: • Remove all project components from site • Rip all compacted hard surfaces such as platforms, works areas, access, and service roads etc. and reshape to blend with the surrounding landscape • Rehabilitate/revegetate all disturbed areas to visually the original state by shaping and planting	
Residual impact	*Minor but generally none (The rehabilitated areas might not be visually compatible with the existing surrounding vegetation).*

The impact on the visual environment during the decommissioning phase is assessed to have a *medium magnitude* over a *local area* and would occur over the *short-term* (less than five years) resulting in a *low consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as MEDIUM. The implementation of mitigation measures would reduce the anticipated impact, but it would remain MEDIUM.

11.1.3.2 OHPL

Decommissioning and closure activities include the dismantling and removal of infrastructure and the rehabilitation of the site back to its current, mostly natural, state.

Table 9-2: OHPL Visual Impact – *DECOMMISSIONING PHASE*

Impact Phase: Decommissioning					
Nature of the impact: Visual Impact					
Description of Impact: Change of the landscape characteristics and key views (visual intrusion) and change to the sense of place					
Impact Status: Negative					
	Extent	**Duration**	**Reversibility**	**Magnitude**	**Probability**
Without Mitigation	Regional	Short Term	Recoverable	Moderate	Probable
Score	3	2	3	3	3
With Mitigation	Regional	Short Term	Recoverable	Moderate	Probable
Score	3	2	3	3	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (33)		Moderate Negative Impact (33)		
Was public comment received?	Yes, and visual and aesthetic issues were not mentioned as a concern.				
Has public comment been included in mitigation measures?	Yes, however, generic sensitivities where considered as visual issues were not listed as a concern				
• Remove all project components from site • Rip all compacted hard surfaces such as platforms, words areas, access and service roads etc. and reshape to blend with the surrounding landscape • Rehabilitate/revegetate all disturbed areas to visually the original state by shaping and planting					
Residual impact	*Minor but generally none (The rehabilitated areas might not be visually compatible with the existing surrounding vegetation).*				

The impact on the visual environment during the decommissioning phase is assessed to have a *medium magnitude* over a *local area* and would occur over the *short-term* (less than five years) resulting in a *low consequence*. The probability of the unmitigated impact is *moderate* resulting in a predicted significance of impact as MEDIUM. The implementation of mitigation measures would reduce the anticipated impact, but it would remain MEDIUM.

10 CUMULATIVE EFFECT

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect how the landscape is experienced, and cumulative effects may be positive or negative. Where they comprise a range of benefits, they may form part of the mitigation measures. In relation to an activity, cumulative impact therefore means *"the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities"* (NEMA EIA Reg GN R982 of 2014).

10.1 The cumulative effect of the Project

Cumulative effects can also arise from the intervisibility of a range of developments and the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual developments may not be significant, but they may adversely impact visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, vegetative cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions (LI-IEMA (2013)). Sequential visibility, for example, as turbines come into and out of sight, can create a cumulative visual impact over time, affecting the overall perception of the landscape. Negatively.

Table 8 summarises the cumulative effect of the Project along with the Sheepmoor WEF and associated OHPL, which make up the cluster development. It also accounts for existing power infrastructure. Figures 10-1, 10-2 and 10-3 illustrate the cumulative effect of the two adjacent, Emvelo and Sheepmoor, WEFs.
d

Table 10: Visual Impact of the Cumulative Effect

Cumulative Impact: Visual and Sense of Place impact					
Description of Cumulative Impact: Change of the landscape characteristics and key views (visual intrusion and flicker effect) and change to the sense of place.					
Impact Status: Negative					
	Extent	Duration	Reversibility	Magnitude	Probability
Without Enhancement	Regional	Long term	Irreversible	High	Highly Probable
Score	3	4	5	4	4
With Enhancement	Regional	Long term	Irreversible	Moderate	Highly Probable
Score	3	4	5	3	4

Significance Calculation	Without Enhancement	With Enhancement
S=(E+D+R+M)*P	High Negative Impact (64)	Moderate Negative Impact (60)
Can Impacts be Enhanced?	No but can be managed at night by managing the red hazard lights on top of the turbines to be not continuous.	
Enhancement: • Manage need for top of turbine red hazard lighting to only when a plane enters the affected airspace rather than be permanently lit. • Limit need for security lighting. • Use non-reflective materials. • Paint all other project infrastructure elements such as operational buildings, support poles etc. a dark colour. • Avoid bright colour/patterns and logos. • Maintain rehabilitated disturbed areas.		
Residual impact	*Yes, but it would be reduced once the turbines and associated infrastructure are removed and revert to the current cumulative infrastructure consisting of transmission lines, power station, etc.*	

The cumulative impact of the Project is HIGH. The Emvelo WEF will be seen together with another proposed WEF's (Sheepmoor) that are planned. These, together with the proposed new transmission power lines running south and through the study area, as well as the existing Camdon power station and powerlines, contribute to the cumulative effect of power infrastructure in the sub-region.

The combined effect of proposed WEF project and the existing power infrastructure and associated infrastructure would cause a major change the nature, sense of study and character of the sub-region's landscape's baseline.

The significance of the cumulative impact of these projects on the visual environment during their operational phase is assessed to have a *high magnitude* and over the *long-term.* The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The implementation of mitigation measures and that receptor sensitivity to the project is low could reduce the anticipated impact, to MODERATE

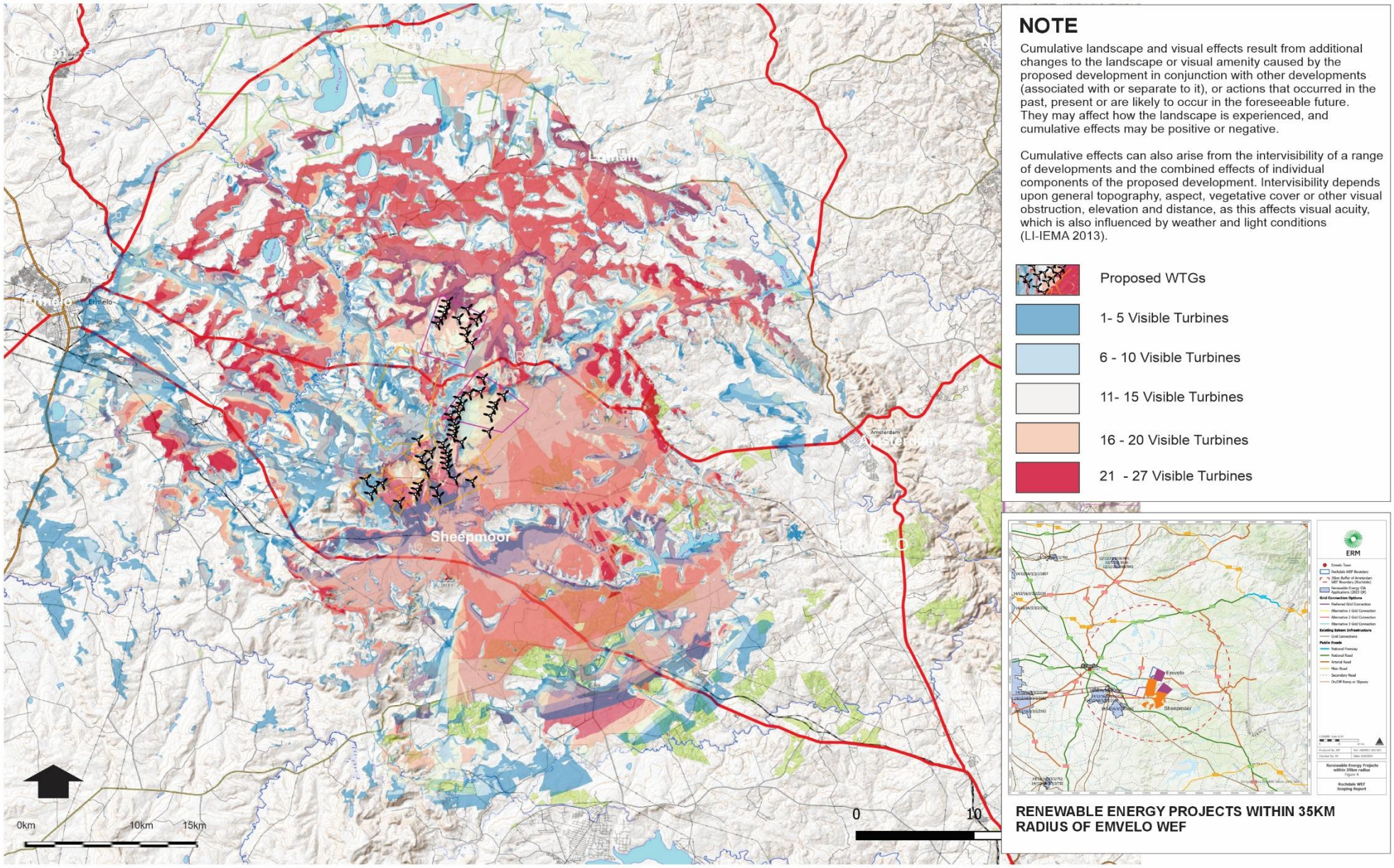


Figure 10-1: CUMULATIVE EFFECT - Mulilo WEF Projects

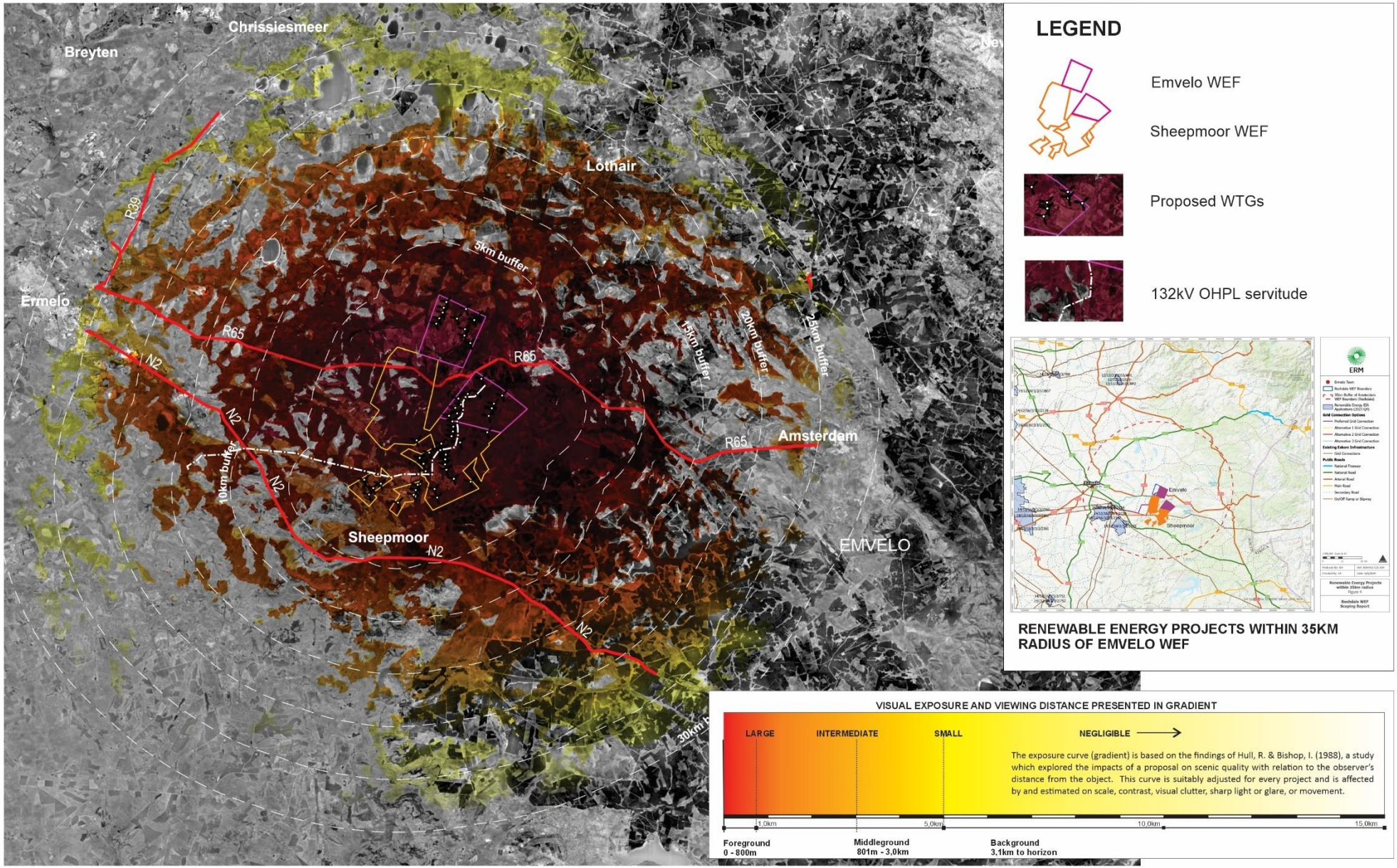


Figure 10-2: CUMULATIVE EFFECT VIEWSHED - Mulilo WEF Projects

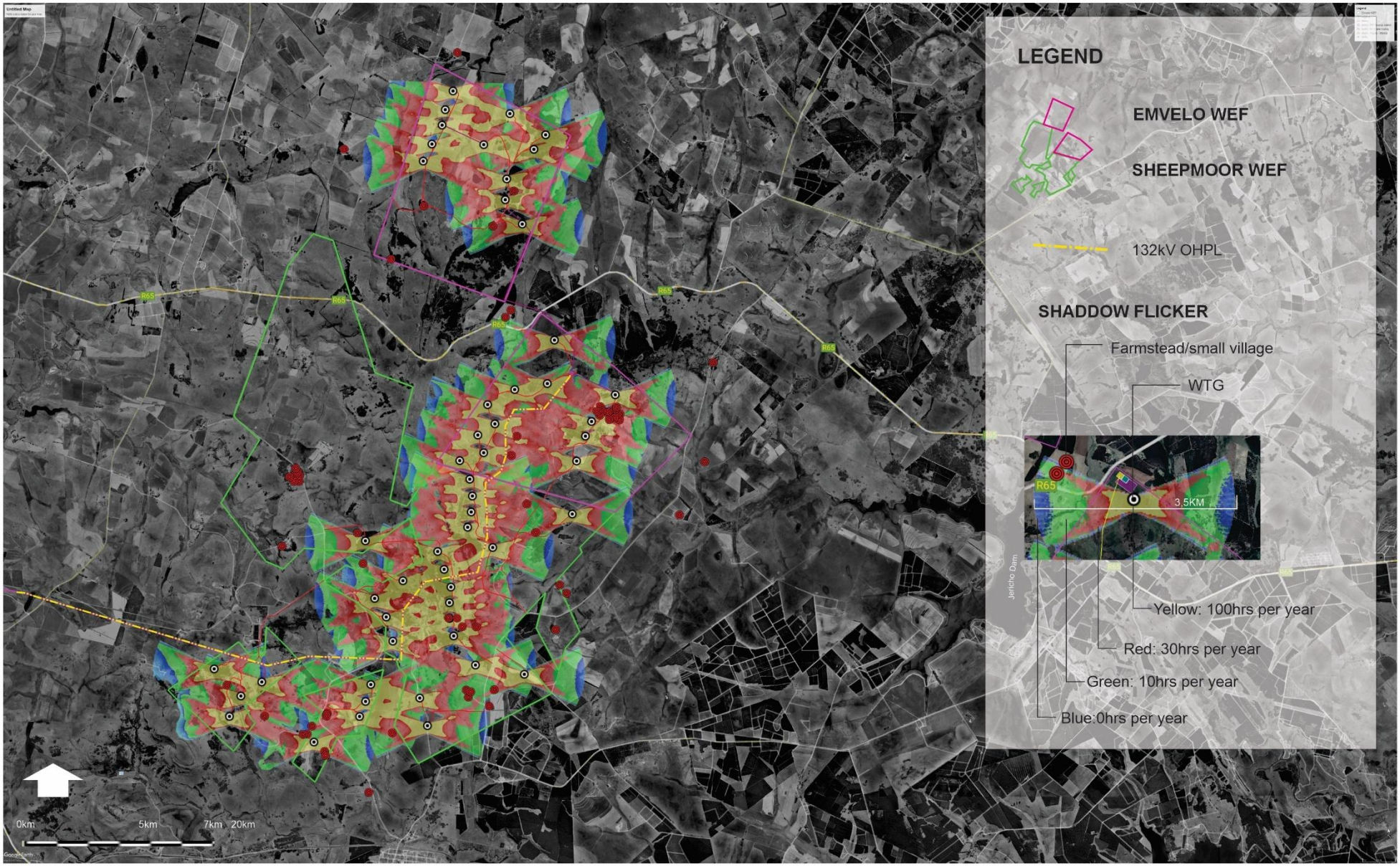


Figure 10-3: FLICKER ANALYSIS CUMULATIVE - Mulilo Projects WEF

11 CONCLUSION

The existing visual condition of the landscape that may be affected by the proposed Emvelo WEF and associated OHPL has been described. The study area's scenic quality has been rated *high* to *low* within the context of the sub-region. The Project site is in a *moderate* rated landscape type. Sensitive viewing areas and landscape types have been identified and mapped, indicating potential sensitivity to the Project, for users of the farmsteads, settlements, and towns and the R65 and the N2 roads.

Impacts on views are the highest when viewers are sensitive to change in the landscape, and the view is focused on and dominated by the change. The Project's visual impact will cause significant changes in the landscape that are noticeable to people viewing the Project.

Construction activities include the removal of vegetation, earthworks required to create building terraces for turbines and the preparation of the internal roads. Construction activities would negatively affect the landscape's visual quality and sense of place relative to its baseline. They would contrast with the patterns that define the structure of the immediate landscape and cause a significant change over a local to regional area, resulting in a moderate high change to key views. Mitigation measures are minimal with the greatest effect only at night.

Operational activities include the regular cleaning and maintenance, vegetation management under and around the turbines and powerline servitudes as well as maintenance of all other infrastructural components. Security lighting and other lighting associated with the movement of security vehicles at night. These activities along with the physical presence of the Project components day and night, constitute the visual impact.

Decommissioning and closure activities include the dismantling and removal of all infrastructure and the rehabilitation of the site back to its current, mostly natural, state.

11.1 Significance of Visual Impact

The significance of impact is based on the worst-case scenario and all project components taken together, i.e. WEF and OHPL.

11.1.1 Construction phase

The impact on the visual environment during the construction phase is assessed to have a potential ***medium severity*** over a ***regional*** area (but extend beyond the site boundary to at least at 10,0km) and would occur over the ***short-term*** (less than five years) resulting in a moderate *consequence*. The probability of the unmitigated impact is ***high*** resulting in a predicted significance of impact as MODERATE. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain MODERATE

11.1.2 Operational Phase

The visual environment during the operational phase is assessed to have a *high magnitude* over a *widespread area* and would occur over the *long-term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The significance of a high impact is that it could have an influence on the decision, and the impact would be unacceptable unless it is effectively mitigated. Mitigation measures are feasible (specifically with regards night lighting, the location of turbines to avoid flicker on affected residential locations and the lack of I&AP concern of the project) and can

reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly to that of MODERATE.

11.1.3 Decommissioning Phase

The impact on the visual environment during the decommissioning phase is assessed to have a *medium magnitude* over a *local area* and would occur over the *short-term* (less than five years) resulting in a *low consequence*. The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as MODERATE. The implementation of mitigation measures would reduce the anticipated impact, but it would remain MODERATE.

11.2 Cumulative Effects

The significance of the cumulative impact of these projects on the visual environment during their operational phase is assessed to have a *high magnitude* and over the *long-term.* The probability of the unmitigated impact is *high* resulting in a predicted significance of impact as HIGH. The implementation of mitigation measures and that receptor sensitivity to the project is low could reduce the anticipated impact, to MODERATE.

11.3 Authors' opinion

It is the opinion of GYLA that the visual impacts associated with the proposed Project are of a nature, scale and duration that will require mitigation to reduce the impact during the operational phase slightly. It must also be noted that the I&APs did not consider visual and aesthetic concerns as a major issue. GYLA believes that the impacts associated with the construction, operation and decommissioning phases can be mitigated from HIGH to MODERATE provided the recommended measures are effectively implemented in the short term and managed in the long term and that the site is effectively rehabilitated during decommissioning. The project is deemed acceptable from a visual perspective.

****GYLA****

12 REFERENCES

Amir, S. & Gidalizon, E. 1990. Expert-based method for the evaluation of visual absorption capacity of the landscape. *Journal of Environmental Management.* Vol. 30, Issue 3: 251 – 263.

Crawford, D., 1994. Using remotely sensed data in landscape visual quality assessment. *Landscape and Urban Planning.* 30: 71-81.

Exigent Engineering Consultants. February 2023. Final Environmental Scoping Report Eridanus Energy (Pty) Ltd (Buffalo 1 Solar Park) Renewable Energy Generation Projects on Farms Buffelsjagt 744-LQ with overhead powerlines to the Eskom Medupi substation, within the Lephalale Local Municipality, Waterberg District Municipality. Unpublished Report. Pretoria.

Hull, R.B. & Bishop, I.E., 1988. Scenic Impacts of Electricity Transmission Towers: The Influence of Landscape Type and Observer Distance. *Journal of Environmental Management.* 27: 99-108.

Ittelson, W.H., Proshansky, H.M., Rivlin, L.G. and Winkel, G.H., 1974. *An Introduction to Environmental Psychology.* Holt, Rinehart and Winston, New York.

Landscape Institute – Institute of Environmental Management and Assessment (LI-IEMA), 2013. *Guidelines for Landscape & Visual Impact Assessment*. 3rd Edition, Routledge, London.

Lange, E., 1994. Integration of computerised visual simulation and visual assessment in environmental planning. *Landscape and Environmental Planning.* 30: 99-112.

Lynch, K., 1992. *Good City Form*, The MIT Press, London. (131)

Mucina, L. & Rutherford, M.C. (eds) 2006. The vegetation of South Africa, Lesotho, and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute, Pretoria.

Oberholzer, B., 2005. Guideline for involving visual & aesthetic specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

PagerPower. *Solar Photovoltaic Glint and Glare Study, SA Mainstream Renewable Power Developments Ltd Scafell Cluster Solar Development*. Report 10268A, December 2020.

Ramsay, J. (October 1993), Identification and assessment of aesthetic values in two Victorian forest regions. *More than meets the eye: identifying and assessing aesthetic value.* Report of the Aesthetic Value Workshop held at the University of Melbourne.

Sama, J. (2000), Program Policy, *Assessing and Mitigating Visual Impact,* Department of Environmental Conservation. New York.

Sheppard, S.R.J. 2005. Validity, reliability, and ethics in visualisation. In Bishop, I. & Lange, E. (Eds.) *Visualisation in Landscape and Environmental Planning: Technology and Applications*. Taylor and Francis, London.

Schapper, J. (October 1993), The importance of aesthetic value in the assessment of landscape heritage. *More than meets the eye: identifying and assessing aesthetic value.* Report of the Aesthetic Value Workshop held at the University of Melbourne.

Tata. *A Brief on Tempered Glass with Anti-Reflective Coating (ARC) on Solar Modules,* Tata Power Solar 25 November 2015.

United States Department of the Interior. 2013. Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands. Bureau of Land Management. Cheyenne, Wyoming. 342 pp, April. First Edition.

Warnock, S. & Brown, N., 1998. Putting Landscape First. *Landscape Design.* 268: 44-46.

WEF

The WEF (turbines) layout, which was assessed in this report, has changed to accommodate comments from the I&APs and to avoid specific sensitivities. This addendum letter confirms that the proposed new (final) layout will not have a bearing on the report's findings. Primarily because most of the changes in the location of individual turbines are limited to less than 200m, and in some instances, turbines have been eliminated. In this instance, the receiver's cone of vision (a 60-degree angle of undistorted vision that a viewer has, extending from their eyes), would observe a similar number of turbines in the same context. The potential visual impact would therefore be the same.

Refer to **Figure A** below, which shows the turbines' original and final layouts and the locations of nearby farms and homesteads.

132 kV OHL

This report assessed the preferred corridor for the power lines. Subsequently, an alternative is being proposed that branches away to the south of the preferred alternative and then returns to it, as illustrated in **Figure B** below. It is our opinion that the alternative route would potentially affect a greater number of sensitive viewing locations (farm/homesteads) as well as residents of Sheepmoor.

The significance of the visual impact of the Project (the worst case scenario of all components of the WEF and OHL taken together) remains as:

Construction phase

The impact on the visual environment during the construction phase is assessed to have a potential *medium severity* over a *regional* area (but extends beyond the site boundary to at least 10,0km) and would occur over the short-term (less than five years), resulting in a moderate *consequence*. The probability of the unmitigated impact is *high,* resulting in a predicted significance of impact as MODERATE. The implementation of mitigation measures would not significantly reduce the anticipated impact, which would remain MODERATE

Operational Phase

The visual environment during the operational phase is assessed to have a *high magnitude* over a *widespread area* and would occur over the *long term* (anticipated to be longer than 10 years). The probability of the unmitigated impact is *high,* resulting in a predicted significance of impact as HIGH. The significance of a high impact is that it could have an influence on the decision, and the impact would be unacceptable unless it is effectively mitigated. Mitigation measures are feasible (specifically with regard to night lighting, the location of turbines to avoid flicker on affected residential locations, and the lack of I&AP concern about the project) and can reduce the visual impact over time. The impact with mitigation is predicted to reduce slightly to that of MODERATE.

Decommissioning Phase

The impact on the visual environment during the decommissioning phase is assessed to have a *medium magnitude* over a *local area* and would occur over the *short term (less than five years), resulting in a low consequence. The probability of the unmitigated impact is high, resulting in a predicted significance of impact*

as MODERATE. The implementation of mitigation measures would reduce the anticipated impact, but it would remain moderate.

Cumulative Effects

The cumulative impact of these projects on the visual environment during their operational phase is assessed to be high magnitude and over the long term. The probability of the unmitigated impact is high, resulting in a predicted significance of impact as HIGH. The implementation of mitigation measures and low receptor sensitivity to the project could reduce the anticipated impact to moderate.

Author's Opinion

It is the opinion of GYLA that the visual impacts associated with the proposed Project are of a nature, scale and duration that will require mitigation to reduce the impact during the operational phase slightly. It must also be noted that the I&APs did not consider visual and aesthetic concerns as a major issue. GYLA believes that the impacts associated with the construction, operation and decommissioning phases can be mitigated from HIGH to MODERATE provided the recommended measures are effectively implemented in the short term and managed in the long term and that the site is effectively rehabilitated during decommissioning. The project is deemed acceptable from a visual perspective.

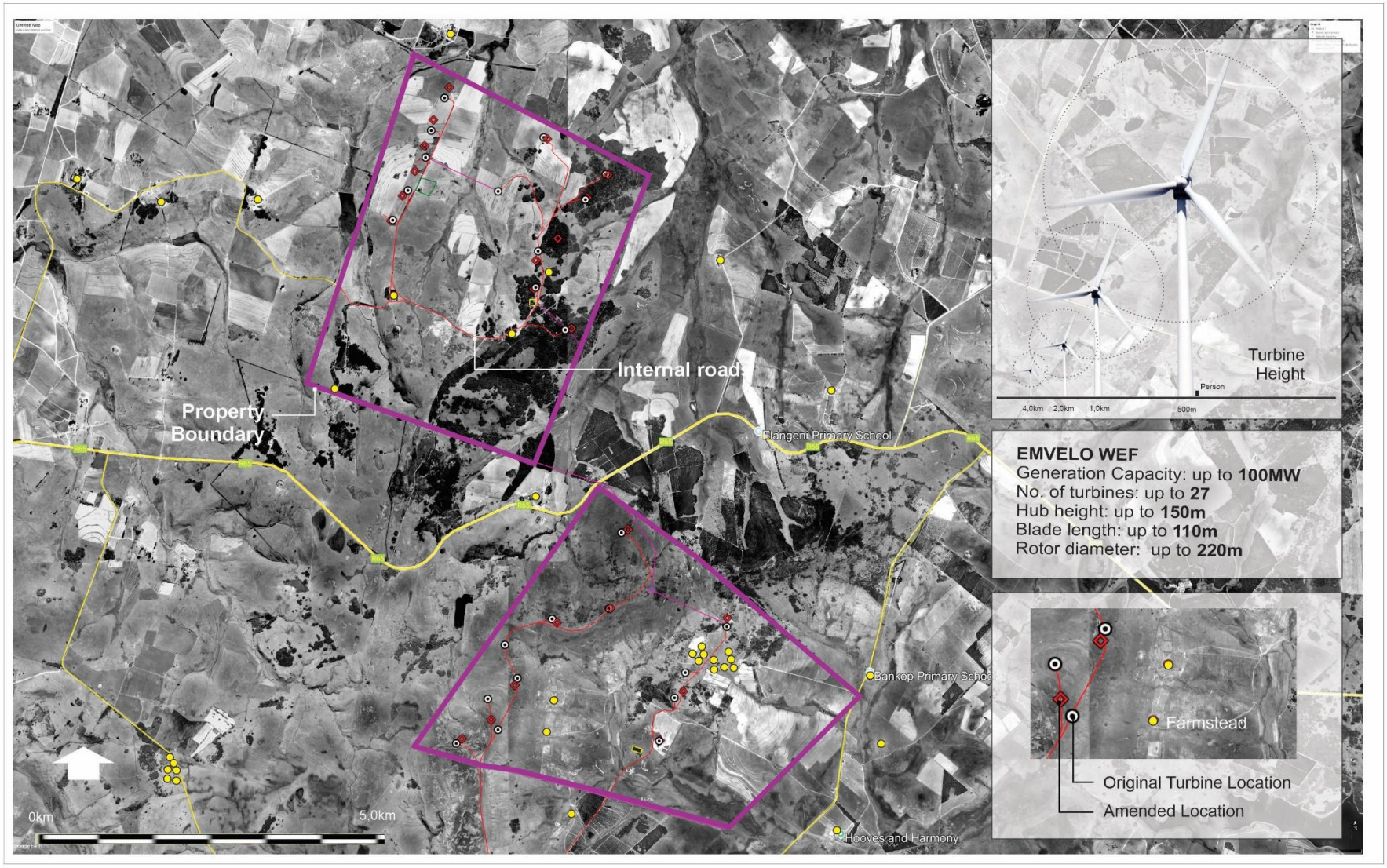


Figure A: LAYOUT EMVELO - Wind Turbine Generator Areas (original and proposed)

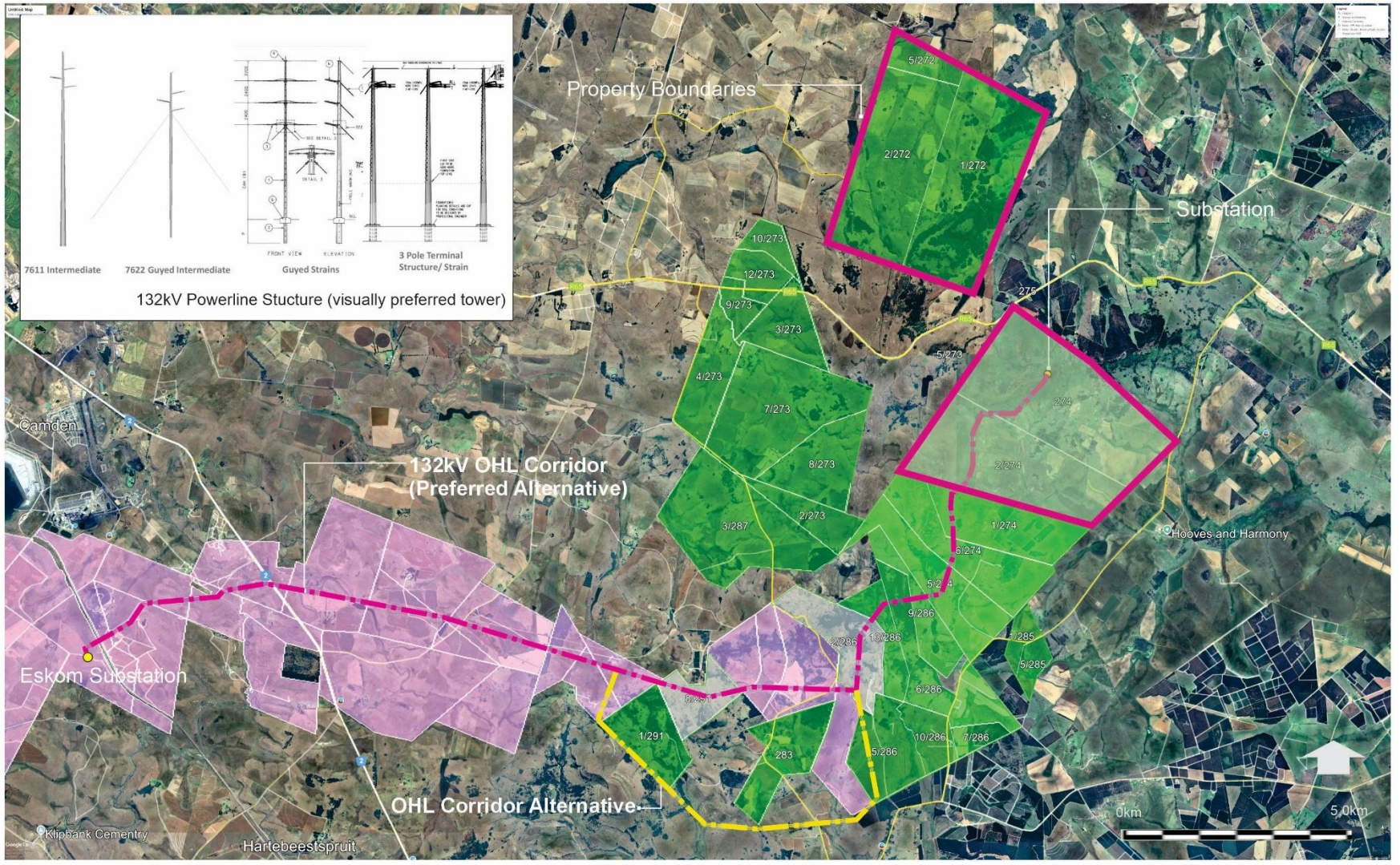


Figure B: LAYOUT EMVELO - 132kV Overhead Poweline Corridors

APPENDIX A: DETERMINING THE VISUAL RESOURCE VALUE OF A LANDSCAPE

To reach an understanding of the effect of development on a landscape resource, it is necessary to consider the distinct aspects of the landscape as follows:

Landscape Elements and Character

The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, savannah, trees, water bodies, buildings and roads are generally quantifiable and can be easily described.

Landscape character is therefore the description of pattern, resulting from combinations of natural (physical and biological) and cultural (land use) factors and how people perceive these. The visual dimension of the landscape reflects the way in which these factors create repetitive groupings and interact to create areas that have a specific visual identity. The process of landscape character assessment can increase appreciation of what makes the landscape distinctive and what is important about an area. The description of landscape character thus focuses on the *nature of the land*, rather than the response of a viewer.

Landscape Value – all encompassing (Aesthetic Value)

Aesthetic value is the emotional response derived from the experience of the environment with its natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings, and attitudes (Ramsay 1993). Thus, aesthetic value encompasses more than the seen view, visual quality, or scenery, and includes atmosphere, landscape character and sense of place (Schapper 1993).

Aesthetic appeal (value) is considered high when the following are present (Ramsay 1993):

- *Abstract qualities*: such as the presence of vivid, distinguished, uncommon or rare features or abstract attributes.
- *Evocative responses*: the ability of the landscape to evoke particularly strong responses in community members or visitors.
- *Meanings*: the existence of a long-standing special meaning to a particular group of people or the ability of the landscape to convey special meanings to viewers in general.
- *Landmark quality*: a particular feature that stands out and is recognised by the broader community.

Sense of Place

Central to the concept of a sense of place is that the place requires uniqueness and distinctiveness. The primary informant of these qualities is the spatial form and character of the natural landscape together with the cultural transformations and traditions associated with historic use and habitation. According to Lynch (1992) sense of place "is the extent to which a person can recognise or recall a place as being distinct from other places - as having a vivid, or unique, or at least particular, character of its own". Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. In some cases, these values allocated to the place are similar for a wide spectrum of users or viewers, giving the place a universally recognised and therefore, strong sense of place.

Scenic Quality

Assigning values to visual resources is a subjective process. The phrase, "beauty is in the eye of the beholder," is often quoted to emphasise the subjectivity in determining scenic values. Yet, researchers have found consistent levels of agreement among individuals asked to evaluate visual quality.

Studies for perceptual psychology have shown human preference for landscapes with a higher visual complexity particularly in scenes with water, over homogeneous areas. Based on contemporary research landscape quality increases when:

- Topographic ruggedness and relative relief increase.
- Where water forms are present.
- Where diverse patterns of grasslands and trees occur.
- Where natural landscape increases and man-made landscape decreases.
- And where land use compatibility increases, and land use edge diversity decreases (Crawford 1994).

Scenic Quality - Explanation of Rating Criteria:

(After The Visual Resource Management System, Department of the Interior of the USA Government, Bureau of Land Management)

Landform: Topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured. Outstanding landforms may be monumental, as the Fish River or Blyde River Canyon, the Drakensberg or other mountain ranges, or they may be exceedingly artistic and subtle as certain pinnacles, arches, and other extraordinary formations.

Vegetation: (Plant communities) Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular (wildflower displays in the Karoo regions). Consider also smaller scale vegetational features, which add striking and intriguing detail elements to the landscape (e.g., gnarled or wind beaten trees, and baobab trees).

Water: That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.

Colour: Consider the overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "colour" are variety, contrast, and harmony.

Adjacent Scenery: Degree to which scenery outside the scenery unit being rated enhances the overall impression of the scenery within the rating unit. The distance which adjacent scenery will influence scenery within the rating unit will normally range from 0-8 kilometres, depending upon the characteristics of the topography, the vegetative cover, and other such factors. This factor is generally applied to units which would normally rate extremely low in score, but the influence of the adjacent unit would enhance the visual quality and raise the score.

Scarcity: This factor provides an opportunity to give added importance to one or all the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is several not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery - the scarcity factor can be used to recognise this type of area and give it the added emphasis it needs.

Cultural Modifications: Cultural modifications in the landform / water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit.

Scenic Quality Inventory and Evaluation Chart

(After The Visual Resource Management System, Department of the Interior of the USA Government, Bureau of Land Management)

Key factors	Rating Criteria and Score		
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major Badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. **5**	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. **3**	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. **1**
Vegetation and landcover	A variety of vegetative types as expressed in interesting forms, textures, and patterns. **5**	Some variety of vegetation, but only one or two major types. **3**	Little or no variety or contrast in vegetation. **1**
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. **5**	Flowing, or still, but not dominant in the landscape. **3**	Absent, or present, but not noticeable. **0**
Colour	Rich colour combinations, variety, or vivid colour; or pleasing contrasts in the soil, rock, vegetation, water, or snow fields. **5**	Some severity or variety in colours and contrast of the soil, rock, and vegetation, but not a dominant scenic element. **3**	Subtle colour variations, contrast, or interest; generally mute tones. **1**
Influence of adjacent scenery	Adjacent scenery greatly enhances visual quality. **5**	Adjacent scenery moderately enhances overall visual quality. **3**	Adjacent scenery has little or no influence on overall visual quality. **0**
Scarcity	One of a kind; or unusually memorable, or exceedingly rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. National and provincial parks and conservation areas *** 5+**	Distinctive, though somewhat like others within the region. **3**	Interesting within its setting, but common within the region. **1**

Cultural modifications	Modifications add favourably to visual variety while promoting visual harmony. **2**	Modifications add little or no visual variety to the area and introduce no discordant elements. **0**	Modifications add variety but are very discordant and promote strong disharmony. **4**

Scenic Quality (i.e. value of the visual resource)

In determining the quality of the visual resource both the objective and the subjective or aesthetic factors associated with the landscape are considered. Many landscapes can be said to have a strong sense of place, regardless of whether they are scenically beautiful but where landscape quality, aesthetic value and a strong sense of place coincide - the visual resource or perceived value of the landscape is very high.

When considering both objective and subjective factors associated with the landscape there is a balance between landscape character and individual landscape features and elements, which would result in the values as follows:

Value of Visual Resource – expressed as Scenic Quality
(After The Landscape Institute with the Institute of Environmental Management and Assessment (2002))

High	Moderate	Low
Areas that exhibit an incredibly positive character with valued features that combine to give the experience of unity, richness, and harmony. These are landscapes that may be of particular importance to conserve, and which may be sensitive change in general and which may be detrimental if change is inappropriately dealt with.	Areas that exhibit positive character, but which may have evidence of alteration to /degradation/erosion of features resulting in areas of more mixed character. Potentially sensitive to change in general; again, change may be detrimental if inappropriately dealt with, but it may not require special or particular attention to detail.	Areas generally negative in character with few, if any, valued features. Scope for positive enhancement frequently occurs.

APPENDIX B: METHOD FOR DETERMINING THE *MAGNITUDE* / *INTESITY* OF LANDSCAPE AND VISUAL IMPACT

A visual impact study analysis addresses the importance of the inherent aesthetics of the landscape, the public value of viewing the natural landscape, and the contrast or change in the landscape from the Project.

For some topics, such as water or air quality, it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. The assessment of likely effects on a landscape resource and on visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations. (The Landscape Institute with the Institute of Environmental Management and Assessment (2002).

Landscape impact assessment includes a combination of objective and subjective judgements, and it is therefore important that a structured and consistent approach is used. It is necessary to differentiate between judgements that involve a degree of subjective opinion (as in the assessment of landscape value) from those that are normally more objective and quantifiable (as in the determination of magnitude of change). Judgement should always be based on training and experience and be supported by clear evidence and reasoned argument. Accordingly, suitably qualified and experienced landscape professionals carry out landscape and visual impact assessments (The Landscape Institute with the Institute of Environmental Management and Assessment (2002),

Landscape and visual assessments are separate, although linked, procedures. The landscape baseline, its analysis and the assessment of landscape effects all contribute to the baseline for visual assessment studies. The assessment of the potential effect on the landscape is carried our as an effect on an environmental resource, i.e. the landscape. Visual effects are assessed as one of the interrelated effects on population.

Landscape Impact

Landscape impacts derive from changes in the physical landscape, which may give rise to changes in its character and from effects to the scenic values of the landscape. This may in turn affect the perceived value ascribed to the landscape. The description and analysis of effects on a landscape resource relies on the adoption of certain basic principles about the positive (or beneficial) and negative (or adverse) effects of change in the landscape. Due to the inherently dynamic nature of the landscape, change arising from a development may not necessarily be significant (Institute of Environmental Assessment & The Landscape Institute (2002)).

Visual Impact

Visual impacts relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity. Visual impact is therefore measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negative impact) or enhances (positive impact) or maintains the visual quality of the area.

To assess the magnitude of visual impact four main factors are considered.

Visual Intrusion:	The nature of intrusion or contrast (physical characteristics) of a project component on the visual quality of the surrounding environment and its compatibility/discord with the landscape and surrounding land use.
Visibility:	The area/points from which project components will be visible.
Visual exposure:	Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion.
Sensitivity:	Sensitivity of visual receptors to the proposed development

Visual Intrusion / contrast

Visual intrusion deals with the notion of contextualism i.e. how well does a project component fit into the ecological and cultural aesthetic of the landscape as a whole? Or conversely what is its contrast with the receiving environment. Combining landform / vegetation contrast with structure contrast derives overall visual intrusion/contrast levels of high, moderate, and low.

Landform / vegetation contrast is the change in vegetation cover and patterns that would result from construction activities. Landform contrast is the change in landforms, exposure of soils, potential for erosion scars, slumping, and other physical disturbances that would be noticed as uncharacteristic in the natural landscape. Structure contrast examines the compatibility of the proposed development with other structures in the landscape and the existing natural landscape. Structure contrast is typically strongest where there are no other structures (e.g., buildings, existing utilities) in the landscape setting.

Photographic panoramas from key viewpoints before and after development are presented to illustrate the nature and change (contrast) to the landscape created by the proposed development. A computer simulation technique is employed to superimpose a graphic of the development onto the panorama. The extent to which the component fits or contrasts with the landscape setting can then be assessed using the following criteria.

- Does the physical development concept have a negative, positive, or neutral effect on the quality of the landscape?
- Does the development enhance or contrast with the patterns or elements that define the structure of the landscape?
- Does the design of the Project enhance and promote cultural continuity, or does it disrupt it?

The risk of the intrusion / contrast can then be measured in terms of the sensitivity of the affected landscape and visual resource given the criteria listed below. For instance, within an industrial area, a new sewage treatment works may have an insignificant landscape and visual impact; whereas in a *valued* landscape it might be considered to be an intrusive element. (Institute of Environmental Assessment & The landscape Institute (1996)).

Visual Intrusion

High	Moderate	Low	Positive
If the Project: - Has a substantial negative effect on the visual quality of the landscape. - Contrasts dramatically with the patterns or elements that define the structure of the landscape. - Contrasts dramatically with land use, settlement, or enclosure patterns. - Is unable to be 'absorbed' into the landscape.	If the Project: - Has a moderate negative effect on the visual quality of the landscape. - Contrasts moderately with the patterns or elements that define the structure of the landscape. - Is partially compatible with land use, settlement, or enclosure patterns. - Is partially 'absorbed' into the landscape.	If the Project: - Has a minimal effect on the visual quality of the landscape. - Contrasts minimally with the patterns or elements that define the structure of the landscape. - Is mostly compatible with land use, settlement, or enclosure patterns. - Is 'absorbed' into the landscape.	If the Project: - Has a beneficial effect on the visual quality of the landscape. - Enhances the patterns or elements that define the structure of the landscape. - Is compatible with land use, settlement, or enclosure patterns.

Result Notable change in landscape characteristics over an extensive area and/or intensive change over a localised area resulting in major changes in key views.	*Result* Moderate change in landscape characteristics over localised area resulting in a moderate change to key views.	*Result* Imperceptible change resulting in a minor change to key views.	*Result* Positive change in key views.

Visual intrusion also diminishes with scenes of higher complexity, as distance increases, the object becomes less of a focal point (more visual distraction), and the observer's attention is diverted by the complexity of the scene (Hull and Bishop (1988)).

Visibility

A viewshed analysis was carried out to define areas, which contain all possible observation sites from which the development would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1.8m above ground level. Topographic data was captured for the site and its environs at 10 m contour intervals to create the Digital Terrain Model (DTM). The DTM includes features such as vegetation, rivers, roads and nearby urban areas. These features were 'draped' over the topographic data to complete the model used to generate the viewshed analysis. It should be noted that viewshed analyses are not absolute indicators of the level of significance (magnitude) of the impact in the view, but merely a statement of the fact of potential visibility. The visibility of a development and its contribution to visual impact is predicted using the criteria listed below:

Visibility

High	Moderate	Low
Visual Receptors If the development is visible from over half the zone of potential influence, and/or views are mostly unobstructed and/or most viewers are affected.	*Visual Receptors* If the development is visible from less than half the zone of potential influence, and/or views are partially obstructed and or many viewers are affected	*Visual Receptors* If the development is visible from less than a quarter of the zone of potential influence, and/or views are mostly obstructed and/or few viewers are affected.

Visual Exposure

Visual exposure relates directly to the distance of the view. It is a criterion used to account for the limiting effect of increased distance on visual impact. The impact of an object in the foreground (0 – 800m) is greater than the impact of that same object in the middle ground (800m – 5.0 km) which, in turn is greater than the impact of the object in the background (greater than 5.0 km) of a particular scene.

Distance from a viewer to a viewed object or area of the landscape influences how visual changes are perceived in the landscape. Generally, changes in form, line, colour, and texture in the landscape become less perceptible with increasing distance.

Areas seen from 0 to 800m are considered foreground; foliage and fine textural details of vegetation are normally perceptible within this zone.

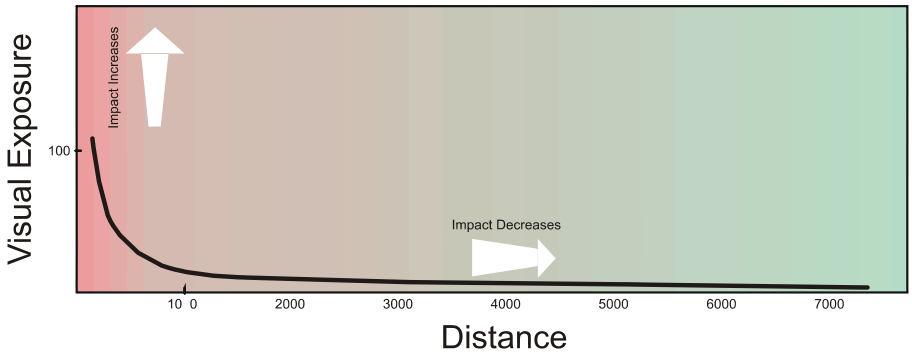
Areas seen from 800m to 5.0km are considered middle ground; vegetation appears as outlines or patterns. Depending on topography and vegetation, middle ground is sometimes considered to be up to 8.0km.

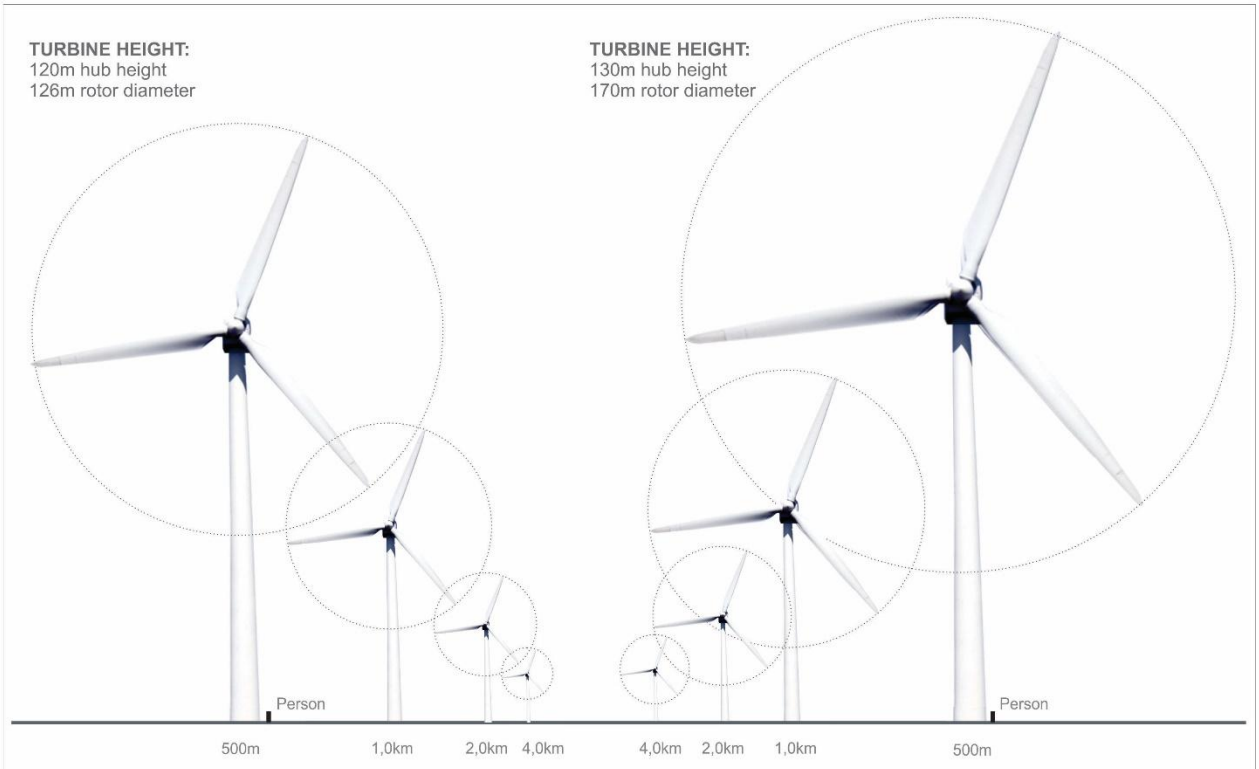
Areas seen from 5.0km to 8.0km and sometimes up to 16km and beyond are considered background. Landforms become the most dominant element at these distances.

Seldom seen areas are those portions of the landscape that, due to topographic relief or vegetation, are screened from the viewpoint or are beyond 16km from the viewpoint. Landforms become the most dominant element at these distances.

The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. Thus, the visual impact at 1000 m would be 25% of the impact as viewed from 500 m. At 2000 m it would be 10% of the impact at 500 m. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (e.g.: Hull and Bishop (1988)) and is used as an important criteria for the study. This principle is illustrated in the Figures below.

Effect of Distance on Visual Exposure





COMPARISON OF TURBINE SIZES_Visual Exposure

Sensitivity of Visual Receptors

When visual intrusion, visibility and visual exposure are incorporated, and qualified by sensitivity criteria (visual receptors) the magnitude of the impact of the development can be determined.

The sensitivity of visual receptors and views will be depended on:

- The location and context of the viewpoint.
- The expectations and occupation or activity of the receptor.
- The importance of the view (which may be determined with respect to is popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art).

The most sensitive receptors may include:

- Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape.
- Communities where the development results in changes in the landscape setting or valued views enjoyed by the community.
- Occupiers of residential properties with views affected by the development.
- These would all be high.

Other receptors include:

- People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value).
- People travelling through or past the affected landscape in cars, on trains or other transport routes.
- People at their place of work.

The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view.

In this process more weight is usually given to changes in the view or visual amenity which are greater in scale, and visible over a wide area. In assessing the effect on views, consideration should be given to the effectiveness of mitigation measures, particularly where planting is proposed for screening purposes (Institute of Environmental Assessment & The Landscape Institute (1996).

Sensitivity of Visual Receptors

High	Moderate	Low
Users of all outdoor recreational facilities including public rights of way, whose intention or interest may be focused on the landscape.	People engaged in outdoor sport or recreation (other than appreciation of the landscape, as in landscapes of acknowledged importance or value).	The least sensitive receptors are likely to be people at their place of work, or engaged in similar activities, whose attention may be focused on their work or activity and who therefore may be potentially less susceptible to changes in the view (i.e. office and industrial areas).
Communities where the development results in changes in the landscape setting or valued views enjoyed by the community.	People travelling through or past the affected landscape in cars, on trains or other transport routes.	

Occupiers of residential properties with views affected by the development.	Roads going through urban and industrial areas

Magnitude of the Visual Impact

Potential visual impacts are determined by analysing how the physical change in the landscape, resulting from the introduction of a project, are viewed and perceived from sensitive viewpoints. Impacts to views are the highest when viewers are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the change. Visual impacts occur when changes in the landscape are noticeable to viewers looking at the landscape from their homes or from parks, and conservation areas, highways and travel routes, and important cultural features and historic sites, especially in foreground views.

The magnitude of impact is assessed through a synthesis of visual intrusion, visibility, visual exposure and viewer sensitivity criteria. Once the magnitude of impact has been established this value is further qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact.

For instance, the fact that visual intrusion and exposure diminishes significantly with distance does not necessarily imply that the relatively small impact that exists at greater distances is unimportant. The level of impact that people consider acceptable may be dependent upon the purpose they have in viewing the landscape. A particular development may be unacceptable to a hiker seeking a natural experience, or a household whose view is impaired, but may be barely noticed by a golfer concentrating on his game or a commuter trying to get to work on time (Ittleson *et al.,* 1974).

In synthesising these criteria a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement. (Institute of Environmental Assessment and The landscape Institute (1996)).

Severity (Magnitude) of Visual Impact

High	Moderate	Low	Negligible
Total loss of or major alteration to key elements/features/characteristics of the baseline.	Partial loss of or alteration to key elements/features/characteristics of the baseline.	Minor loss of or alteration to key elements/features/characteristics of the baseline.	Very minor loss or alteration to key elements/features/characteristics of the baseline.
I.e. Pre-development landscape or view and/or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that may be prominent but may not necessarily be substantially uncharacteristic when set within the attributes	I.e. Pre-development landscape or view and/or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and/or introduction of elements that are not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.

	of the receiving landscape.		
High scenic quality impacts would result.	Moderate scenic quality impacts would result	Low scenic quality impacts would result.	Negligible scenic quality impacts would result.

Cumulative effects

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility (visibility) of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The landscape Institute (1996)).

APPENDIX C: CRITERIA FOR ASSESSMENT METHODOLOGY (ERM)

The purpose of the assessment of impacts in an EIA is to evaluate the likely extent and overall significance that a potential impact may have on an identified receptor or resource. Another important aspect of the assessment of impacts is to quantify those impacts that are not scientific-based or evidence-based and include the opinions of others (i.e., the involvement and comment from I&APs).

A successful assessment of the potential significance of impacts will include the description and development of 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.

A 7-step approach for the determination of significance of potential impacts was developed by ERM to align with the requirements of Appendix 3 of the EIA Regulations, 2014 (as amended). The approach is both objective and scientific based to allow appointed specialists and EAPs to retain independence throughout the assessment process.

ERM has adapted this 7-step approach from standard ranking metrics such as the Hacking Method, Crawford Method etc. The ERM 7-step approach complies with the method provided in the EIA guideline document (GN 654 of 2010) and considers international EIA Regulatory reporting standards such as the newly amended European Environmental Impact Assessment (EIA) Directive (2014/52/EU).

The 7-Step approach for determining the significance of impacts pre, and post mitigation, is described below:

Step 1: Predict potential impacts by means of an appraisal of:

Site Surveys,

Project-related components and infrastructure,

Activities related with the project life cycle,

The nature and profile of the receiving environment and potential sensitive environmental features and attributes,

Input received during public participation from all stakeholders, and

The relevant legal framework applicable to the proposed development

Step 2: Determination of whether the potential impacts identified in **Step 1** will be *direct* (caused by construction, operation, decommissioning or maintenance activities on the proposed development site or immediate surroundings of the site), *indirect* (not immediately observable or do not occur on the proposed development site or immediate surroundings of the site), *residual* (those impacts which remain after post mitigation) and *cumulative* (the combined impact of the project when considered in conjunction with similar projects in proximity).

Step 3: Description and determination of the significance of the predicted impacts in terms of the criteria below to ensure a consistent and systematic basis for the decision-making process. Significance is numerically quantified on the basis score of the following impact parameters:

1. ***Extent*** **(E)** of the impact: The geographical extent of the impact on a given environmental receptor.
2. ***Duration*** **(D)** of the impact: The length of permanence of the impact on the environmental receptor.
3. ***Reversibility*** **(R) of the impact**: The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change
4. ***Magnitude*** **(M)** of the impact: The degree of alteration of the affected environmental receptor.

5. ***Probability* (P)** of the impact: The likelihood of the impact occurring.

A widely accepted numerical quantification of significance is the formula:

S=(E+D+R+M)*P

Where: *Significance=(Extent+Duration+Reversibility+Magnitude) * Probability*

The following has also been considered when determining the significance of a potential impact.

6. **Nature (N)** of the impact: A description of what causes the effect, what will be affected, and how it will be affected.
7. **Status (S)** of the impact: described as either positive, negative, or neutral
8. **Cumulative impacts**.
9. Inclusion of **Public comment.**

The significance of environmental impacts is determined and ranked by considering the criteria presented in **Table 1** below. All criteria are rank according to 'Very Low,' 'Low,' 'Moderate,' 'High' and 'Very High' and are assigned scores of 1 to 5, respectively.

Table 1: Defining the significant in terms of the impact criteria.

Impact Criteria	Definition	Score	Criteria Description
Extent (E)	Site	1	Impact is on the site only
	Local	2	Impact is localized inside the activity area
	Regional	3	Impact is localized outside the activity area
	National	4	Widespread impact beyond site boundary. May be defined in various ways, e.g. cadastral, catchment, topographic
	International	5	Impact widespread far beyond site boundary. Nationally or beyond
Duration (D)	Immediate	1	On impact only
	Short term	2	Quickly reversible, less than project life. Usually up to 5 years.
	Medium term	3	Reversible over time. Usually between 5 and 15 years.
	Long term	4	Longer than 10 years. Usually for the project life.
	Permanent	5	Indefinite
Magnitude (M)	Very Low	1	No impact on processes
	Low	2	Qualitative: Minor deterioration, nuisance or irritation, minor change in species/habitat/diversity or resource, no or very little quality deterioration.

Impact Criteria	Definition	Score	Criteria Description
			Quantitative: No measurable change; Recommended level will never be exceeded.
	Moderate	3	Qualitative: Moderate deterioration, discomfort, Partial loss of habitat /biodiversity /resource or slight or alteration. Quantitative: Measurable deterioration; Recommended level will occasionally be exceeded.
	High	4	Qualitative: Substantial deterioration death, illness or injury, loss of habitat /diversity or resource, severe alteration, or disturbance of important processes. Quantitative: Measurable deterioration; Recommended level will often be exceeded(e.g. pollution)
	Very High	5	Permanent cessation of processes
Reversibility (R)	Reversible	1	Recovery which does not require rehabilitation and/or mitigation.
	Recoverable	3	Recovery which does require rehabilitation and/or mitigation.
	Irreversible	5	Not possible, despite action. The impact will persist, and no mitigation will remedy or reverse the impact.
Probability (P)	Improbable	1	Not likely at all. No known risk or vulnerability to natural or induced hazards
	Low Probability	2	Unlikely; low likelihood; Seldom; low risk or vulnerability to natural or induced hazards
	Probable	3	Possible, distinct possibility, frequent; medium risk or vulnerability to natural or induced hazards.
	Highly Probable	4	Highly likely that there will be a continuous impact. High risk or vulnerability to natural or induced hazards
	Definite	5	Definite, regardless of prevention measures.

The *significance* (s) of potential impacts identified according to the criteria above has been colour coded for the purpose of comparison. This colour coding will be used in impact tables.

Significance is deemed Negative (-)			**Significance is deemed Positive (+)**		
0 - 30	**31 - 60**	**61 - 100**	**0 - 30**	**31 - 60**	**61 - 100**
Low	**Moderate**	**High**	**Low**	**Moderate**	**High**

Step 4: Determination of practical and reasonable mitigation measures based on specialists' inputs and field observations following the mitigation hierarchy (avoid, minimise, manage, mitigate, or rehabilitate).

Step 5: Evaluation of predicted residual impacts after implementation of mitigation measures.

Step 6: Determination of the significance of the impact taking into consideration the predicted residual impacts after implementation of mitigation measures.

Step 7: Based on an acceptable significance of the impact, determination of the need and desirability of the proposed development and an opinion as to whether the development should proceed or not.

The Assessment of the significance of potential impacts is then populated in an Impact Summary Table.

APPENDIX D: CRITERIA FOR PHOTO / COMPUTER SIMULATION

To characterise the nature and magnitude of visual intrusion of the proposed Project, a photographic simulation technique was used. This method was used according to Sheppard (in Lange 1994), where a visual simulation is good quality when the following five criteria are met.

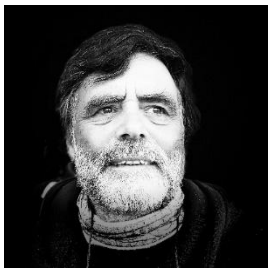
Representativeness:	A simulation should represent important and typical views of a project.
Accuracy:	The similarity between a simulation and the reality after the Project has been realised.
Visual clarity:	Detail, parts and overall contents have to be clearly recognisable.
Interest:	A simulation should hold the attention of the viewer.
Legitimacy:	A simulation is defensible if it can be shown how it was produced and to what degree it is accurate.

To comply with this standard it was decided to produce a stationary or static simulation (Van Dortmont in Lange, 1994), which shows the proposed development from a typical static observation points (Critical View Points).

Photographs are taken on site during a site visit with a manual focus, 50mm focal depth digital camera. All camera settings are recorded and the position of each panoramic view is recorded by means of a GPS. These positions, coordinates are then placed on the virtual landscape (see below).

A scale model of the proposal is built in virtual space, scale 1:1, based on CAD (vector) information as supplied by the architect / designers. This model is then placed on a virtual landscape, scale 1:1, as produced by means of GIS software. The accuracy of this depends on the contour intervals.

The camera views are placed on the points as recorded on the virtual landscape. The respective photographs are overlaid onto the camera views, and the orientation of the cameras adjusted accordingly. The light source is adjusted to suit the view. Each view is then rendered as per the process above.



Graham Young PrLArch FILASA

PO Box 331, Groenkloof, 0027
Tel: +27 0(82) 462 1491
grahamyounglandarch@gmail.com

Graham is a registered landscape architect with interest and experience in landscape architecture, urban design, and environmental planning. He holds a degree in landscape architecture from the University of Toronto and has practiced in Canada and Africa, where he has spent the greater part of his working life. He has served as President of the Institute of Landscape Architects of South Africa (ILASA) and as Vice President of the Board of Control for Landscape Architects.

During his 30 years plus career he has received ILASA and other industry awards. He has published widely on landscape architectural issues and has had projects published both locally and internationally in, scientific and design journals and books. He was a being a founding member of Newtown Landscape Architects and is also a senior lecturer, teaching landscape architecture and urban design at post and undergraduate levels, at the University of Pretoria. He has been a visiting studio critic at the University of Witwatersrand and University of Cape Town and in 2011 was invited to the University of Rhode Island, USA as their Distinguished International Scholar for that year. Recently, Graham resigned from NLA and now practices as a Sole Proprietor.

A niche specialty of his is Visual Impact Assessment for which he was cited with an ILASA Merit Award in 1999. He has completed over 250 specialist reports for projects in South Africa, Canada, and other African countries. He was on the panel that developed the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes* (2005) and produced a research document for Eskom, *The Visual Impacts of Power Line* (2009). In 2011, he produced '*Guidelines for involving visual and aesthetic specialists'* for the Aapravasi Ghat Trust Fund Technical Committee (they manage a World Heritage Site) along with the *Visual Impact Assessment Training Module Guideline Document.*

*** GYLA ***

APPENDIX F: SPECIALIST DECLARATION

SMREC Ref. No.: JT0073 – Mulilo Cluster WEF, near Ermelo, MP Province

15 May 2025

Lucian Barbeau (Project Manager)
Arcus Consultancies Services South Africa Pty (Ltd)
240 Main Road, Rondebosch
Cape Town
7700

Dear Lucian,

RE: TRAFFIC AND TRANSPORTATION SPECIALIST ADDENDUM LETTER, MULILO CLUSTER EMVELO WIND ENERGY FACILITY ("WEF"), NEAR ERMELO, MP PROVINCE

This Traffic and Transportation Specialist Addendum letter relates to the proposed changes to the final layout of the Emvelo WEF which are summarised below.

According to the information received from the Environmental Specialists, the revised final layout Emvelo WEF (**Final Layout Emvelo WEF *'Amsterdam Layout 05-05-2025.kmz')*** has impacted the following spatial considerations, specifically:

1. *Removal of 2 Wind Turbine Generators (WTGs) and shifting/rearrangement of WTG positions*
2. *Addition and rearrangement of temporary construction camp areas and permanent O&M site facilities*
3. *Re-routing of the MV cables*
4. *Realignment of internal site access roads*

Verification Statement (based on revised considerations)
This letter serves to confirm that the abovementioned amendments as contained in the revised layout *'Amsterdam Layout 05-05-2025.kmz'* will not have a significant impact on the recommendations of the Specialist Study - Traffic impact Assessment (TIA) dated 11 February 2025. Thus, the proposed amendment of the development layout can be supported subject to incorporating the recommendations outlined in the specialist study (Traffic Impact Assessment: Proposed Mulilo Cluster Emvelo WEF 1 and WEF 2, near Ermelo, MP Province).

General development details of the Mulilo Cluster Emvelo Wind Energy Facility ("WEF") are outlined below.

Project Description

The Mulilo Cluster Emvelo Wind Energy Facility ("WEF") is, located southwest of the town of Ermelo within the jurisdiction of the Msukaligwa Local and the Gert Sibande District Municipalities, in the Mpumalanga Province.

An *Environmental Authorisation (EA) is being submitted for the approval of the Environmental Management Programme (EMPr), Generic EMPrs, and Final Layout Emvelo WEF 'Amsterdam Layout 05-05-2025.kmz' to ensure that final engineering design considerations and statutory obligations are in place to support implementation of the project.*

The main components of the Mulio Cluster WEF and associated infrastructure includes inter alia:

1. *Up to 22 wind turbine generators (WTGs)*
2. *Hub heights of up to 150m*

3. *Rotor diameters up to 220m*
4. *Tip heights of up to 260m*
5. *WTG outputs of up to 260MW*
6. *A 33kV/132kV on-site IPP substation and Eskom Collector Station which will include a switchyard with collector infrastructure up to 1 ha.*
7. *Up to 33kV underground reticulation between the turbines, to be laid underground and along roads or existing areas of transformed land, where technically feasible.*
8. *Associated balance of site facilities and plant areas which will include:*
    a. *Temporary tower laydown areas.*
    b. *Temporary construction camps areas.*
    c. *Permanent Operation and Maintenance (O&M) buildings.*
    d. *Access roads to the site and between project components with a width of up to 12m.*
    e. *Perimeter fencing, fencing of all buildings, and on-site IPP substation and Eskom Collector Station fencing.*

Thank you for your attention to this matter. Should you have any questions or require further information, please do not hesitate to contact the undersigned.

Yours sincerely,



Victor de Abreu
Functional General Manager

Phone: +27 (11) 369 0600
Mobile: +27 (82) 416 9393
Email: Victor.deAbreu@smec.com

EMVELO WIND ENERGY FACILITY AND GRID CONNECTION

MPUMALANGA, SOUTH AFRICA

BAT (CHIROPTERA) EIA REPORT

February 2025

Produced for

Emvelo Wind Energy Facility (Pty) Ltd

Produced by

Camissa Sustainability Consulting

Amsterdam, Netherlands

CONTENTS

1 INTRODUCTION 1
1.1 Scope and Objectives 2
2 ASSUMPTIONS AND LIMITATIONS 2
3 LEGAL REQUIREMENTS AND GUIDELINES 3
4 SURVEY METHODOLOGY 3
5 SPECIALIST FINDINGS 5
5.1 Ecological Baseline 5
5.2 Pre-Construction Bat Monitoring Results 7
6 IDENTIFICATION AND ASSESSMENT OF IMPACTS 11
6.1 Wind Energy Facility 12
6.2 Grid Connection 19
6.3 Cumulative Impacts 21
7 ENVIRONMENTAL MANAGEMENT PROGRAMME 24
8 CONCLUSION 26
9 REFERENCES 27

Appendix 1: Figures
Appendix 2: Specialist CV
Appendix 3: Specialist Declaration
Appendix 4: SACNASP Certificate

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

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 3
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5.1, Section 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
g) an identification of any areas to be avoided, including buffers;	Section 6, Figure 5
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Appendix 1 (Figure 3)
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Section 5
k) any mitigation measures for inclusion in the EMPr;	Section 6, Section 7

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
l) any conditions for inclusion in the environmental authorisation;	Section 6, Section 7
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6, Section 7
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	NA
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	NA
q) any other information requested by the competent authority.	NA
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Appendix 5: Site Sensitivity Verification Report

1 INTRODUCTION

Emvelo Wind Energy Facility (Pty) Ltd are proposing the development of a commercial wind energy project located near Ermelo, within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province. The project forms part of a development cluster that is expected to comprise two separate Wind Energy Facilities (WEFs).

This EIA report covers the Emvelo WEF which is proposed to comprise up to 25 turbines with a maximum output capacity of up to 260 MW. The WEF will have an anticipated lifespan of 25 – 30 years. In addition to the wind energy infrastructure, it is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation. The proposed technical details of Emvelo WEF are presented below:

Developer / Applicant	Emvelo WEF
DFFE Reference	To be confirmed
WEF Generation Capacity	Up to 260 MW
Site Access	Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3m width for underground 33 kV reticulation.
Number of Turbines	Up to 25
Hub Height from ground level	Up to 150 m
Blade Length	Up to 110 m
Rotor Diameter	Up to 220 m
Length of internal roads	Unknown at this point.
Width of internal roads	Up to 12 m to be rehabilitated to up to 9 m.
On-site substation capacity	Up to 132 kV
Proximity to grid connection	Approximately 25 km
Grid Connection Capacity	Up to 132 kV
Temporary turbine construction laydown and storage areas.	Crane platforms and hardstand laydown area up to 40 ha (Up to 1 ha per turbine)
Permanent footprint area dimensions, including roads, turbine hardstand areas, O&M buildings and battery pad.	O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha
Operations and maintenance buildings (O&M building) with parking area	Up to 1 ha
Height of fencing	2.8 m
Type of fencing	Where site offices are required, temporary screen fencing used to screen offices from the wider landscape.

1.1 Scope and Objectives

This EIA report presents a Bat (Chiroptera) Impact Assessment for the Emvelo WEF and associated grid connection. Collisions with wind turbine blades are a leading cause of bat mortality globally (Cryan, 2011; O'Shea et al., 2016). Given the nature, scale, and uncertainty of these impacts to bats, specialist studies are required to assess the risks of renewable energy infrastructure on bats (Rodrigues 2015, MacEwan et al. 2020b, SANBI 2020, Bennun et al. 2021).

The objectives of this assessment are to present the baseline ecological condition of the project site for bats, and to use these characterisations to predict and assess the potential impact of the project on bat species and their habitats as well as to provide actions to mitigate impacts if required.

2 ASSUMPTIONS AND LIMITATIONS

The core techniques used to assess bat activity in this study are acoustic monitoring and roost surveys, both of which have several limitations which will influence the findings and recommendations of this study.

Acoustic monitoring allows for rapid, passive collection of a large volume of bat activity data which can help identify the bat species present within a particular location and their associated spatio-temporal relative activity patterns. In the context of wind farms, acoustic monitoring is therefore a useful technique however, there are several constraints that must be acknowledged. These are discussed in detail by Voigt et al. (2021), Adams et al. (2012), and Kunz et al. (2007a) and fundamentally, include that acoustic monitoring cannot provide an indication of bat abundance or population size at a site. In addition, population demographics such as age and sex of bats cannot generally be determined from echolocation calls.

Due to the large volume of data collected by bat detectors it is impractical and prohibitively time-consuming to inspect each file for echolocation calls and to identify the associated bat species. Specialised statistical software uses bat call reference libraries to automate the identification process but developing such libraries is challenging given the variation individual species display in their echolocation call structure and overlap between species. This study used the Wildlife Acoustics library "Bats of South Africa Version 5.4.2", but this excludes reference calls for most South African species thus these may have been overlooked. However, given the duration of the monitoring and spatial coverage of the detectors, the acoustic data provides a reasonable inventory of the species present, and a good indication of the relative magnitude of bat activity. Lastly, bat activity is notably variable in response to a number of factors such as land use change, climactic variability, variations in prey abundance and meteorological conditions which can vary over different time scales. Since this study is limited to 12 months, the baseline conditions presented here may not be representative of activity over longer time frames meaning risk may be misinterpreted.

The major limitation with roost surveys is finding roosting bats. Bats use a diversity of roosting sites including trees, buildings, crevices, and underground sites (caves and mines). The presence of these features at a site can help to target roost searches but evidence of bats may not always be apparent even if bats are present. Importantly, the absence of bat evidence in these situations does not equate to evidence of bat absence (Collins 2006). Thus, this study uses a precautionary approach and will apply buffers to roosts (largely buildings and rocky crevices) even if bats were not located given their potential role in supporting roosting bats.

It is difficult to assess the risk to bats during operation of the proposed facility based on acoustic data collected during pre-construction surveys. For example, Hein et al. (2013) showed that pre-construction bat activity was not a significant indicator of collision risk. Lintott et al. (2016) argued that environmental impact assessments do not predict the risks to bats accurately. This may partly be because it is hypothesized that bats may be attracted to wind turbines (Cryan and Barclay 2009, Guest et al. 2022) which some evidence suggests may be the case (Horn et al. 2008, Richardson et al. 2021). While this report makes predications about the potential risk to bats posed by the project, these carry a degree of uncertainty and

must be verified by using post-construction surveys to ensure that the predictions are accurate and bat behaviour has not altered from pre-construction levels (Lintott et al. 2016).

Risk to bats was determined based on median bat activity per night derived from the bat activity dataset collected with acoustic monitoring. Median values were compared to those in Table 5 in MacEwan et al. (2020b) which provides height-specific fatality risk categories (high, medium, low) based on bat activity sampled in different South African terrestrial ecoregions. The Project Area of Influence (PAOI) is situated in the Highveld Grasslands ecoregion (Dinerstein et al. 2019) however reference values are not available for this ecoregion in MacEwan et al. (2020b). Instead, median values were compared to reference values for the Drakensberg Grasslands, Woodlands and Forest ecoregion. While bat activity levels differ between these two ecoregions this difference is small (MacEwan et al. 2020a). The lack of a direct reference for the Highveld Grasslands ecoregion is therefore not a major limitation and the comparison is suitable to provide an evaluation of risk.

3 LEGAL REQUIREMENTS AND GUIDELINES

The EIA processes for this project is being undertaken in terms of Government Notice (GN) No. R. 983 of 4 December 2014 (as amended to GNR 327), promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) EIA Regulations, 2014 (as amended). In addition, there are various international, regional, and local legislation, policies, regulations, guidelines, conventions, and treaties in place for the protection of biodiversity, under which bats would also be protected or considered. These create a policy environment and impact management framework aiming to prevent excessive impacts to biodiversity and which was used to assess risk of this specific project. Specific policies include the following:

- Convention on Biological Diversity Post-2020 Global Biodiversity Framework
- United Nations Sustainable Development Goals
- Convention on the Conservation of Migratory Species of Wild Animals (1979)
- Convention on Biological Diversity (1993)
- Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)
- National Environmental Management Act, 1998 (NEMA, Act No. 107 of 1998)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
- Northern Cape Nature Conservation Act (Act 9 of 2009)
- The Equator Principles (2013)
- International Finance Corporation Performance Standards (PS6)
- The Red List of Mammals of South Africa, Swaziland, and Lesotho (2016)
- South Africa National Biodiversity Strategy and Action Plan (2005)
- Guidelines for the implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for environmental impact assessments in South Africa
- Mitigating biodiversity impacts associated with solar and wind energy development. IUCN Guidelines for project developers (2021)
- South African Good Practise Guidelines for Surveying Bats in Wind Energy Facility Developments – Pre-Construction (2020)
- South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (2020)
- South African Bat Fatality Threshold Guidelines (2018)
- Mitigation Guidance for Bats at Operational Wind Energy Facilities in South Africa (2018)

4 SURVEY METHODOLOGY

The Project Area of Influence (PAOI) was defined as the Area of Interest (AoI) of the development cluster plus a 10 km buffer given that bats are flying mammals (Scottish Natural Heritage 2019). This area was studied at a desktop level to determine which bat species (i.e., impact receptors) are likely to occur within the PAOI, to

provide information on their natural history and conservation status, and to contextualise the project site within the larger social-ecological environment with respect to bats.

Bats were also studied through 12 months of acoustic monitoring in the AoI which began on 26 April 2022 and ended on 4 July 2023. After this, monitoring continued at one met mast location until 11 November 2023. Bat activity was sampled at 11 locations (Figure 1, Table 1) within the AoI with Wildlife Acoustics, Inc. SM4 bat detectors. At nine locations (AM4 – AM12), SMM-U2 microphones were positioned at the top of a 10 m aluminium mast. At the remaining two locations (AM1 and AM3), microphones were positioned on meteorological towers at 10 m, 50 m, and 90 mrespectively. Equipment at AM12 was stolen and therefore data from this location were not available to be assessed in this report.

The bat detectors were programmed to record activity nightly, from 30 minutes before sunset to 30 minutes after sunrise, and this report summarises 518 nights of bat activity data. This monitoring period therefore spans of all four seasons providing a representative account of temporal bat activity patterns across a year. Acoustic data retrieved from each bat detector were processed using Kaleidoscope® Pro (Version 5.4.2, Wildlife Acoustics, Inc.). Bats were automatically identified using the embedded "Bats of South Africa Version 5.4.0" reference library and verified by inspecting echolocation files. The number of acoustic files recorded was used as a measure to quantify bat activity, whereby each file was considered one bat pass of the microphone.

Roost surveys were undertaken which entailed discussions with landowners to locate any known roosts or potential roosts with evidence of bats. In addition, buildings at farmsteads within the PAOI, as well as accessible rocky outcrops/crevices, were systematically surveyed during field visits in November 2022 (spring), and January 2023 (summer). The surveys aimed to directly observe roosting bats, locate evidence of roosting bats (e.g., culled insect remains, fur-oil-stained exit and entry points, guano/droppings), and assess the likelihood for each potential roost to support bats.

Table 1: Summary of the Bat Acoustic Monitoring Sampling Locations and Effort

Bat Detector	Coordinates	# Sample Nights	Altitude (m)	Habitat Features
AM1 (Met mast)	-26.612298°S 30.317572°E	10m: 518 50 m: 226 90 m: 478	1,778	In Wakkerstroom Montane Grassland, 400 m west of small escarpment, 560 m north of farm dam, 440 m west of woodland patch, 560 m northeast of wetland
AM3 (Met Mast)	-26.587572°S 30.284137°E	10 m: 340 50 m: 435 90 m: 326	1,748	In Wakkerstroom Montane Grassland, 420 m west of farmstead, 420 m east of stream and seep wetland
AM4	-26.665933°S 30.321221°E	208	1,550	In Eastern Highveld Grassland, 360 m west of cultivated area, 230 m southeast of woodland, 240 m north east of stream, 430 m south east of depression wetland
AM5	-26.611025°S 30.363393°E	377	1,515	In Eastern Highveld Grassland, on border of cultivated areas and disturbed grassland, 470 m southeast of stream, wetland and woodland patch, 2.4 km northwest of farmstead
AM6	-26.562101°S 30.296970°E	242	1,732	In Wakkerstroom Montane Grassland, at edge of woodland patch, 80 m east of depression wetland, 255 m west of stream
AM7	-26.640015°S 30.306442°E	194	1,655	Within wooded valley, 60 m west of stream, 300 m east of seep wetland
AM8	-26.621551°S 30.277550°E	137	1,735	In Wakkerstroom Montane Grassland, 680 m west of woodland patch,167 m north of seep wetland
AM9	-26.549013°S 30.315353°E	51	1,667	In Eastern Highveld Grassland adjacent to wetland and surrounded by trees
AM10	-26.592367° S 30.336850°E	163	1,696	In Wakkerstroom Montane Grassland, above small escarpment in shallow wooded valley

Table 1: Summary of the Bat Acoustic Monitoring Sampling Locations and Effort				
Bat Detector	**Coordinates**	**# Sample Nights**	**Altitude (m)**	**Habitat Features**
AM11	-26.632172°S 30.265925°E	163	1,694	In Eastern Highveld Grassland adjacent to tree edge line, 220 m south east of wetland, installed at farmstead

5 SPECIALIST FINDINGS

5.1 Ecological Baseline

The Project Area of Influence (PAOI) is situated in the Grassland Biome and comprises predominantly Eastern Highveld Grassland vegetation (Figure 1). The landscape associated with this vegetation consists of slight to moderately undulating plains with small scattered rocky outcrops. The vegetation is short, dense grassland (Mucina and Rutherford 2006). Wakkerstroom Montane Grassland occurs in the middle of the PAOI, on low mountains and undulating plains. Here the vegetation comprises short montane grassland on plateaus and flat areas. On steep, east facing slopes and in drainage areas, short forest and thicket occurs. Both vegetation types are endemic, and Eastern Highveld Grassland is classified as Vulnerable while Wakkerstroom Montane Grassland is classified as Least Concern (SANBI 2018). The PAOI includes some low hills and wetland depressions and has largely been transformed by cultivation in the west, commercial forestry in the east and urban sprawl, including extensive areas of alien invasive trees. The PAOI is in a summer rainfall region and has a cool-temperate climate with dry winters, frequent occurrence of frost and large differences in both diurnal and seasonal temperature extremes (Mucina and Rutherford 2006).

Critical Biodiversity Areas (CBA), areas of high biodiversity value that must be maintained in a natural state, are located throughout the PAOI, classified as either “CBA Irreplaceable” and “CBA Optimal” (Figure 1). The former category comprises 1) areas required to meet conservation targets and those with irreplaceability values greater than 80 %, 2) areas which represent critical linkages or pinch-points in the landscape that must remain natural, and 3) Critically Endangered ecosystems (MTPA 2014). The latter category comprises areas that are not ‘irreplaceable’, but they are the most optimal land configuration to meet all biodiversity targets. Ecological Support Areas (ESA), not essential for meeting biodiversity targets but important in supporting the functioning of CBAs and delivering important ecosystem services, are also located throughout the PAOI.

Parts of the PAOI fall within a National Protected Areas Expansion Strategy (NPAES) Focus area (Moist Escarpment Grasslands), targeted for protected area expansion for improved ecosystem representation, ecological sustainability and resilience to climate change. Chrissiesmeer Protected Environment and Jericho Dam Nature Reserve overlap the north and east of the PAOI respectively (Figure 1).

Bat roosting sites in the PAOI are relatively limited and unlikely to support large congregations of bats, with no underground sites (e.g., caves, mines, sinkholes) known to be present. The closest known major bat roost is approximately 70 km north of the PAOI. Although occasional ridges and rocky outcrops are features of the landscape (Mucina and Rutherford 2006) these are not extensive. Some bat species could roost in these features. Bats are likely to roost in buildings associated with farmsteads within and bordering the AoI especially Cape Serotine and Egyptian Free-tailed Bat (Monadjem et al. 2020). Trees growing at these farmsteads and elsewhere on site where they form clumps, could also provide roosting spaces for bats, even though most are alien invasive species. Completed surveys of some buildings in the of the PAOI did not reveal the presence of roosting bats and as such were assessed as being of low relative suitability. However, these could be used by bats as night-roosts (locations used by bats to feed on captured prey, or to rest between foraging bouts) and should therefore still be considered, and avoided where possible, in the spatial planning.

Sensitive features in the PAOI at which bat foraging activity may be concentrated include farm buildings where they would forage for insects attracted to lighting (Rydell 1992, Jung and Kalko 2010), dams and wetland areas (Sirami et al. 2013), within and along the edge of woodland/tree patches, and over cultivated

areas (Bohmann et al. 2011, Noer et al. 2012). Free-tailed bats (Molossidae) will fly at high altitudes, and their foraging habitat is essentially all airspaces (McCracken et al. 2008, Nguyen et al. 2019).

Based on current taxonomic information and bat occurrence data, 23 species could occur within the PAOI (Table 2). The majority have a low likelihood of occurrence however the potential suite of species includes 10 high risk species, including fruit bats (Pteropodiae) and free-tailed bats (Molossidae) which are vulnerable to wind energy impacts in South Africa (MacEwan 2016, Aronson 2022).

Table 2: Bat Species Potentially Occurring within the PAOI

Common Name Species Name	Key Habitat Requirements*	Prob. Of Occurrence	Conservation Status		Wind Energy Risk[δ]
			IUCN[†]	RSA[!]	
Natal Long-fingered bat *Miniopterus natalensis*	Temperate or subtropical species. Primarily in savannahs and grasslands. Roosts in caves, mines, and road culverts. Clutter- edge forager. Migratory.	**Confirmed (5,018 passes)**	LC/U	LC	**High**
Lessor Long-fingered bat *Miniopterus fraterculus*	Temperate species, associated with grasslands. Cave-dependant but also roosts in tunnels and mines. Habitat includes savannah bushveld, moister mistbelt and coastal forest habitats. Clutter-edge forager. Migratory.	Moderate	LC/U	LC	**High**
Cape Serotine *Laephotis capensis*	Arid semi-desert, montane grassland, forests, savannah and shrubland. Roosts in vegetation and human-made structures. Clutter-edge forager.	**Confirmed (50,243 passes)**	LC/S	LC	**High**
Mauritian tomb bat *Taphozous mauritianus*	Savannah woodland preferring open habitat. Roosts on rock faces, the outer bark of trees or on the outer walls of buildings under the eaves of roofs. Forages in urban areas and over cultivation. Open- air forager.	High	LC/U	LC	**High**
Little Free-tailed bat *Mops pumilus*	Semi-arid savannah, forested regions, woodland habitats. Roosts in narrow cracks in rock and trees but also in buildings. Open-air forager. Forages in urban areas and over cultivation.	**Confirmed (1,767 passes)**	LC/U	LC	**High**
Midas Free-tailed bat *Mops midas*	Hot low-lying savannah and woodland. Roosts in narrow cracks in rock and trees but also in buildings. Open-air forager.	Low	LC/D	LC	**High**
Egyptian Free-tailed bat *Tadarida aegyptiaca*	Desert, semi-arid scrub, savannah, grassland, and agricultural land. Roosts in rocky crevices, caves, vegetation, and human-made structures. Open-air forager.	**Confirmed (20,995 passes)**	LC/U	LC	**High**
Wahlberg's Epauletted fruit bat *Epomophorus wahlbergi*	Roost in dense foliage of large, leafy trees. Associated with forest and forest-edge habitats but will forage in urban environments.	Low	LC/S	LC	**High**
African Straw-coloured fruit bat *Eidolon helvum*	Non-breeding migrant in the PAOI.	Low	NT/D	LC	**High**
Egyptian Rousette *Rousettus aegyptiacus*	Distribution influenced by availability of suitable caves roosts.	Low	LC/S	LC	**High**
Temminck's Myotis *Myotis tricolor*	Montane forests, rainforests, coastal forests, savannah woodlands, arid thicket, and fynbos. Roosts communally in caves (and mines) and closely associated with mountainous terrain. Migratory. Clutter-edge forager.	Low	LC/U	LC	**Medium-High**
Welwitsch's Myotis *Myotis welwitschii*	Mainly open woodland and savannah but also high-altitude grassland, tropical dry forest, montane tropical moist forest, savannah and shrublands. Clutter-edge forager.	Low	LC/U	LC	**Medium-High**
Yellow-bellied house bat *Scotophilus dinganii*	Occurs throughout the Savannah Biome but avoids open habitats such as grasslands and Karoo scrub. Roosts in hollow trees and buildings. Clutter-edge forager.	**Confirmed (169 passes)**	LC/U	LC	**Medium-High**
Dusky Pipistrelle *Pipistrellus hesperidus*	Woody habitats, such as riparian vegetation and forest patches. Recorded roosting in narrow cracks in rocks and under the loose bark of dead trees. Clutter-edge forager.	Low	LC/U	LC	**Medium-High**
Rusty Pipistrelle	Savannah woodland and associated with open water	Low	LC/U	LC	**Medium-**

Pipistrellus rusticus	bodies. Roosts in trees and old buildings. Clutter-edge forager.				High
Long-tailed Serotine *Eptesicus hottentotus*	Montane grasslands, marshland and well- wooded riverbanks, mountainous terrain near water. Roosts in caves, mines, and rocky crevices. Clutter-edge forager.	**Confirmed (368 passes)**	LC/U	LC	**Medium**
Egyptian Slit-faced bat *Nycteris thebaica*	Savannah, desert, arid rocky areas, and riparian strips. Gregarious and roosts in caves but also in mine adits, Aardvark holes, rock crevices, road culverts, roofs, and hollow trees. Clutter forager.	Medium	LC/U	LC	**Low**
Geoffroy's Horseshoe bat *Rhinolophus clivosus*	Savannah woodland, shrubland, dry, riparian forest, open grasslands, and semi- desert. Roosts in caves, rock crevices, disused mines, hollow baobabs, and buildings. Clutter forager.	Medium	LC/U	LC	**Low**
Bushveld Horseshoe bat *Rhinolophus simulator*	Occurs in caves within areas of moist savannah, adjacent to rivers and savannah woodland, montane habitats, and coastal mosaics. Commonly associated with riparian forest and along wooded drainage lines. Roosts in caves and mines. Clutter forager.	Medium	LC/D	LC	**Low**
Blasius's Horseshoe bat *Rhinolophus blasii*	Savannah woodlands and are dependent on the availability of daylight roosting sites such as caves, mines, or boulder piles.Clutter forager.	Low	LC/D	NT	**Low**
Darling's Horseshoe bat *Rhinolophus darlingi*	Mesic woodland savannahs. Roosts in caves, boulder piles, mines, culverts, large hollow trees and disused buildings. Clutter forager.	Low	LC/U	LC	**Low**
Sundevall's Leaf-nosed bat *Hipposideros caffer*	Savannah, bushveld and/or coastal forests, near to rivers and other water sources. Roosts in caves, sinkholes, rock fissures, hollow trees, mines, and culverts. Clutter forager.	Low	LC/D	LC	**Low**
Percival's Short-eared Trident bat *Cloeotis percivali*	Savannah and woodland areas. Roosts in caves and mine tunnels. Clutter forager.	Low	LC/U	EN	**Low**

*Child et al. (2016), *Monadjem et al. (2020); [!] Child et al. (2016); [†] IUCN (2021); [δ] MacEwan et al. (2020b)

5.2 Pre-Construction Bat Monitoring Results

Six bat species were confirmed to occur in the PAOI (Table 2) including four species classified as high risk from wind energy development: Natal Long-fingered bat, Cape Serotine, Little Free-tailed bat, and Egyptian Free-tailed bat. All of these species have a conservation status of Least Concern (both globally and regionally) and no red data species with a higher conservation status were detected. Although these species are currently classified as Least Concern, Rodhouse et al. (2019), Davy et al. (2020) and Frick et al. (2017) have all shown that in North America, Least Concern bats may be experiencing impacts due to wind farms that could result in changes to their conservation status. The global population trend is unknown for Natal Long-fingered bat, Little Free-tailed bat, and Egyptian Free-tailed bat but stable for Cape serotine. Given the unknown population trends for some of these species and the evidence of impacts from wind farms, ongoing monitoring and adaptive management will be essential to ensure their conservation status does not deteriorate.

A total of 80,051[1] bat passes were recorded over 518 sample nights. Most activity was attributed to Cape serotine (63 %) and Egyptian free-tailed bat (27 %). These species comprise the majority of bat fatalities at South African wind farms (Aronson 2022). Natal long-fingered bat accounted for 6 % of total activity. The remaining three species (Little free-tailed bat, Long-tailed serotine and Yellow-bellied house bat) were seldomly recorded and the magnitude of their activity suggests they would be at low risk of impacts. As such, the remainder of this section focuses on impacts to Egyptian free-tailed bat, Cape serotine and Natal long-fingered bat.

Based on MacEwan et al. (2020b), Cape serotine activity was predominantly low but high activity was recorded at AM5, AM8, AM9 and AM11, in summer and autumn (Table 3). The latter two monitoring stations were located at a farm dam and at a farmstead respectively indicating higher activity in relation to

[1] Exclusive of an additional 1,491 bat passes unable to be identified to a species.

these landscape features. This species was also recorded at 50 m and 90 m but the magnitude of its activity was mostly low except for at AM3-50 during March and April when its activity suggests medium risk. Based on the dataset, this species is largely predicted to be at low collision risk. However, bats in the same family (Vespertilionidae) are known to be attracted to wind turbines in the United Kingdom (Richardson et al. 2021). Thus, although the data suggest a low collision risk, the installation of wind turbines in the landscape can alter bat activity patterns. Collision risk for this species will also depend on how close turbine blades reach the ground, with risk increasing the closer the blades reach the ground (Garvin et al. 2024).

Table 3: Median number of bat passes per hour per night for Cape serotine and associated risk based on MacEwan et al. (2020b).

site	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	
AM1-10	0.19	0.18	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	Risk Rating
AM1-50		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		High
AM1-90		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Medium
AM3-10	1.35	0.56		0.08	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.49	Low
AM3-50	0.00	0.00	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No Data
AM3-90	0.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AM4	0.29	1.20		0.39	0.08	0.00	0.00	0.08	0.93	0.74	0.00		
AM5	0.19	4.65	3.32	1.27	0.08		0.00	0.08	0.54	0.79	0.56	0.88	
AM6				1.01	0.22	0.00	0.07	0.23	0.61	0.00	0.28		
AM7				0.00	0.00	0.00	0.00	0.00	0.20		0.00		
AM8				0.08	0.00	1.11	0.81	0.08	2.18				
AM9		8.19	8.53	0.00									
AM10	0.19	0.00	0.26	0.08	0.08							0.00	
AM11	25.90	20.76	12.50	6.14	3.10							15.07	

The timeseries data indicate a clear seasonal pattern in bat activity for the Cape serotine (Table 4), with the mean number of bat passes per hour peaking significantly during summer, reaching up to 13.66 passes per hour. This is largely driven by activity at AM11 and AM9. This heightened activity in summer likely reflects optimal weather conditions and increased prey availability. In autumn, bat activity remains relatively moderate, with values between 0.02 and 3.48 passes per hour, suggesting continued but reduced presence compared to summer. In contrast, winter and spring exhibit notably lower levels of activity, with mean passes per hour not exceeding 1.17 in spring and 0.68 in winter. This seasonal trend suggests that Cape serotine bats are minimally active during colder months, likely due to reduced foraging opportunities or temperature constraints. Additionally, within each season, there is a gradual decrease in bat passes across a night. Peak activity in summer and spring is between 19:00 and 21:00, in autumn between 18:00 and 20:00, and in winter between 17:00 and 19:00.

Table 4: Heatmap showing the mean number of bat passes per hour for Cape serotine. Colour gradient is relative and not based on thresholds.

Time Period	Autumn	Spring	Summer	Winter
17:00 – 18:00	1.28	0.01	0.00	0.58
18:00 – 19:00	3.48	0.73	0.27	0.68
19:00 – 20:00	2.51	1.17	13.66	0.21
20:00 – 21:00	1.80	1.06	7.40	0.13
21:00 – 22:00	1.29	0.92	4.01	0.06
22:00 – 23:00	1.07	0.68	3.39	0.02
23:00 – 00:00	0.82	0.45	2.63	0.00
00:00 – 01:00	0.73	0.46	2.13	0.00
01:00 – 02:00	0.73	0.27	1.56	0.00
02:00 – 03:00	0.66	0.25	1.24	0.00

03:00 – 04:00	0.49	0.20	1.08	0.00
04:00 – 05:00	0.41	0.08	2.64	0.00
05:00 – 06:00	0.51	0.00	0.62	0.00
06:00 – 07:00	0.02	0.00	0.00	0.04

The data showed that at 50 m and 90 m, moderate collision risk is predicted for Egyptian free-tailed bat apart from during autumn and spring when high risk is predicted (Table 5). High risk is predicted near AM11 in autumn, and AM4 and AM5 during spring. Egyptian free-tailed bat is flexible in its foraging strategy, and it is thought that the habitat below has little influence on this species (Monadjem et al. 2020). These bats are open-air foragers based on their morphology and echolocation (Norberg and Rayner 1987) which means they tends to forage high in the air.

Table 5: Median number of bat passes per hour per night for Egyptian free-tailed bat and associated risk based on MacEwan et al. (2020b).

site	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Risk Rating
AM1-10	0.10	0.18	0.86	0.00	0.07	0.00	0.00	0.08	0.08	0.40	0.75	0.29	High
AM1-50		0.18	0.34	0.56	0.15		0.00	0.08	0.08	0.17	0.28		Medium
AM1-90		0.00	0.17	0.25	0.08	0.00	0.00	0.00	0.08	0.18	0.19		Low
AM3-10	0.09	0.00		0.23	0.15	0.00	0.00	0.08	0.33	0.17	0.62	0.39	No Data
AM3-50	0.10	0.04	0.51	0.62	0.08	0.00	0.00	0.08	0.16	0.45	0.52	0.20	
AM3-90	0.00			0.08	0.08	0.00	0.00	0.08	0.17	0.44	0.24	0.00	
AM4	0.00	0.00		0.39	0.23	0.00	0.07	0.39	1.95	2.57	0.55		
AM5	0.00	0.09	0.51	0.78	0.26		0.19	0.39	1.59	2.00	1.83	0.59	
AM6				0.08	0.08	0.00	0.00	0.00	0.37	0.17	0.00		
AM7				0.00	0.00	0.00	0.00	0.00	0.08		0.00		
AM8				0.15	0.08	0.07	0.00	0.08	0.57				
AM9		0.31	0.60	0.00									
AM10	0.00	0.00	0.00	0.08	0.08							0.00	
AM11	0.39	0.45	1.55	2.23	0.54							1.13	

Table 6: Heatmap showing the mean number of bat passes per hour for Egyptian free-tailed bat. Colour gradient is relative and not based on thresholds.

Time Period	Autumn	Spring	Summer	Winter
17:00 – 18:00	0.04	0.03	0.00	0.08
18:00 – 19:00	0.47	0.54	0.02	0.36
19:00 – 20:00	0.67	0.96	0.46	0.22
20:00 – 21:00	0.78	1.03	0.50	0.17
21:00 – 22:00	0.77	1.11	0.46	0.10
22:00 – 23:00	0.75	1.09	0.54	0.08
23:00 – 00:00	0.57	1.11	0.46	0.05
00:00 – 01:00	0.55	1.40	0.57	0.03
01:00 – 02:00	0.51	1.14	0.55	0.02
02:00 – 03:00	0.44	0.83	0.36	0.01
03:00 – 04:00	0.26	0.54	0.16	0.02
04:00 – 05:00	0.15	0.13	0.11	0.00
05:00 – 06:00	0.03	0.01	0.00	0.00
06:00 – 07:00	0.01	0.00	0.00	0.02

In spring, Egyptian free-tailed bat shows the highest activity levels overall, with peak passes per hour occurring around midnight (00:00 – 01:00) at 1.4 passes per hour (Table 6). This elevated activity during

spring nights aligns somewhat with the Cape serotine data, where spring showed moderate activity; however, for the Egyptian free-tailed bat, spring is a clear peak season. In summer, activity for the Egyptian free-tailed bat is relatively lower compared to spring, with values not exceeding 0.57 passes per hour and generally concentrated in the earlier hours of the night. This is a notable contrast to Cape serotine, which displayed its highest seasonal activity in summer. This suggests that while the Cape serotine is more active during summer, the Egyptian free-tailed bat is less active during this period, potentially indicating differing ecological preferences or behavioural patterns. Autumn displays a moderate level of activity for the Egyptian free-tailed bat, with values peaking around 20:00 – 21:00 at 0.78 passes per hour and then gradually decreasing through the night. This pattern is consistent with the Cape serotine, where autumn also showed moderate activity. In winter, the Egyptian free-tailed bat shows low activity levels across all hours, with peak activity reaching only 0.36 passes per hour early in the evening (18:00–19:00) and decreasing to nearly zero later at night. This aligns with the winter results for the Cape serotine bat, confirming that winter is a low-activity season for both species.

Table 7: Median number of bat passes per hour per night for Natal long-fingered bat and associated risk based on MacEwan et al. (2020b).

site	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
AM1-10	0.10	0.09	3.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AM1-50		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
AM1-90		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AM3-10	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AM3-50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AM3-90	0.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AM4	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AM5	0.00	0.13	0.26	0.23	0.00		0.00	0.00	0.00	0.00	0.00	0.00
AM6				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AM7				0.00	0.00	0.00	0.00	0.00	0.00		0.00	
AM8				0.00	0.00	0.00	0.04	0.08	0.24			
AM9		3.30	2.86	0.04								
AM10	0.00	0.00	0.00	0.00	0.00							0.00
AM11	0.19	0.27	0.75	0.24	0.08							0.00

Risk Rating
High
Medium
Low
No Data

Activity of Natal long-fingered bat was predominantly low but high activity was recorded during spring at AM1 and AM9. Medium activity was also recorded during spring at AM5 and AM11 (Table 7). As such, overall impacts to this species are anticipated to be low, especially since activity levels at 50 m and 90 m were assessed as low based on criteria in MacEwan et al (2020b). However, this species may experience high cumulative impacts (see Section 6.3).

Table 7: Heatmap showing the mean number of bat passes per hour for Natal long-fingered bat. Colour gradient is relative and not based on thresholds.

Time Period	Autumn	Spring	Summer	Winter
17:00 – 18:00	0.06	0.00	0.00	0.12
18:00 – 19:00	0.22	0.00	0.02	0.07
19:00 – 20:00	0.18	0.01	0.15	0.02
20:00 – 21:00	0.58	0.01	0.07	0.02
21:00 – 22:00	0.69	0.02	0.34	0.02
22:00 – 23:00	0.42	0.01	0.35	0.02
23:00 – 00:00	0.27	0.02	0.24	0.01
00:00 – 01:00	0.22	0.02	0.21	0.01

01:00 – 02:00	0.15	0.00	0.13	0.00
02:00 – 03:00	0.16	0.00	0.06	0.00
03:00 – 04:00	0.10	0.00	0.02	0.00
04:00 – 05:00	0.05	0.00	0.02	0.00
05:00 – 06:00	0.19	0.00	0.02	0.00
06:00 – 07:00	0.00	0.00	0.00	0.00

The timeseries data showed that this species exhibits relatively low and stable activity levels across all seasons, with a modest peak in autumn, where its activity reaches a maximum of 0.69 bat passes per hour between 21:00 and 22:00. This peak, though limited, suggests a slight preference for early evening hours in the autumn months. Throughout spring, summer, and winter, however, the Natal long-fingered bat maintains very low activity, rarely exceeding 0.35 passes per hour at any given time. The hourly distribution shows that this species activity slightly tapers off in the late evening and early morning hours, with a marked decline around midnight. This pattern suggests that the Natal long-fingered bat may have brief foraging periods early in the night, possibly returning to roost sites earlier than other nocturnal species. This species is migratory, and although difficult to show, the peak in activity in autumn could be suggestive of some bats (e.g. females) moving through the site to roosting sites north elsewhere in Mpumalanga or Limpopo after mating.

6 IDENTIFICATION AND ASSESSMENT OF IMPACTS

Impacts to bats that are likely to occur because of the construction, operation and decommissioning of the wind energy facility and grid connection are identified and assessed in the following section. The unit of analysis against which impacts were assessed is the local bat community and their associated habitats within the PAOI. Impacts considered for assessment include habitat modification and disturbance, displacement, fatality due to collisions with wind turbine blades, and light pollution since these are the major impacts likely to be associated with the project (Kunz et al. 2007b, Cryan and Barclay 2009, Bará and C. Lima 2024, Voigt et al. 2024). For each impact, the respective mitigation measures were categorised into those aimed at first avoiding impacts, then minimising impacts, and finally restoring areas impacted (Figure 2).

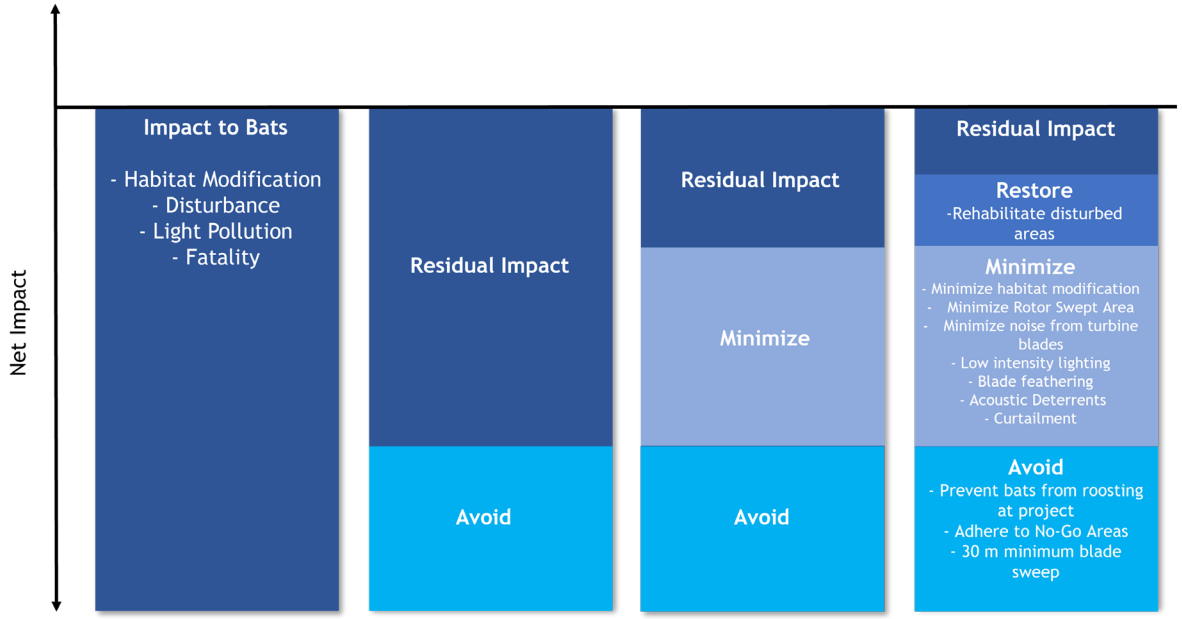


Figure 2: Mitigation Hierarchy applied to the Project with Mitigation Measures.

6.1 Wind Energy Facility

6.1.1 Construction Phase

IMPACTS

Removal of native vegetation, noise and dust generated during construction activities, and the presence of new infrastructure in the landscape, will negatively and indirectly impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement (Kunz et al. 2007b, Millon et al. 2015, Millon et al. 2018, Bennun et al. 2021, Leroux et al. 2022, Tolvanen et al. 2023).

Construction of WEF infrastructure could result in destruction (direct impact) of bat roosts (rocky crevices, buildings) and disturbance (indirect impact) of bat roosts potentially resulting in roost abandonment. Bat mortality can occur if roosts which contain bats are destroyed. Installation of new infrastructure in the landscape (e.g., buildings, turbines, road culverts) can provide new roosting spaces for some bat species, attracting them to areas with wind turbines and potentially increasing the likelihood of collisions.

Mitigation (Avoid)

Habitat modification impacts can be avoided by buffering habitat and landscape features (Table 8) that bats use to spatially limit the potential for bats to interact with project infrastructure, and to avoid impacting key bat habitat (Barré et al. 2018, Leroux et al. 2022). All key habitat features were buffered by 200 m as per best practise (Rodrigues 2015, MacEwan et al. 2020b).

To align with regional conservation and integrated development planning, the Mpumalanga Biodiversity Sector Plan Handbook (MTPA 2014) was consulted to guide spatial risk in the AoI. The intention was to align biodiversity conservation policy objectives with renewable energy policy objectives, attempting to minimize trade-offs between conflicting goals (Jackson 2011, Gasparatos et al. 2017). The handbook includes a map of terrestrial areas that are important for conserving biodiversity and ecological processes – Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) respectively.

CBA Irreplaceable Areas were categorised as No-Go (Table 8) because the conservation goals for these areas are to maintain them in a natural state with no loss of ecosystems, functionality or species, and with no flexibility in land-use options (MTPA 2014). CBA optimal and areas with Highveld grassland were classified as high risk. Although the primary objective of the CBA optimal areas is to maintain these spaces in a natural state with no loss of ecosystems, functionality or species, some flexibility in land-use options is permitted (MTPA 2014), therefore these areas must be avoid as much as possible. The remaining areas were assigned low or medium risk where all infrastructure development should be prioritized. These included modified land, areas with invasive alien trees (plantations), ESA, and other Natural Areas (Table 8). Similarly, in ecological supports areas (ESAs), the objective is to maintain habitats in a natural, or near-natural, state with limited loss of ecosystems or functionality. Hence, these areas were classified as medium risk, permitting the siting of turbines in these spaces.

All turbines will be subjected to a post-construction bat fatality monitoring program which will monitor residual impacts at turbines located in CBA optimal and ecological support areas, as well as turbines in low-risk areas. The results of this monitoring will inform management actions where needed to ensure alignment with the MTPA objectives to limit impacts to biodiversity.

Table 8: Features used to assign spatial risk categories in the AoI for bats (Chiroptera)

Risk Level			
Low	**Medium**	**High**	**No-Go**
Heavily modified land	NPAES	CBA Optimal	CBA Irreplaceable Areas
Moderately modified land	ESA Landscape corridor	Highveld Grassland	Minor Watercourses (50 m buffer)
Cleared Invaded	ESA Local corridor		Farm Dams (200 m buffer)
Transformed	Other Natural Areas		Pan depressions (200m buffer)
Plantation/Invaded	Montane Grassland		Houses (200 m buffer)
			Buildings (200 m buffer)
			Seeps (200 m)

			CVB Wetlands (200 m)
			Rivers with floodplains (200 m buffer)
			Rocky Outcrops (200 m buffer)

No infrastructure (including O&M buildings) may be placed within buffered No-Go areas (Figure 3). However, road infrastructure may need to be routed through sensitive areas for practical reasons. Existing road networks should be used as much as possible in these cases to limit the creation of additional roads which have known impacts on wildlife (Perumal et al. 2021).

To avoid bats roosting in new project infrastructure, all buildings must be properly sealed to prevent bats from roosting. If bats colonize these spaces, a suitably qualified bat ecologist must be engaged to remove them.

Disturbance effects can be avoided by restricting construction activities to daylight hours (i.e., no construction at night) and avoiding blasting near rocky outcrops.

Mitigation (Minimize and Restore)

Modification and disturbance of bat habitat is likely to have species specific effects depending on species foraging guild, season, and distance to wind turbines (Barré et al. 2018, Leroux et al. 2022). For example, clutter edge species (e.g., Cape serotine) are more likely to be impacted by habitat modification given their greater association with physical habitat features compared to high-flying species (e.g., Egyptian free-tailed bat). As such, buffers may not be effective to fully remove all impacts.

Beyond avoidance, measures to minimize further impacts include minimizing the clearing of native vegetation, minimizing disturbance and destruction of rocky outcrops, and applying good construction abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during construction. Where native trees, rocky outcrops or buildings need to be removed (although this must be avoided), these features must be examined by a suitably qualified bat ecologist before construction commences to search for roosting bats. Following construction, all areas disturbed must be rehabilitated through native species planting within all areas under the projects control.

IMPACT PHASE: CONSTRUCTION					
Nature of the impact: MODIFICATION & DISTURBANCE OF BAT HABITAT (ROOSTING, FORAGING, COMMUTING)					
Description of impact Removal of native vegetation, noise and dust generated during construction activities, and the presence of new infrastructure in the landscape, will negatively and indirectly impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement. Construction of WEF infrastructure could result in destruction and/or disturbance to bat roosts, and inadvertently provide new roosting spaces for some bat species in risky locations.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	1	1	3	2	2
With Mitigation	1	1	2	1	1
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**Low Negative Impact (14)**			**Low Negative Impact (5)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities: - Limit potential for bats to roost in project infrastructure (e.g., buildings, turbines) by ensuring they are properly sealed such that bats cannot gain access. - No construction activities at night. - No placement of infrastructure (except roads) in no-go areas. - No blasting near rocky crevices.					

- Minimize clearing of native vegetation - Minimize disturbance and destruction of rocky outcrops, native trees and buildings, and where this is required, these features should be examined for roosting bats. - Apply good construction abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during construction. - Rehabilitate and enhance all areas disturbed during construction (including aquatic habitat).	
Residual impact	Residual impacts are likely to be minor although buffer distances have been shown to be ineffective at avoiding and minimizing risk to bats because these are two small for some species (Barré et al. 2018, Tolvanen et al. 2023).

6.1.2 Operational Phase

IMPACTS

Bat mortality (direct impact) through collisions with wind turbine blades is the principal impact of wind energy facilities on bats during operation of the facility (Cryan and Barclay 2009, Arnett et al. 2016, Voigt et al. 2024). Displacement of bats from their preferred areas may also occur due to turbine noise emissions (Ellerbrok et al. 2024, Voigt et al. 2024).

Mitigation (Avoid)

Collisions can be avoided by not placing wind turbines in the vicinity of bat habitats which for bats includes both physical landscape features themselves (near wetlands, vegetation etc.) and open airspace away from these features (Schnitzler et al. 2003). Risk of collision impact is related to bat morphology with fast flying, open-air species more likely to be impacted than low-flying species who forage closer to the ground, in edge spaces near vegetation, or in dense cluttered spaces (Schnitzler et al. 2003, Thaxter et al. 2017, Aronson 2022). Impacts to low-flying species can be further avoided by ensuring blades do not sweep close to ground level (Figure 4).

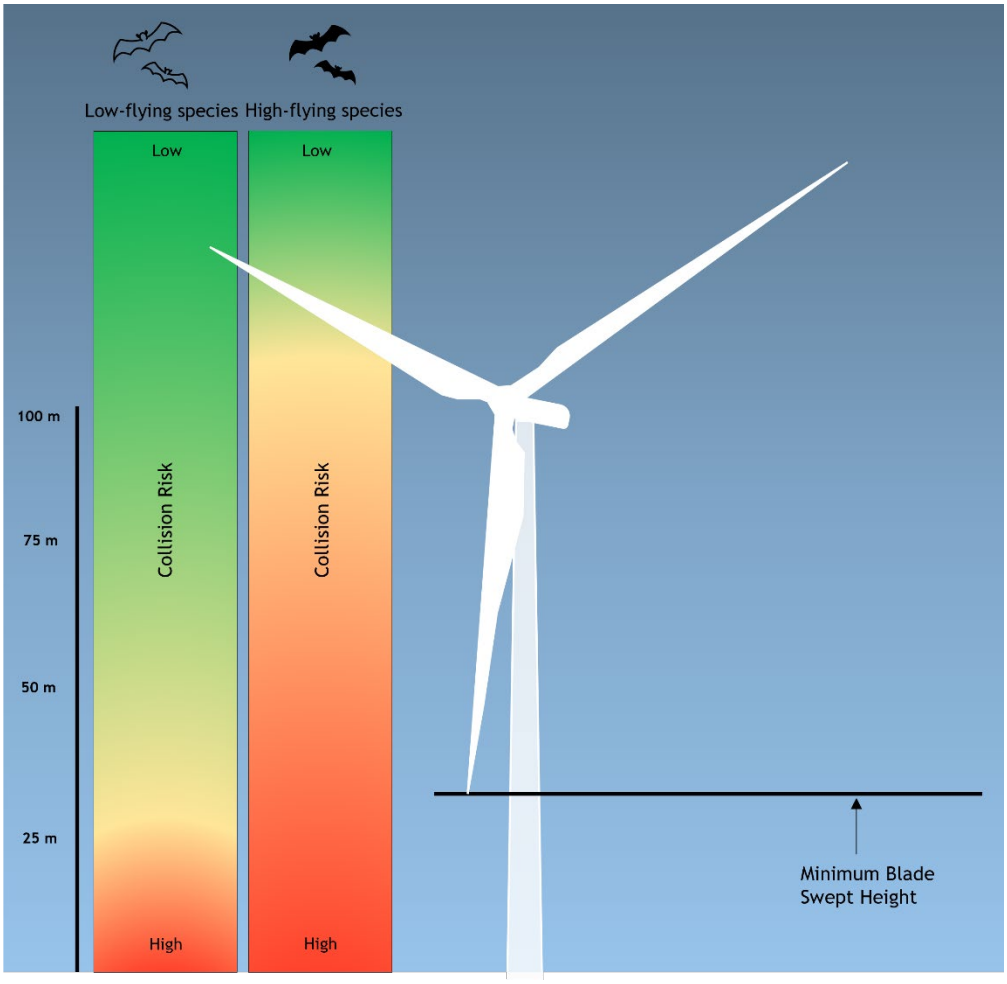


Figure 4: Conceptual Framework used to differentiate risk between low and high-flying bat species and the relationship with turbine size.

The species principally at collision risk from the proposed project are Cape serotine and Egyptian free-tailed bat since other species were recorded less often. High risk was identified for Cape serotine at ground level (represented by 10 m) at some locations (Table 3) but generally low risk at height (above 50 m). Activity is likely to decrease exponentially between these two heights (Wellig et al. 2018) meaning risk would decrease from high at 10 m to low at 50 m and above. The size of the rotor swept area should account for this because the lower the blades sweep the ground, the higher risk they will present to bats (Garvin et al. 2024). It is therefore recommended to maintain a minimum blade sweep of 30 m to avoid collision impacts as much as possible. There is limited published emperical evidence for this specific height but based on the activity of Cape serotine this is likely to be a reasonable height were risk would reduce from high to moderate or low.

Collision impacts can also be avoided by not installing wind turbines within or adjacent to key bat habitats, and adhering to the No-Go buffers (Figure 3). To ensure no parts of the wind turbines, including the blade tips, intrude into bat buffers, all buffers were adjusted (increased by 77 m) to account for the blade length and hub height of the assessed turbine in line with Mitchell-Jones and Carlin (2014) and based on the following equation:

$$b = \sqrt{(buffer + bl)^2 - (hh - fh)^2}$$

[Eq. 1]

$$b = \sqrt{(200 + 110)^2 - (140 - 0)^2}$$

$$b = 277\ m$$

Where:
b = adjusted/blade tip buffer
buffer = 200 m[2]
bl: Turbine blade length = 110 m
hh: Hub height = 140 m
fh: Feature height = 0 m

The specific turbine height assessed in this report has a 140 m hub height and 220 m rotor diameter, based on the minimum blade sweep of 30 m. This represents a likely hub height and the maximum blade length being applied for. This reports therefore assesses the worst-case scenario for bats; namely the largest rotor swept area. Should the turbine size change, the adjusted/blade tip buffers must be updated to account for any changes in the hub height or blade length. No turbines are within buffered areas and hence the turbine layout is acceptable in its current form (Figure 3).

Mitigation (Minimize and Restore)

For some high-flying species such as Egyptian free-tailed bat, the habitat or land use below does not generally influence their activity (Monadjem et al. 2020) which makes habitat based mitigations (e.g., buffers) less effective. This species was recorded at 50 m and 90 m, where median activity levels suggest high risk during autumn and spring (Table 5). Mitigation to avoid impacts to higher-flying species should include the choice of turbine design since this has the potential to influence bat fatality (Barclay et al. 2007) but the impact of turbine size on bat fatality is poorly understood. Generally, impacts to high-flying species should be avoided by limiting the size of the rotor swept area as much as practicable since they are active across much of the rotor swept zone.

However, due to the characteristics of the species present on site, i.e., high risk, open-air foraging species, residual impacts could occur since there is still likely to be a high degree of risky airspace even with a minimized rotor swept area. In addition, some bats may be attracted to turbines (Horn et al. 2008, Cryan and Barclay 2009, Richardson et al. 2021, Guest et al. 2022, Leroux et al. 2022) once installed and operational and therefore additional mitigation measures would be needed to minimize impacts.

The first additional mitigation measure to minimize residual collision impacts is the use of **blade feathering** to prevent free-wheeling of blades below the turbine cut-in speed. This has been shown to reduce bat fatality with the benefit of not impacting on energy production (Young et al. 2011, Good et al. 2012).

During operation, bat fatality monitoring must be undertaken to search for bat carcasses beneath wind turbines to measure the residual impact of the WEF on bats for a minimum of two years (Aronson et al. 2020). Mitigation measures that are known to further minimize bat fatality if needed based on the fatality monitoring results include **curtailment** and/or **acoustic deterrents** (Arnett et al. 2013, Romano et al. 2019, Weaver et al. 2020). These techniques must be used if post-construction fatality monitoring indicates that species fatality thresholds have been exceeded (MacEwan et al. 2018) to minimize impacts, maintain the impacts to bats within acceptable limits of change and prevent declines in the impacted bat population. The bat fatality thresholds for the project were determined based on area of influence of the turbines of 2,007 hectares. This was based on a minimum convex polygon around all turbines, plus an additional buffer around this space of 110 m corresponding to the turbine blade length. Based on the bat fatality threshold for the Highveld Grasslands ecoregion (MacEwan et al. 2018), the bat fatality threshold for the Emvelo project is 16 bats per least concern species.

According to the threshold guidance (MacEwan et al. 2018), should the annual fatality threshold be exceeded, curtailment and/or acoustic deterrents must be used to reduce fatality levels to below the threshold. For frugivorous bats, conservation important or rare/range restricted bats, i.e., Species of Special Concern (SSC), the annual fatality threshold is 1 individual. The likelihood of SSC's being present on site is low (Table 2).

A Biodiversity Management Plan (BMP) for bats must be developed by a bat ecologist before commencement of operation which includes the post-construction fatality monitoring plan design, fatality

[2] 50 m for drainage lines, resulting in a buffer to blade tip of 77 m.

thresholds calculations and rationale, and an adaptive management response plan that provides a timeous action pathway for mitigation (e.g. curtailment or deterrents) should fatality thresholds be exceeded. Smart curtailment approaches which shut down turbines based on real time bat acoustic activity data are favoured over blanket curtailment because these will be less disruptive to turbine operation.

Since displacement of bats is likely driven by turbine noise, this can be minimized by serration of the back edges of the blade, by using a low-noise blade airfoil design or with blade trailing-edge brushes (Bošnjaković et al. 2024; Ellerbrok et al. 2024).

IMPACT PHASE: OPERATION					
Nature of the impact: BAT FATALITY					
Description of impact Bat mortality (direct impact) through collisions and/or barotrauma with wind turbine blades is the principal impact of wind energy facilities on bats.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	3	4	3	4	5
With Mitigation	3	4	2	3	3
Significance Calculation		Without Mitigation		With Mitigation	
S=(E+D+R+M)*P		**High Negative Impact (70)**		**Moderate Negative Impact (36)**	
Was public comment received?		No			
Has public comment been included in mitigation measures?		No, no comments received			
Mitigation measures to reduce residual risk or enhance opportunities: - No placement of turbines and infrastructure (apart from roads and the OHL) within no-go areas - Maintain a minimum blade sweep of 30 m to avoid impacts to lower flying bats such as clutter-edge species (e.g., Cape serotine, Natal long-fingered bat). - Minimize the rotor diameter - Feather blades to prevent free-wheeling below the turbine cut-in speed - Implement post-construction fatality monitoring and apply smart curtailment or deterrents if fatality thresholds are exceeded.					
Residual impact	Curtailment and deterrents can successfully reduce bat fatality (Arnett 2011, Arnett et al. 2016, Weaver et al. 2020), but not completely. Through the application of fatality thresholds, residual impacts should be minimized.				

IMPACT PHASE: OPERATION					
Nature of the impact: DISPLACEMENT					
Description of impact Avoidance of wind turbines by bats, in some cases over several hundred meters distance, has been observed for various species in different habitats, including farmland, resulting in displacement impacts (Tolvanen et al. 2023, Voigt et al. 2024). Displacement, likely caused by wind turbine operation (e.g., wake turbulences and noise emissions), tends to increase with the number and size of turbines.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	3	4	3	3	3
With Mitigation	3	4	2	2	2
Significance Calculation		Without Mitigation		With Mitigation	
S=(E+D+R+M)*P		**Moderate Negative Impact (39)**		**Low Negative Impact (22)**	

Was public comment received?	No
Has public comment been included in mitigation measures?	No, no comments received
Mitigation measures to reduce residual risk or enhance opportunities: - Reduce turbine noise emissions by serration of the back edges of the blade, by using a low-noise blade airfoil design or with blade trailing-edge brushes (Bošnjaković et al. 2024; Ellerbrok et al. 2024).	
Residual impact	Residual impacts are likely to be minor although buffer distances have been shown to be ineffective at avoiding and minimizing risk to bats because these are two small for some species (Barré et al. 2018, Tolvanen et al. 2023).

6.1.3 Decommissioning Phase

IMPACTS

Impacts during the decommissioning phase will be indirect and involve disturbance to bats through excessive noise and dust, and damage to vegetation.

Mitigation (Avoid)

Disturbance effects can be avoided by restricting decommissioning activities to daylight hours (i.e., no works at night).

Mitigation (Minimize and Restore)

Disturbance can be minimized by applying good abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during decommissioning works. All areas disturbed must be rehabilitated through native species planting within all areas under the projects control.

IMPACT PHASE: DECOMMISSIONING					
Nature of the impact: DISTURBANCE OF BATS					
Description of impact Impacts during the decommissioning phase will be indirect and involve disturbance to bats through excessive noise and dust, and damage to vegetation.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	1	1	3	3	3
With Mitigation	1	1	2	2	2
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**Low Negative Impact (24)**			**Low Negative Impact (12)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities: - No decommissioning activities at night. - Apply good abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during decommissioning activities. - Rehabilitate and enhance all areas disturbed during construction (including aquatic habitat).					
Residual impact	Residual impacts are likely to be minor since ceasing project activities on site is likely to benefit bats.				

6.2 Grid Connection

6.2.1 Construction Phase

The direct impact of grid connection infrastructure is collisions with powerlines. Insectivorous bats are unlikely to collide with powerlines since they can avoid these obstacles using echolocation but fruit bats do collide with powerlines (Tella et al. 2020). The likelihood of occurrence for fruit bats species in the AoI is low (Table 2). Indirect impacts include loss of habitat to construct substations and OHL pylons, and ecological light pollution (Longcore and Rich 2004).

IMPACT PHASE: CONSTRUCTION					
Nature of the impact: MODIFICATION & DISTURBANCE OF BAT HABITAT (ROOSTING, FORAGING, COMMUTING)					
Description of impact Vegetation clearing for grid connection infrastructure (access roads, substation buildings, pylons), as well as noise and dust generated during the construction phase, will impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement (Kunz et al. 2007b, Millon et al. 2018, Bennun et al. 2021). This impact is likely to have species specific effects; clutter edge species (e.g., Cape serotine) are more likely to be impacted by habitat modification given their greater association with physical habitat features compared to high-flying species (e.g., Egyptian free-tailed bat). Construction of grid connection infrastructure could result in destruction (direct impact) of bat roosts (trees, buildings) and disturbance (indirect impact) of bat roosts potentially resulting in roost abandonment. Bat mortality can occur if roosts which contain bats are destroyed. Installation of new infrastructure in the landscape (e.g., buildings) can inadvertently provide new roosting spaces for some bat species, attracting them to areas with wind turbines and potentially increasing the likelihood of collisions.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	1	1	3	2	2
With Mitigation	1	1	2	1	1
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**Low Negative Impact (14)**			**Low Negative Impact (5)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities: - Limit potential for bats to roost in project infrastructure (e.g., buildings) by ensuring they are properly sealed such that bats cannot gain access. - No construction activities at night. - No placement of pylons within 200 m of key habitat features specifically including buildings, dams/wetlands, and rivers/streams. The OHL itself is permitted to cross over No-Go Areas for practical routing reasons but pylon positions must avoid No-Go Areas where feasible. Therefore the maximum possible span should be implemented to avoid the sensitive area while ensuring the technical feasibility of the development. - No blasting near rocky crevices. - The construction compounds, laydown areas, and batching plants must avoid No-Go areas. - Minimize clearing of native vegetation - Minimize disturbance and destruction of rocky outcrops, native trees and buildings, and where this is required, these features should be examined for roosting bats. - Apply good construction abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during construction. - Rehabilitate and enhance all areas disturbed during construction (including aquatic habitat).					

Residual impact	Residual impacts are likely to be minor although buffer distances have been shown to be ineffective at avoiding and minimizing risk to bats because these are two small for some species (Barré et al. 2018, Tolvanen et al. 2023).

6.2.2 Operational Phase

IMPACT PHASE: OPERATION					
Nature of the impact: LIGHT POLLUTION					
Description of impact Construction of grid infrastructure will increase ecological light pollution from artificial lighting associated with the substation and other operational and maintenance buildings. Light pollution can alter ecological dynamics (Horváth et al. 2009). Lighting attracts and can cause direct mortality of insects, reducing the prey base for bats, especially bat species that are light-phobic. These species may also be displaced from previous foraging areas due to lighting. Other bat species forage around lights, attracted by higher numbers of insects. This may bring these species into the vicinity of the project and indirectly increase the risk of collision with wind turbines.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	3	4	3	3	3
With Mitigation	3	4	2	2	2
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**Moderate Negative Impact (39)**			**Low Negative Impact (22)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities: - No placement of substations and operational and maintenance buildings within no-go areas. - Avoid excessive lighting - Use of motion-sensor lighting, avoid sky-glow by using hoods and downward facing lighting, increase spacing between lighting units, and use low pressure sodium lights (Rydell 1992, Stone 2012).					
Residual impact	Given the limited extent of light pollution currently in the region, the application of the above mitigation measures is likely to result in minor residual impacts.				

6.2.3 Decommissioning Phase

IMPACT PHASE: DECOMMISSIONING					
Nature of the impact: DISTURBANCE OF BATS					
Description of impact Impacts during the decommissioning phase will be indirect and involve disturbance to bats through excessive noise and dust, and damage to vegetation.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	1	1	3	3	3
With Mitigation	1	1	2	2	2
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**Low Negative Impact (24)**			**Low Negative Impact (12)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities:					

- No decommissioning activities at night. - Apply good abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste) created during decommissioning activities. - Rehabilitate and enhance all areas disturbed during construction (including aquatic habitat).	
Residual impact	Residual impacts are likely to be minor since ceasing project activities on site is likely to benefit bats.

6.3 Cumulative Impacts

For the purposes of the cumulative impact assessment (CIA), cumulative impacts are defined as the total impacts resulting from the successive, incremental, and/or combined effects of a project when added to other existing, planned and/or reasonably anticipated future projects, as well as background pressures (IFC 2013). The project considered here is the Emvelo Wind Energy Facility. The goal of this assessment is to evaluate the potential resulting impact to the vulnerability and/or risk to the sustainability of the bat species affected (IFC 2013).

6.3.1 Step 1: VECs and spatial-temporal boundary

Following guidance in IFC (2013), the first step in the CIA was to determine the Valued Environmental Components (VECs), the bat species most likely to be affected by cumulative impacts, and the temporal and geographic scope of the analysis.

Of the species recorded in the PAOI during the acoustic monitoring, and based on bat distribution records (ACR 2020), Cape serotine (*Laephotis capensis*), Natal long-fingered (*Miniopterus natalensis*) and Egyptian free-tailed bat (*Tadarida aegyptiaca*) are most likely to be impacted cumulatively. This is because they are the most widespread bat species in South Africa (Monadjem et al. 2020), classified as high risk species to wind energy impacts (MacEwan et al. 2020b), the most impacted by operating wind energy facilities in the country (Aronson 2022).

The temporal time frame over which cumulative impacts are considered was 25 years, the typical lifespan of a renewable energy facility. However, cumulative effects could extend beyond this timeframe if development of the cluster of three projects is phased over time.

The Ecologically Appropriate Area of Analysis (EAAA) for the assessment was determined by considering the ecology of the three VECs.

The acoustic monitoring confirmed the presence of Natal long-fingered bat in the PAOI, a migratory species which moves seasonally between winter hibernacula and summer maternity cave roosts in South Africa (van der Merwe 1975, Miller-Butterworth et al. 2003). In north-eastern South Africa, where the proposed development is planned, van der Merwe (1975) showed migration between maternity caves in Limpopo and hibernacula caves in Gauteng/North-West undertaken by pregnant females (who later return south with weaned pups), with caves separated by 150 km at least. Males typically undertake shorter movements (> 60 km) between various highveld caves (van der Merwe 1975). This migration increases the potential that these bats will encounter wind turbines or be displaced by them (Millon et al. 2018), especially if these are placed along migratory routes. Although these movements are typically north-south, Pretorius et al. (2020) suggest that movement could also occur east-west between Gauteng and a maternity cave in Sudwala, Mpumalanga, a distance of approximately 250 km. Although additional research is needed to better understand long and short distance movements of Natal long-fingered bat in South Africa more precisely, given the numerous roost sites (both caves and mines) in Mpumalanga and body of work already demonstrating or suggesting migratory behavior in the north-east of the country between these sites, it is reasonable that cumulative impacts of wind energy may impact this species at large scales and hence cumulative impacts need to be assessed accordingly. Based on van der Merwe (1975), a 150 km radius around the PAOI was therefore defined as EAAA1 (Figure 5), especially since cumulative impacts should be evaluated across scales potentially affected species are likely to occur (Voigt et al. 2012, Lehnert et al. 2014).

The remaining VECs are not migratory and hence a second, smaller EAAA was used. Data on the spatial ecology of the Egyptian free-tailed bat and Cape serotine, specifically the sizes of their foraging or community ranges, are not available. Data from European free-tailed bat, *Tadarida teniotis*, in Portugal (Marques et al. 2004) and Serotine bat, *Eptesicus serotinus*, in England (Robinson and Stebbings 1997) were used as surrogates. Feeding areas for some *T. teniotis* individuals were over 30 km from their roost while the maximum distance between *E. serotinus* feeding areas was over 41 km.

Cumulative impact assessment in South African typically consider developments within a radius of 35 km which therefore is potentially in line with the movement ecology of the two VECs. Hence the EAAA2 was a 35 km radius around the PAOI.

6.3.2 Step 2: Other Activities and External Drivers

The second step in the CIA was to identify other past, existing, or planned activities within the EAAA1 and EAAA2 and to assess the external influences and stressors on the three VECs. With reference to the Renewable Energy Application database (Q2, 2024), currently two others wind energy projects are located within the EAAA2 including the Sheepmoor WEF. Approximately 35 other development projects are located within EAAA1 (Figure 5). Given that EAAA1 also includes a Renewable Energy Development Zone (REDZ), it is reasonable to expect further development over the 25-year period considered in this assessment.

There are no documented major past threats to Egyptian free-tailed bat and Cape serotine or current threats to them other than renewable energy (Child et al. 2016). Egyptian free-tailed bats can also be threated indirectly by roost disturbance, especially caves. This CIA considers renewable energy the primary impact to these VECs. Natal long-fingered bat is locally threatened in parts of its range by habitat loss resulting from conversion of land to agricultural use, incidental poisoning with insecticides, loss of prey base, and the disturbance of roosting and maternity caves (Child et al. 2016).

6.3.3 Step 3: Baseline Status of VECs

Egyptian free-tailed bat is very widely distributed, locally common and recorded from many protected areas in South Africa however, although the population is stable, the population size is unknown (Child et al. 2016). It is classified as Least Concern nationally and globally. This species is present in the PAOI and based on its activity levels, it is at high risk of collision during autumn and spring (Table 5). It is flexible in its habitat requirements and one reason for its wide distribution is its affinity to roost in buildings or other man-made structures (Monadjem et al. 2020).

Cape serotine is also widely distributed in South Africa with a large population and hence is classified as Least Concern nationally and globally. However, it is possible that this species comprises a complex of closely related species (Monadjem et al. 2020). The population trend is stable, but the population size is unknown. Although this species is present in the PAOI its activity levels suggest low risk of collision (Table 3) although no data between 10 m and 50 m were recorded on site to verify this. This species was recorded at 50 m, so it is reasonable to assume some level of risk between 10 m and 50 m. Cape serotine is also flexible in its habitat requirements and its use of buildings and other anthropogenic structures as roosts has possibly led to its numbers increasing.

Natal long-fingered bat is a common and widespread species, classified as Least Concern nationally and globally with a stable national population, but it may be experiencing local declines (Child et al. 2016). The size of the national population is unknown but this species roosts in large colonies; De Hoop Guano cave in the Western Cape hosts approximately 200,000 individuals, and in the Highveld, some caves may contain up to 4000 individuals (Child et al. 2016). Activity levels of this species in the AoI were relatively low and this species was seldomly recorded in the rotor swept area but high activity was recorded closer to ground level in spring (Table 7).

6.3.4 Step 4: Assess Cumulative Impacts on VECs

The key potential impacts that could affect the long-term sustainability and/or viability of the three VECs in EAAA1 and EAAA2 are collisions with wind turbines. This may lead to local extinctions and fragmentation of the national population since bats have low reproductive rates (Barclay and Harder 2003). Other impacts may include displacement from foraging and commuting areas, and along migration routes, due to wind turbines (Millon et al. 2018, Leroux et al. 2022).

6.3.5 Step 5: Assess Significance of Predicted Cumulative Impacts

Rodhouse et al. (2019), Davy et al. (2020) and Frick et al. (2017) have all shown that in North America, Least Concern bats may be experiencing impacts due to wind farms that could result in changes to their conservation status. This may be a future scenario for widespread, common Least Concern bats species in South Africa. As such, the significance of cumulative impacts is assessed as High without mitigation. The application of mitigation measures is anticipated to reduce the overall cumulative impact of the project to a moderate level.

Nature of the impact: CUMULATIVE IMPACTS					
Description of impact The total impacts resulting from the successive, incremental, and/or combined effects of the project when added to other existing, planned and/or reasonably anticipated future projects, as well as background pressures.					
	Extent (E)	**Duration (D)**	**Reversibility (R)**	**Magnitude (M)**	**Probability (P)**
Without Mitigation	3	4	3	4	5
With Mitigation	3	4	2	3	3
Significance Calculation	Without Mitigation			With Mitigation	
S=(E+D+R+M)*P	**High Negative Impact (70)**			**Moderate Negative Impact (36)**	
Was public comment received?	No				
Has public comment been included in mitigation measures?	No, no comments received				
Mitigation measures to reduce residual risk or enhance opportunities: The mitigation measures proposed in this report (buffering key habitats used by bats, use of appropriate lighting technology, blade feathering, and using smart curtailment and/or acoustic deterrents) should be applied to all future projects so that there is a collective management responsibility (IFC 2013).					
Residual impact	Curtailment and deterrents can successfully reduce bat fatality (Arnett 2011, Arnett et al. 2016, Weaver et al. 2020), but not completely. Through the application of fatality thresholds across all projects in the cumulative impact area, residual impacts should be minimized.				

6.3.6 Step 6: Management of Cumulative Impacts

Management interventions for bats at operating wind farms in South Africa are guided by fatality thresholds, which aim to mitigate population-level impacts. These thresholds are set below the rate at which populations could decline due to anthropogenic pressures (MacEwan et al. 2018). For this project, thresholds have been established, and similar measures should be applied to all future wind energy developments. In theory, if each development implements thresholds and appropriate mitigation measures when exceedances occur, the EAAA1 and EAAA2 VEC populations should not decline due to wind energy impacts.

The mitigation measures proposed in this report (buffering key habitats used by bats, use of appropriate lighting technology, blade feathering, and using smart curtailment and/or acoustic deterrents) should be applied to all future projects so that there is a collective management responsibility (IFC 2013).

7 ENVIRONMENTAL MANAGEMENT PROGRAMME

Objective: Avoid and minimize modification of bat habitats			
Project component/s	All project infrastructure		
Potential Impact	Vegetation clearing for project infrastructure, as well as noise, dust and pollution generated during construction activities, will impact bats by removing habitat used for foraging and commuting, through disturbance, and displacement. Construction of WEF infrastructure could result in destruction and/or disturbance to bat roosts and inadvertently provide new roosting spaces for some bat species in risky locations.		
Activity/risk source	All construction activities and associated activities (e.g., driving)		
Mitigation: Target/Objective	1. Avoid potential for bats to roost in project infrastructure (e.g., buildings, and turbines) 2. Minimize disturbance to bats 3. Minimize habitat loss 4. Minimize displacement of bats		
Mitigation		**Responsibility**	**Timeframe**
1. Ensure all project infrastructure (e.g., buildings, and turbines) is properly sealed such that bats cannot gain access. 2. No construction activities at night, apply good construction abatement control practices to reduce emissions and pollutants (e.g., noise, erosion, waste). 3. No placement of infrastructure (except roads and OHL) within No-Go areas. 4. Minimize clearing of native vegetation, minimize disturbance and destruction of farm buildings on site, minimize removal of native trees. Rehabilitate and enhance all areas disturbed during construction, (including aquatic habitat). 5. Reduce turbine noise emissions by serration of the back edges of the blade, by using a low-noise blade airfoil design or using blade trailing-edge brushes.		Project Developer Contractor	During design and planning phase and throughout construction phase
Performance Indicator	No bat roosts are destroyed No bats colonise new project infrastructure for roosting No infrastructure in No-Go areas (except roads and OHL) All areas disturbed during construction are rehabilitated		
Monitoring	An appointed ECO must inspect all new project infrastructure, in conjunction with or via training from a bat ecologist, to ensure bats cannot gain access. ECO to ensure compliance with good construction abatement control practices. ECO must ensure no infrastructure is placed in No-Go areas (see Figure 3). If a bat roost is encountered during construction, the ECO must consult a bat ecologist to determine appropriate actions. ECO to ensure all disturbed areas are rehabilitated. ECO to ensure turbine blades have appropriate noise-reduction technology.		

Objective: Avoid and minimize bat fatality	
Project component/s	Wind turbines
Potential Impact	Bat mortality through collisions with wind turbine blades.

Activity/risk source	Operating Wind Turbines
Mitigation: Target/Objective	1. Avoid bat fatalities through turbine layout design and turbine dimensions 2. Minimize bat fatalities using smart curtailment or deterrents during operation

Mitigation	Responsibility	Timeframe
1. No placement of turbines in No-Go Areas (Figure 3). 2. Maintain a minimum blade sweep of 30 m to avoid impacts to lower flying bats such as clutter-edge species (e.g., Cape serotine, Natal long-fingered bat). 3. Minimize the rotor diameter 4. Feather blades to prevent free-wheeling below the turbine cut-in speed 5. Implement fatality monitoring throughout the operational phase 6. Apply smart curtailment or deterrents if fatality thresholds are exceeded. Annual fatality threshold per Least Concern species = 16 individuals. Annual fatality threshold per Species of Special Concern = 1 individual for each of [African Straw-coloured fruit bat, Wahlberg's Epauletted fruit bat, Percival's Short-eared Trident bat, Blasius's Horseshoe bat, Egyptian Rousette and Lessor Long-fingered bat].	Project Developer Operator	BMP developed prior to operation. BMP active throughout operation phase.

Performance Indicator	≤ 16 individuals per Least Concern species killed annually ≤ 1 individual per Species of Special Concern killed annually
Monitoring	ECO must ensure no turbines are placed in No-Go areas, including the blade tips (Figure 3). ECO must ensure the dimensions of the final selected turbine adhere to requirements (A minimum blade sweep of 30 m). A Biodiversity Management Plan (BMP) for bats must be developed which includes the design of a post-construction fatality monitoring program (PCFM) for bats, and an adaptive management response plan that provides an escalating scale of mitigation should fatality thresholds be exceeded. ECO to ensure adherence to BMP and any mitigation measures implemented

Objective: Reduce impact of light pollution	
Project component/s	All project infrastructure
Potential Impact	Construction of project infrastructure will increase ecological light pollution from artificial lighting associated with turbines, the substation and other operational and maintenance buildings. Light pollution can alter ecological dynamics (Horváth et al. 2009, Bará and C. Lima 2024). Lighting attracts and can cause direct mortality of insects, reducing the prey base for bats, especially bat species that are light-phobic. These species may also be displaced from previous foraging areas due to lighting. Other bat species forage around lights, attracted by higher numbers of insects. This may bring these species into the vicinity of the project and indirectly increase the risk of collision with wind turbines.
Activity/risk source	Light sources from project infrastructure
Mitigation: Target/Objective	1. Avoid light pollution 2. Minimize light pollution

Mitigation	Responsibility	Timeframe

1. No placement of infrastructure within No-Go areas (Figure 3). 2. Use motion-sensor lighting, avoid sky-glow by using hoods and downward facing lighting, increase spacing between lighting units, and use low pressure sodium lights	Project Developer Operator	During design and planning phase and throughout operation phase.
Performance Indicator	Limited attraction of insects to light sources Limited foraging of bats around light sources Limited mortality at insects at light sources	
Monitoring	ECO must ensure no infrastructure is in No-Go areas (Figure 3). ECO must ensure motion-sensor lighting is used. ECO must ensure all lighting fixtures have hoods and/or are downward facing, where appropriate, to prevent sky-glow. ECO must ensure minimum lighting is used and lighting is spaced to prevent excessive use of lighting. ECO must ensure low-pressure sodium lighting is used.	

8 CONCLUSION

This EIA report assessed impacts to bats that could occur because of the construction, operation and decommission of the Emvelo WEF and grid connection. The assessment was based on 16 months of baseline data on bat activity recorded at the project. Based on these data, the key issue for the WEF will be managing collision impacts to Cape serotine and Egyptian free-tailed bat, and cumulative impacts.

The first mitigation measure proposed to manage risk is to adhere to the no-go buffers which aim to spatially avoid impacts by buffering key habitat features used by bats. This measure is likely to be effective for most bat species recorded at the project, but additional mitigation measures are needed to avoid impacts to free-tailed bats, which forage high in the air, and to reduce residual impacts.

Turbine design can be effective, and it is recommended to maintain a minimum blade sweep of at least 30 m. However, free-tailed bats will still collide with turbine blades above this height and as such, the rotor diameter must be limited as much as practicable to minimize the space where collisions might occur. Additionally, blade feathering must be implemented to limit the rotation of turbine blades below the turbine cut-in speed when electricity is not being generated.

Mitigation measures to minimize residual impacts after the application of the above measures include smart curtailment and acoustic deterrents. As such, the project should consider the cost and feasibility of these measures. The residual impacts must be monitored using post-construction fatality monitoring for a minimum of two years (Aronson et al. 2020). Smart curtailment and/or acoustic deterrents must be used if this monitoring indicates that species fatality thresholds have been exceeded (MacEwan et al. 2018) to maintain the impacts to bats within acceptable limits of change and prevent declines in the impacted bat populations.

The overall impact to bats was assessed as moderate after the application of the mitigation measures proposed to avoid and minimize impacts to bats. However, on a species level, the project presents differential risk and impacts to bats must be managed adaptively during the operational phase, particularly for those species (e.g. Egyptian free-tailed bat and Cape serotine) for which high risk is predicted during some periods.

This adaptive management will be guided by the Environmental Management Programme for bats which must include the development of a Biodiversity Management Plan (BMP) to manage impacts to bats during

the operation of the facility. The BMP for bats must be developed by a bat ecologist before the commencement of operation and must include the post-construction fatality monitoring plan design, fatality thresholds calculations and rationale (updated as required), and an adaptive management response plan that provides a timeous action pathway for mitigation, including roles and responsibilities, should fatality thresholds be exceeded. Provided these measures are adhered to, the project assessed can be approved.

9 REFERENCES

ACR. 2020. African Chiroptera Report 2020. V. Van Cakenberghe and E.C.J. Seamark (Eds). AfricanBats NPC, Pretoria. i-xv + 8542 pp.

Adams, A. M., M. K. Jantzen, R. M. Hamilton, and M. B. Fenton. 2012. Do you hear what I hear? Implications of detector selection for acoustic monitoring of bats. Methods in Ecology and Evolution **3**:992-998.

Arnett, E. B. 2011. Altering turbine speed reduces bat mortality at wind-energy facilities. Frontiers in Ecology and the Environment **9**:209-214.

Arnett, E. B., E. F. Baerwald, F. Mathews, Luisa Rodrigues, A. Rodríguez-Durán, J. Rydell, R. Villegas-Patraca, and C. C. Voigt. 2016. Impacts of Wind Energy Development on Bats: A Global Perspective. Pages 295 - 323 *in* C. C. Voigt and T. Kingston, editors. Bats in the Anthropocene: Conservation of Bats in a Changing World. Springer.

Arnett, E. B., G. D. Johnson, W. P. Erickson, and C. D. Hein. 2013. A Synthesis Of Operational Mitigation Studies To Reduce Bat Fatalities At Wind Energy Facilities In North America. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International. Austin, Texas, USA.

Aronson, J. 2022. Current state of knowledge of wind energy impacts on bats in South Africa. Acta Chiropterologica **24(1)**:221-238.

Aronson, J., E. Richardson, K. MacEwan, D. Jacobs, W. Marais, P. Taylor, S. Sowler, H. C., and L. Richards. 2020. South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities – ed 2. South African Bat Assessment Association.

Bará, S., and R. C. Lima. 2024. Quantifying the visual impact of wind farm lights on the nocturnal landscape. Journal of Quantitative Spectroscopy and Radiative Transfer **329**:109203.

Barclay, R. M. R., E. F. Baerwald, and J. C. Gruver. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology **85**:381-387.

Barclay, R. M. R., and L. D. Harder. 2003. Life histories of bats: Life in the slow lane. Pages 209-253 *in* T. H. Kunz and M. B. Fenton, editors. Bat Ecology. The University of Chicago Press, Chicago.

Barré, K., I. Le Viol, Y. Bas, R. Julliard, and C. Kerbiriou. 2018. Estimating habitat loss due to wind turbine avoidance by bats: Implications for European siting guidance. Biological Conservation **226**:205-214.

Bennun, L., J. van Bochove, C. Ng, C. Samper, H. Rainey, and H. C. Rosenbaum. 2021. Mitigating Biodiversity Impacts Associated with Solar and Wind Energy Development: Guidelines for Project Developers.

Bohmann, K., A. Monadjem, C. Lehmkuhl Noer, M. Rasmussen, M. R. K. Zeale, E. Clare, G. Jones, E. Willerslev, and M. T. P. Gilbert. 2011. Molecular Diet Analysis of Two African Free-Tailed Bats (Molossidae) Using High Throughput Sequencing. PloS one **6**:e21441.

Bošnjaković, M., Hrkać, F., Stoić, M., & Hradovi, I. (2024). Environmental Impact of Wind Farms. Environments, 11(11), 257.

Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo, and H. T. Davies-Mostert, editors. 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Collins, J. 2006. Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). Bat Conservation Trust, London.

Cryan, P. M., and R. M. R. Barclay. 2009. Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. Journal of Mammalogy **90**:1330-1340.

Davy, C. M., K. Squires, and J. R. Zimmerling. 2020. Estimation of spatiotemporal trends in bat abundance from mortality data collected at wind turbines. Conservation Biology:12.

Dinerstein, E., C. Vynne, E. Sala, A. R. Joshi, S. Fernando, T. E. Lovejoy, J. Mayorga, D. Olson, G. P. Asner, J. E. M. Baillie, N. D. Burgess, K. Burkart, R. F. Noss, Y. P. Zhang, A. Baccini, T. Birch, N. Hahn, L. N. Joppa, and E. Wikramanayake. 2019. A Global Deal For Nature: Guiding principles, milestones, and targets. Science Advances **5**:eaaw2869.

Ellerbrok, J. S., Farwig, N., Peter, F., & Voigt, C. C. (2024). Forest bat activity declines with increasing wind speed in proximity of operating wind turbines. Global Ecology and Conservation, 49, e02782.

Frick, W. F., E. F. Baerwald, J. F. Pollock, R. M. R. Barclay, J. A. Szymanski, T. J. Weller, A. L. Russell, S. C. Loeb, R. A. Medellin, and L. P. McGuire. 2017. Fatalities at wind turbines may threaten population viability of a migratory bat. Biological Conservation **209**:172-177.

Garvin, J. C., J. L. Simonis, and J. L. Taylor. 2024. Does size matter? Investigation of the effect of wind turbine size on bird and bat mortality. Biological Conservation **291**:110474.

Gasparatos, A., C. N. H. Doll, M. Esteban, A. Ahmed, and T. A. Olang. 2017. Renewable energy and biodiversity: Implications for transitioning to a Green Economy. Renewable and Sustainable Energy Reviews **70**:161-184.

Good, R. E., W. Erickson, A. Merrill, S. Simon, K. Murray, and K. Bay. 2012. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana. Prepared for Fowler Ridge Wind Farm by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Guest, E. E., B. F. Stamps, N. D. Durish, A. M. Hale, C. D. Hein, B. P. Morton, S. P. Weaver, and S. R. Fritts. 2022. An Updated Review of Hypotheses Regarding Bat Attraction to Wind Turbines. Animals **12**:343.

Hein, C. D., J. Gruver, and E. B. Arnett. 2013. Relating pre-construction bat activity and post-construction bat fatality to predict risk at wind energy facilities: a synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International, Austin, TX, USA.

Horn, J. W., E. B. Arnett, and T. H. Kunz. 2008. Behavioral responses of bats to operating wind turbines. The Journal of Wildlife Management **72**:123-132.

Horváth, G., G. Kriska, P. Malik, and B. Robertson. 2009. Polarized light pollution: a new kind of ecological photopollution. Frontiers in Ecology and the Environment **7**:317-325.

International Finance Corporation (IFC). 2013. Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. Washington D.C., USA. Available at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/ publications_handbook_cumulativeimpactassessment.

IUCN. 2021. The IUCN Red List of Threatened Species. Version 2021-1. https://www.iucnredlist.org. Downloaded on 11 Aug 2021.

Jackson, A. L. R. 2011. Renewable energy vs. biodiversity: Policy conflicts and the future of nature conservation. Global Environmental Change **21**:1195-1208.

Jung, K., and E. K. V. Kalko. 2010. Where forest meets urbanization: foraging plasticity of aerial insectivorous bats in an anthropogenically altered environment. Journal of Mammalogy **91**:144-153.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak. 2007a. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. The Journal of Wildlife Management **71**:2449-2486.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher, and M. D. Tuttle. 2007b. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment **5**:315-324.

Lehnert, L. S., S. Kramer-Schadt, S. Schönborn, O. Lindecke, I. Niermann, and C. C. Voigt. 2014. Wind farm facilities in Germany kill noctule bats from near and far. PloS one **9**:e103106.

Leroux, C., C. Kerbiriou, I. Le Viol, N. Valet, and K. Barré. 2022. Distance to hedgerows drives local repulsion and attraction of wind turbines on bats: Implications for spatial siting. Journal of Applied Ecology **59**:2142-2153.

Lintott, P. R., S. M. Richardson, D. J. Hosken, S. A. Fensome, and F. Mathews. 2016. Ecological impact assessments fail to reduce risk of bat casualties at wind farms. Current Biology **26**:R1135-R1136.

Longcore, T., and C. Rich. 2004. Ecological light pollution. Frontiers in Ecology and the Environment **2**:191–198.

MacEwan, K. 2016. Fruit bats and wind turbine fatalities in South Africa. African Bat Conservation News **42**.

MacEwan, K., J. Aronson, E. Richardson, P. Taylor, B. Coverdale, D. Jacobs, L. Leeuwner, W. Marais, and L. Richards. 2018. South African Bat Fatality Threshold Guidelines – ed 2. South African Bat Assessment Association.

MacEwan, K., T. W. Morgan, C. A. Lötter, and A. T. Tredennick. 2020a. Bat Activity Across South Africa: Implications for Wind Energy Development. African Journal of Wildlife Research **50**.

MacEwan, K., S. Sowler, J. Aronson, and C. A. Lötter. 2020b. South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities - ed 5. South African Bat Assessment Association.

Marques, J. T., A. Rainho, M. CarapuÃ§o, P. Oliveira, and J. M. Palmeirim. 2004. Foraging Behaviour and Habitat use by the European Free-Tailed Bat Tadarida teniotis. Acta Chiropterologica **6**:99-110.

McCracken, G. F., E. H. Gillam, J. K. Westbrook, Y.-F. Lee, M. L. Jensen, and B. B. Balsley. 2008. Brazilian free-tailed bats (*Tadarida brasiliensis*: Molossidae, Chiroptera) at high altitude: links to migratory insect populations. Integrative and Comparative Biology **48**:107-118.

Miller-Butterworth, C. M., D. S. Jacobs, and E. H. Harley. 2003. Strong population substructure is correlated with morphology and ecology in a migratory bat. Nature 424:187-191.

Millon, L., C. Colin, F. Brescia, and C. Kerbiriou. 2018. Wind turbines impact bat activity, leading to high losses of habitat use in a biodiversity hotspot. Ecological Engineering **112**:51-54.

Millon, L., J.-F. Julien, R. Julliard, and C. Kerbiriou. 2015. Bat activity in intensively farmed landscapes with wind turbines and offset measures. Ecological Engineering **75**:250-257.

Mitchell-Jones, T., and C. Carlin. 2014. Bats and Onshore Wind Turbines Interim Guidance. Natural England Technical Information Note TIN051. Natural England.

Monadjem, A., P. J. Taylor, F. P. D. Cotterill, and M. C. Schoeman. 2020. Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. 2nd edition.

MTPA. 2014. Mpumalanga Biodiversity Sector Plan Handbook.*in* C. Lötter M.C., M.J. and Lechmere-Oertel R.G., editor. Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit).

Mucina, L., and M. C. Rutherford. 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Nguyen, T. N., A. Ruangwiset, and S. Bumrungsri. 2019. Vertical stratification in foraging activity of Chaerephon plicatus (Molossidae, Chiroptera) in Central Thailand. Mammalian Biology **96**:1-6.

Noer, C. L., T. Dabelsteen, K. Bohmann, and A. Monadjem. 2012. Molossid bats in an African agro-ecosystem select sugarcane fields as foraging habitat. African Zoology **47**:1-11.

Pretorius, M., H. Broders, and M. Keith. 2020. Threat analysis of modelled potential migratory routes for Miniopterus natalensis in South Africa. Austral Ecology 45:1110 - 1122.

Richardson, S. M., P. R. Lintott, D. J. Hosken, T. Economou, and F. Mathews. 2021. Peaks in bat activity at turbines and the implications for mitigating the impact of wind energy developments on bats. Scientific Reports **11**:3636.

Robinson, M. F., and R. E. Stebbings. 1997. Home range and habitat use by the serotine bat, Eptesicus serotinus, in England. Journal of Zoology **243**:117-136.

Rodhouse, T. J., R. M. Rodriguez, K. M. Banner, P. C. Ormsbee, J. Barnett, and K. M. Irvine. 2019. Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors. Ecology and Evolution **9**:11078-11088.

Rodrigues, L. B., L.; Dubourg-Savage, M.; Karapandža, B.; Kovač, D.; Kervyn, T.; Dekker, J.; Kepel, A.; Bach, P.; Collins, J.; Harbusch, C.; Park, K.; Micevski, B.; Minderman, J. 2015. Guidelines for Consideration of Bats in Wind Farm Projects Revision 2014. EUROBATS Publication Series No. 6 (English Version). UNEP/EUROBATS Secretariat, Bonn, Germany, 133 pp.

Romano, W. B., J. R. Skalski, R. L. Townsend, K. W. Kinzie, K. D. Coppinger, and M. F. Miller. 2019. Evaluation of an acoustic deterrent to reduce bat mortalities at an Illinois wind farm. Wildlife Society Bulletin **43**:608-618.

Rydell, J. 1992. Exploitation of insects around streetlamps by bats in Sweden. Functional Ecology **6**:744-750.

Schnitzler, H.-U., C. F. Moss, and A. Denzinger. 2003. From spatial orientation to food acquisition in echolocating bats. TRENDS in Ecology and Evolution **18**:386-394.

Scottish Natural Heritage. 2019. Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation.

Sirami, C. l., D. S. Jacobs, and G. S. Cumming. 2013. Artificial wetlands and surrounding habitats provide important foraging habitat for bats in agricultural landscapes in the Western Cape, South Africa. Biological Conservation **164**:30-38.

South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 2.1 2021.

Stone, E. L. 2012. Bats and Lighting: Overview of current evidence and mitigation.

Tella, J. L., D. Hernández-Brito, G. Blanco, and F. Hiraldo. 2020. Urban Sprawl, Food Subsidies and Power Lines: An Ecological Trap for Large Frugivorous Bats in Sri Lanka? Diversity **12**:94.

Thaxter, C. B., G. M. Buchanan, J. Carr, S. H. M. Butchart, T. Newbold, R. E. Green, J. A. Tobias, W. B. Foden, S. Brien, and J. W. Pearce-Higgins. 2017. Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment. Proceedings of the Royal Society B: Biological Sciences **284**.

Tolvanen, A., H. Routavaara, M. Jokikokko, and P. Rana. 2023. How far are birds, bats, and terrestrial mammals displaced from onshore wind power development? – A systematic review. Biological Conservation **288**:110382.

van der Merwe, M. 1975. Preliminary study on the annual movements of the Natal clinging bat. South African Journal of Science 71:237-241.

Voigt, C. C., E. Bernard, J. C.-C. Huang, W. F. Frick, C. Kerbiriou, K. MacEwan, F. Mathews, A. Rodríguez-Durán, C. Scholz, P. W. Webala, J. Welbergen, and M. Whitby. 2024. Toward solving the global green–green dilemma between wind energy production and bat conservation. Bioscience **74**:240-252.

Voigt, C. C., A. G. Popa-Lisseanu, I. Niermann, and S. Kramer-Schadt. 2012. The catchment area of wind farms for European bats: A plea for international regulations. Biological Conservation **153**:80-86.

Voigt, C. C., D. Russo, V. Runkel, and H. R. Goerlitz. 2021. Limitations of acoustic monitoring at wind turbines to evaluate fatality risk of bats. Mammal Review **n/a**.

Weaver, S. P., C. D. Hein, T. R. Simpson, J. W. Evans, and I. Castro-Arellano. 2020. Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. Global Ecology and Conservation:e01099.

Wellig, S. D., S. Nusslé, D. Miltner, O. Kohle, O. Glaizot, V. Braunisch, M. K. Obrist, and R. Arlettaz. 2018. Mitigating the negative impacts of tall wind turbines on bats: Vertical activity profiles and relationships to wind speed. PloS one **13**:e0192493.

Young, D. P., Jr, K. Bay, S. Nomani, and W. L. Tidhar. 2011. Nedpower Mount Storm Wind Energy Facility Post-Construction Avian and Bat Monitoring: July - October 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Appendix 1: Figures

Appendix 2: Specialist CV

Appendix 3: Specialist Declaration

Appendix 4: SACNASP Certificate

Faunal Impact Assessment

PROPOSED MULILO CLUSTER WEF, ERMELO, MPUMALANGA PROVINCE

Compiled for: ERM Southern Africa (Pty) Ltd

Applicant: Emvelo WEF

July 2025



Jonathan Colville
Terrestrial Ecologist
&
Faunal Surveys

Birding Africa

Report Information

Document name	**Emvelo – Faunal Impact Assessment**
Number of pages:	**39**
Authors involved in compiling this report:	Jonathan Colville (PhD) – Terrestrial Ecologist & Faunal Surveys Callan Cohen (PhD) – Birding Africa
Authors contact details:	**Email:** jonathan.colville@gmail.com | **Phone:** +27 83 564 5050 **Email:** callan@birdingafrica.com | **Phone:** +27 83 256 0491
Document version:	1.0

Citation

Colville, J.F. & Cohen, C. 2023. Faunal Assessment for Proposed Mulilo Cluster WEF, Ermelo, Mpumalanga Province: Emvelo WEF. Prepared for Arcus Consultancy Services South Africa (Pty) Limited (an ERM Group Company), 15 May 2025.

Executive Summary

ERM has been engaged by Emvelo Wind Energy Facility (Pty) LTD to undertake an EIA for the proposed development of a commercial wind farm cluster that is expected to comprise two separate (up to 260 MW) Wind Energy Facilities (WEFs). The proposed WEF project will entail several new infrastructure developments, including 40 turbines, access roads, and OHPLs. Jonathan Colville and Callan Cohen were appointed to undertake a faunal specialist study, with particular focus on two faunal SCC and associated high grassland habitats.

A site sensitivity verification assessment was undertaken in May 2023 (Colville and Cohen, 2023). From this, together with a desktop study, a faunal site sensitivity and constraints map was generated for the proposed WEF. The site sensitivity assessment concluded that the proposed development would have a low impact within areas of low sensitivity (transformed areas), and a medium to high impact within areas of potentially high faunal sensitivity (intact natural habitat, ecological corridors, and certain landscape features). The faunal site sensitivity assessment further concluded that site sensitivities and potential impacts, particularly on high sensitive areas, would need to be assessed through seasonally-appropriate micro-siting once the final footprint area and sizes for turbines and access roads are finalised.

Final layouts of turbine placement, access roads, OHPLs, and other associated developments were provided by ERM on 30 January 2025. The final layout plans indicate that several wind turbines and access roads fall within areas of high faunal sensitivity. For example, the area of escarpment grassland habitat that Colville and Cohen (2023) considered as the most significant area of faunal sensitivity has eight turbines, new access roads, and all OHL alternatives proposed for this area.

No micro-siting was undertaken and this faunal impact assessment relied on information gathered during the faunal site sensitivity verification phase and focussed on potential faunal impacts on the high sensitive habitats as identified by Colville and Cohen (2023). The potential impacts associated with the construction, operational, and cumulative impacts are given in impact assessment tables below. Several mitigation measures are put forward to reduce the likely impact of the proposed development. Several management actions are proposed for inclusion into a draft EMPr.

The expected impacts of the proposed development include habitat fragmentation, noise and visual disturbances, affecting animal behaviour and changes in their movement, including displacement, and distribution patterns across landscapes. Faunal integrity relies on inter-connected grassland habitats across landscapes. In addition, total area developed and associated impacts would need to be considered within the broader context of the two planned WEFs: Emvelo and Sheepmoor. High negative impacts can be reduced with mitigation to moderate negative impacts, and some positive impacts are also likely to result from the mitigation measures. The primary mitigation measures required to reduce the potential impacts on faunal SCC should include avoiding placement of turbines and access roads across high faunal sensitive areas; minimising destruction and disturbance of high sensitive grassland habitats; undertaking an alien plant and Oribi management plan starting at and to continue through the construction phase and extend to the decommission phase, and if high faunal sensitive areas are impacted, then secure conservation off-sets will be needed. Considering the lack of empirical data for wind farm impacts on non-volant mammals, such long-term monitoring may help to better inform on the impacts of future WEF projects on local populations of the highly threatened Oribi species. One indirect impact

to consider is related to reducing the effect of artificial light at night (ALAN) pollution on local insect populations.

The no-go alternative is likely to lead to continuing loss of grassland habitat from alien plant invasions and agricultural activities. Although mitigation could reduce these high negative impacts and produce positive impacts, this is highly unlikely to occur. The no-go alternative is therefore not the preferred alternative.

Cumulative impacts may become more significant if added to existing or future impacts from other activities, such as other renewable energy projects, in the area. For example, any remaining Oribi sub-populations and any contiguous areas of intact grassland are considered as high conservation importance. The proposed development will occur in a broader area within a mosaic of habitat that is highly fragmented and disturbed. The overall cumulative impacts of the development are considered likely to be moderate negative, and potentially low positive after enhancements, including the required off-sets with regard to loss of any high faunal sensitive areas. Off-set areas to be determined for any high faunal sensitive areas that are to be developed; these should form part of a long-term conservation programme and to be determine by an off-set specialist.

Overall, it is the specialists' opinion that the proposed development will have an overall moderate negative significance on faunal SCC and therefore the proposed development can be approved in terms of the specific theme of this terrestrial animal species assessment: on the condition that all mitigation measures are implemented and that high sensitive faunal habitat is largely avoided and/or off-set, and an alien plant and Oribi management plan be undertaken, starting at pre-construction and extending to the operational phase, and into the decommissioning phase.

Table of Contents

Report Information 2
Executive Summary 3
Table of Contents 5
List of Figures 7
Specialist Details 8
Conditions Pertaining to this Report 10
Introduction 11
Terms of Reference 12
Considered Infrastructure of the Development 12
Assumptions and Limitations 13
Methodology 13
Assessments of Impacts 14
Construction Phase Impacts 16
Operational Phase Impacts 18
Decommissioning Phase Impacts 21
Cumulative Impacts 22
Impact Statement 24
Activities for Inclusion in draft EMPr 24
References 26
Appendix-1 – CV Dr Jonathan Colville 28
Appendix-2 – CV Dr Callan Cohen 33
Appendix-3 – Project Details 34

Appendix-4 – Impact Assessment Methodology 35

List of Figures

Figure 1: Faunal sensitivity map generated during the site sensitivity and scoping phase (see Colville and Cohen, 2023) overlaid onto the latest 05 May 2025 project layout showing project developments, including access roads and turbine placement positions. The high sensitive escarpment area (dark green-shaded) was considered the most significant faunal habitat. 14

Figure 2: The high sensitive escarpment area (dark green-shaded) was considered the most significant faunal habitat; multiple turbines, access roads and OHPLs are proposed for this area.16

Specialist Details

Specialist Details | Jonathan Colville -- Terrestrial Ecologist & Faunal Surveys	
Company Name	Jonathan Colville -- Terrestrial Ecologist & Faunal Surveys
Email Address	jonathan.colville@gmail.com
Telephone	+27 (0) 83 564 5050
Highest Qualification	PhD Zoology | University of Cape Town | 2009
SACNASP Reg. No.	134759
Areas of Specialisation	Terrestrial faunal ecology and conservation

Jonathan Colville of Terrestrial Ecologist & Faunal Surveys has over fourteen years post-PhD experience in the fields of terrestrial ecology, including investigating the spatial patterns of South Africa's animal and plant diversity. Between 2009 and 2019, Jonathan was involved with the South African National Biodiversity Institute's (SANBI) Biodiversity, Research, Assessment and Monitoring Division (BRAM) undertaking ecological research on South Africa's animal and plant diversity. Since 2020, Jonathan has been operating as a specialist faunal consultant for EIAs and conservation projects. A CV is provided below in Appendix 1.

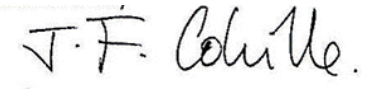
Specialist Details | Callan Cohen -- Birding Africa	
Company Name	Birding Africa
Email Address	callan@birdingafrica.con
Telephone	+27 83 256 0491
Highest Qualification	PhD Ornithology | University of Cape Town | 2011
Areas of Specialisation	Ornithology, Ecology, Odonata

Callan Cohen (Director of Birding Africa) has extensive knowledge of Cape birds and is a recognised international expert on African birds. He has a PhD in Ornithology from the University of Cape Town where he is a Research Associate of the FitzPatrick Institute of African Ornithology. He has co-authored two books on South African birds and contributed to five others, including the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000). He has over 30 years of experience of bird field surveys. A CV is provided below in Appendix 2.

Signed Statement of Independence:

In terms of Chapter 5 of the National Environmental Management Act of 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2014, specialists involved in Environment Assessment Processes must declare their independence and provide their contact details, relevant experience, and a curriculum vitae.

I, Jonathan F. Colville, as the appointed independent specialists, do hereby declare that I am financially and otherwise independent of the client and their EAP, and that all opinions expressed in this document are my own and based on my scientific and professional knowledge, and available information.



Jonathan F. Colville

Conditions Pertaining to this Report

The content of this report is based on our best scientific and professional knowledge, and available information. We reserve the right to modify the report in any way deemed fit should new, additional, relevant, or previously unavailable or undisclosed information becomes known to us from on-going research or further work in this field, or pertaining to this investigation, and we will inform ERM accordingly. This report must not be altered or added to without the prior written consent of Jonathan Colville and Callan Cohen. This also refers to electronic copies of the report, which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must refer to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

Introduction

ERM has been engaged by Emvelo Wind Energy Facility (Pty) LTD to undertake an EIA for the proposed development of a commercial wind farm cluster that is expected to comprise two separate (up to 260 MW) Wind Energy Facilities (WEFs). Each WEF will apply for its own grid connection route to connect to the proposed new Camden B substation via approximately 20 – 32 km long 132 kV overhead transmission lines. The powerlines are proposed and are assessed within a 300 m assessment corridor each. The proposed development sites are located near Ermelo and falls within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province. This faunal scoping report covers the Emvelo WEF and covers the non-avifaunal component of the animal species theme.

The Emvelo WEF is proposed to comprise up to 40 turbines with a maximum output capacity of up to 260 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 25-30 years. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design. It is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation.

Faunal specialists Dr Callan Cohen and Dr Jonathan Colville undertook a site sensitivity verification assessment during the site sensitivity verification and scoping phase of this project (Colville and Cohen, 2023). During early autumn (9–11 May 2023) the project area was visited to assess faunal habitat and the likelihood of any flagged faunal SCC occurring with the project area. From this, together with a desktop study, a faunal site sensitivity and constraints map was generated for the proposed Emvelo WEF (Figure 1).

The National Web-based Environmental Screening Tool (https://screening.environment.gov.za/screeningtool/) indicated that the proposed development was rated as overall **High** sensitivity for two animal species of Conservation Concern (SCC), with possible suitable habitat for:

- One katydid species:
    - Lalande's Black-winged Clonia (*Clonia lalandei*): Medium sensitivity
- One mammal species:
    - Oribi (*Ourebia ourebi ourebi*): Medium sensitivity.

The faunal site sensitivity assessment of Colville and Cohen (2023) concluded that the proposed development will most likely have a low impact within areas of low sensitivity (transformed areas), and a medium to high impact within areas of potentially high faunal sensitivity (intact natural habitat, ecological corridors, and certain landscape features). The project area was also considered as having the correct vegetation and habitat (topography) to support both the katydid and Oribi.

The faunal site sensitivity assessment of Colville and Cohen (2023) concluded that site sensitivities and potential impacts, particularly on high sensitive areas, would need to be assessed through seasonally-appropriate micro-siting once the final footprint area and sizes for turbines and access roads are finalised.

Final layouts of turbine placement, access roads, OHL, and other associated developments (Figure 1-2; Appendix 3) were provided by ERM on 30 January 2025. The final layout plant has several wind turbines and access roads falling within high faunal sensitivity. For example, the area of escarpment grassland habitat (Figure 1–2) that Colville and Cohen (2023) considered as the most significant area of faunal sensitivity has eight turbines, new access roads, and all OHPL alternatives proposed for this area.

This faunal impact assessment focusses on potential faunal impacts for the proposed project and focusses on the high sensitive habitats as identified by Colville and Cohen (2023). The potential impacts associated with the construction, operational, and cumulative impacts are given in impact assessment tables below, as provided to us by ERM (Appendix 4).

Terms of Reference

We were appointed by ERM to conduct a faunal impact assessment for the proposed Emvelo WEF project. This would entail an assessment of the nature and the extent of the potential impacts of the proposed development on the populations of faunal SCC located within the high sensitive areas falling within the project layout, as stipulated in the Government Gazette, No. 43855 (Published in Government Notice No. 1150) of 30 October 2020 (and 49028 with amendment 3717 of July 2023): '*Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species' and following SANBI's (2020) 'Guidelines for the Implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for Environmental Impact Assessments In South Africa'*.

1. Following the impact assessment methodology provided by ERM (Appendix 4), estimate the nature and the extent of the potential impacts of the proposed development on the populations of the faunal SCC located within the project layout.
2. Assess impacts at the construction, operational, decommissioning, and cumulative project phases.
3. Provide potential mitigation measures to reduce the impacts of the development.
4. Provide a terrestrial animal species impact assessment report detailing the findings of the impact assessment and include a reasoned opinion, based on the findings of the specialist assessment process, regarding the acceptability, or not, of the development, and if the development should receive approval or not.
5. Provide any mitigation and monitoring measures for inclusion in the draft EMPr.

Considered Infrastructure of the Development

The infrastructure assessed in this impact assessment are for those as given by ERM on 30 January 2025 (Figure 1–2; Appendix 3). Impact was assessed based broadly on the type of infrastructure, footprint size and geographic position.

Assumptions and Limitations

The following limitations and assumptions apply to this assessment:

- It is assumed that all third-party information used (e.g. GIS data and species historical records) was correct at the time of generating this report.
- This impact assessment was undertaken based on the information provided by ERM, including a project layout and an edited Specialist Information Docket (October 2024) for the various infrastructure developments (Figure 1; Appendix 3).
- The project site has only been visited once during early autumn (9–11 May 2023). The project area falls within a summer-rainfall region and therefore undertaking a site visit in early autumn limits the detection of faunal SCC at the project site (South African National Biodiversity Institute, 2020). The May 2023 site sensitivity assessment also relied on surveying and assessing broad habitat features and utilising ecosystem-level data, such as intact vegetation type, and known habitat and distributional records for faunal SCC.
- No micro-siting of turbine and access road has been undertaken in high sensitive areas in relation to the final project layout of January 2025 (see recommendations in Colville and Cohen (2023)).
- The far north-western access road route was not visited during the site visit as it was only recently included in the final layout given on 05 May 2025.
- Despite increasing prevalence, there is currently limited scientific evidence and empirical data on the impacts of wind farms on invertebrate and on non-volant mammals (Docrat, 2023; Helldin et al., 2012; Klich et al., 2024; Lopucki and Mróz, 2016; Tolvanen et al., 2023). This is especially evident for South Africa, where except for birds, there is almost no information based on scientific studies concerning the impacts of wind farms on other faunal elements, such as mammals and invertebrates. Consequently, there is limited local information and published guidance specifically on the impacts of wind farms on faunal SCC with regards to aspects such as habitat fragmentation and noise disturbances in grassland habitats such as found at the project site.
- The impacts from wind farms in South Africa should therefore ideally follow a precautionary approach, and provide mitigation measures around avoidance and minimisation, when it comes to sensitive faunal SCC and their associated habitats. This is especially important as new wind farm developments that will occur in remote areas with limited access roads are likely to have impacts at the population level of faunal SCC (Helldin et al., 2012).

Methodology

An Impact Assessment Rating was used and tables supplied by ERM were copied and used in this report (Appendix 4).

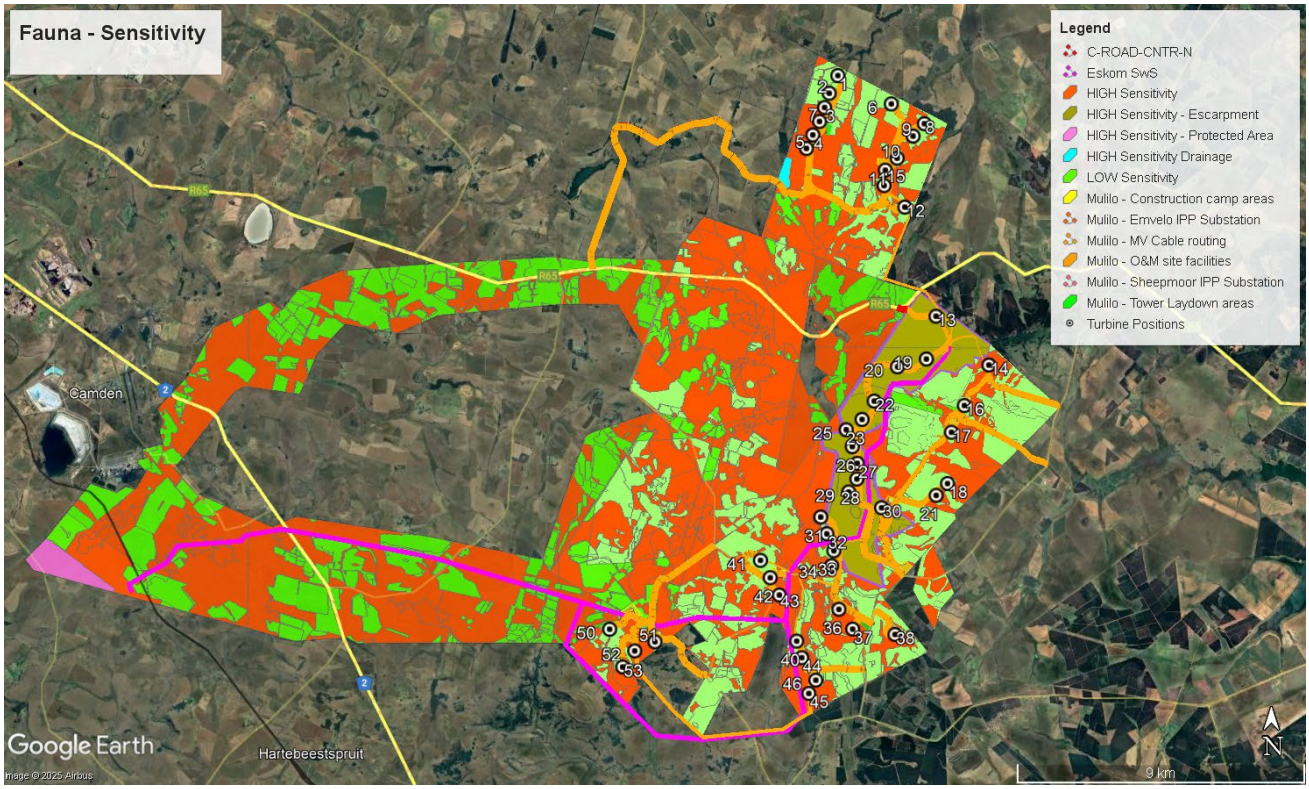


Figure 1: Faunal sensitivity map generated during the site sensitivity and scoping phase (see Colville and Cohen, 2023) overlaid onto the latest 05 May 2025 project layout showing project developments, including access roads and turbine placement positions. The high sensitive escarpment area (dark green-shaded) was considered the most significant faunal habitat.

Assessments of Impacts

The various identified faunal impacts are assessed below for the different phases (construction/operational) of the proposed wind farm development. Impacts are based on the information as provided to date by ERM, and any changes to these or to the project would require a reassessment.

The final layout plan of 05 May 2025 places several turbines, new access roads, and OHPL alternatives within high sensitive areas (Figure 1–2). Several of these areas appear to offer ideal habitat for the Oribi, katydid, and the high sensitive escarpment area is likely of general importance for a range of faunal groups, representative of a large contiguous and ecologically intact area of mostly good-quality montane grassland.

Overall, the impact significance during the different phases of the proposed development is considered high (-) and moderate (-) when mitigation is considered, although it is uncertain if mitigation would fully reduce impacts due to the potentially large total amount of high sensitive habitat loss. Lack of micro-siting of turbine and roads further limits confidence in assessing final impacts. Main impacts will likely come from the building of access road, especially in high sensitive areas where no established roads currently exist. Although turbines have relatively small footprints and impacts during construction can be limited to a certain degree, the main impacts from

turbines are likely to come during their operational phase. Access roads could also have continued impacts during the operational phase (Helldin et al., 2012). All OHPL alternatives should have low-medium impacts during construction, if no associated servitude road is built. During their operation phase they should have limited impacts on faunal SCC, although long-term avoidance by mammals of habitat associated with OHPLs has been observed in some cases (Tyler et al., 2014).

Mitigation measures are based around a hierarchical approach of avoidance, minimizing, and compensation. The scoping phase indicated several areas of high sensitive habitat potentially to be avoided (see also Terrestrial Biodiversity and Botanical Specialist reports); however, the placement of turbines and access roads within the high sensitive areas leaves minimizing and compensation as the two remaining mitigation measures. In this regard, Mulilo's stated aim of removal and management of the dense alien plant infestations and the implementation of a comprehensive Oribi management plan could form the main mitigation measures of the operational phase of the project. In addition, these measures are considered as potentially positive impacts of the proposed WEF and therefore possibly more favourable over a longer-term period than the no-go alternative. Another compensatory measure would require off-setting any high faunal sensitive areas lost with an area that is set-aside as a conservation area.

A final note of caution, for the construction of large wind farms – such as the Emvelo WEF – the seemingly small footprint and localised effects of turbines can add up to potentially significant impacts with possible consequences at the population level of faunal SCC (Helldin et al., 2012). In addition, total area developed and associated impacts would need to be considered within the broader context of the two planned WEFs: Emvelo and Sheepmoor.

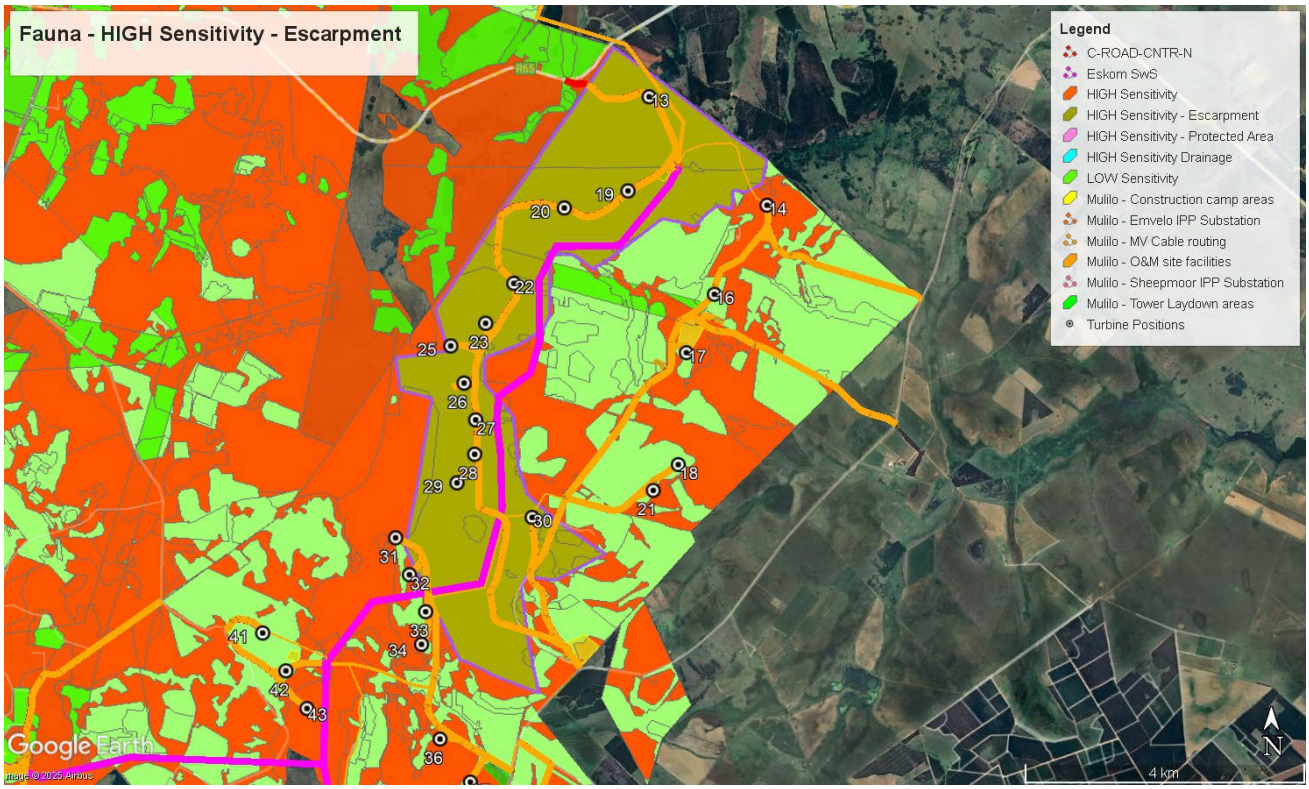


Figure 2: The high sensitive escarpment area (dark green-shaded) was considered the most significant faunal habitat; multiple turbines, access roads and OHPLs are proposed for this area.

Construction Phase Impacts

The construction phase will result in a higher concentration of human activity, vehicle transportation, and noise, as well as a general loss of faunal habitats across a relatively large area due to the removal of natural vegetation. Several significant negative impacts are therefore likely to occur during the construction phase within areas of high faunal sensitivity.

Some of the grassland habitat found at the project site is found outside of the project area and therefore losses may not necessarily be considered as irreplaceable. The removal and rehabilitation of areas infested with alien plants may create new grassland habitat. However, with only approx. 33% of Eastern Highveld Grassland remaining, irreplaceable loss of habitat is during the construction phase is a possibility without mitigation.

The No-go alternative would potentially see the high sensitive grassland habitats of the project area becoming increasingly disturbed through agricultural activities and alien plants, as currently seen in parts of the project area. The No-go alternative with mitigation, would likely see a long-term positive impact on faunal SCC and grassland habitats; however, it is unlikely that these mitigation measures would ever be implemented.

Impact Phase: Construction					
Nature of the impact: Habitat fragmentation, noise and visual disturbances, affecting animal behaviour and changes in their movement and distribution patterns across landscapes.					
Description of Impact: Detailed description of impact Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use. Some animal species will actively avoid areas near turbines, leading to their displacement or changes in their movement and distribution patterns across landscapes. Increased vehicle movement on access roads related to turbine maintenance, increased human activities around turbines and other project infrastructure, could further compound these impacts. Consequences of such impacts can result in the loss of populations of faunal SCC; restrict movement of fauna through ecological corridors; and the fragmentation of sub-populations of faunal SCC across high sensitive grassland habitats.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long Term	Recoverable	High	Definite
Score	3	4	3	4	5
With Mitigation	Regional	Medium Term	Recoverable	High	Highly Probable
Score	3	3	3	4	4
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	**High (-) Impact (70)**		**Moderate (-) Impact (52)**		
Was public comment received?	NO				
Has public comment been included in mitigation measures?	NO				
Mitigation measures to reduce residual risk or enhance opportunities:					

- If possible, micro-siting of turbine and access roads pre-construction; even small adjustments in placement can help avoid ecologically sensitive areas.
- If high sensitive areas are to be developed, then off-sets will be required.
- Implementation of a preconstruction Oribi survey to help identify sensitive areas for this SCC.
- Clearing of natural vegetation should be kept to a minimum where possible.
- The smallest possible working corridor, particularly close to sensitive habitats, must be used.
- A ~5 m buffer zone should also be considered for any development close to any high sensitive areas.
- No construction vehicles are allowed within no-go areas.
- Limiting the number and speed of vehicle movements to, from, and within the project area.
- All temporary/permanent security fences will need to be modified (e.g. maintaining a gap, at reasonable intervals, between the base of the fence and the ground of approx. 30 cm) to allow small and medium-sized animals to move freely through and to not act as a barrier to dispersal.
- Any drainage/water run-off trenches required to be built alongside roads should be shallow and broad with low-angle sides (<30 degrees) so as not to trap fossorial invertebrates (e.g. dung beetles) and small vertebrates (e.g. moles, snakes, tortoises).
- Alien invasive vegetation found on the project area should be removed by an alien plant clearing team during the construction phase; invasive alien plants are seen as a significant threat to faunal SCC.
- Restoration and rehabilitation: Natural vegetation or biodiversity features impacted from construction-related activities that could not be completely avoided and/or minimised through re-vegetating of temporary-use and lay-down areas as soon as reasonably practicable after the construction phase.
- Providing toolbox talks to onsite personnel to ensure that they are aware of the biodiversity mitigation measures for construction phase of the project.

Residual impact	*Vegetation and soil disturbance, and alterations to local landuse patterns are likely to remain even after site restoration.*

Impact Phase: Construction -- No-go alternative

Nature of the impact: Disturbance and habitat loss associated with continued alien plant infestation and agricultural landuse practices (ploughing, over-grazing).

Description of Impact:

Loss of local populations of faunal SCC through continued loss of remaining patches of grassland habitat from alien plants, over-grazing, and agriculture. Consequences of such impacts can result in the loss of populations of SCC; Further fragmentation of sub-populations of SCC across grassland habitats.

Impact Status: Negative

	E	D	R	M	P
Without Mitigation	Regional	Long Term	Recoverable	High	Definite
Score	3	4	3	4	5
With Mitigation	Regional	Long Term	Recoverable	Moderate	High Probable
Score	3	4	3	3	4

Significance Calculation	**Without Mitigation**	**With Mitigation**
S=(E+D+R+M)*P	**High (-) Impact (65)**	**Moderate (+) Impact (52)**
Was public comment received?	NO	
Has public comment been included in mitigation measures?	NO	

Mitigation measures to reduce residual risk or enhance opportunities:

- Alien invasive vegetation found on the project area should be removed; invasive alien plants are seen as a significant threat to faunal SCC.

• Management plans for grassland habitats (e.g. alien plant removal, fire regime plan) can be implemented to favour maintaining functioning grassland ecosystems and faunal habitat.	
Residual impact	*Yes, potentially positive in terms of restoration and management of sensitive grassland habitats and associated faunal SCC. However, there is low confidence that these mitigation measures would be implemented*

Operational Phase Impacts

Although several studies have confirmed negative impacts during the operation of wind farms on insects (Voigt, 2021; Weschler, 2023) and selected non-volant species, results can vary across species and habitats (Klich et al., 2024; Lopucki and Mróz, 2016; Schöll and Nopp-Mayr, 2021; Tolvanen et al., 2023; Tyler et al., 2014). However, consensus suggests that the operational phase of wind farms can impact insects and non-volant species, mostly through two main effects: habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use. Some animal species will actively avoid areas near turbines, leading to their displacement or changes in their movement and distribution patterns across landscapes. Increased vehicle movement on access roads related to turbine maintenance, increased human activities around turbines and other project infrastructure, could further compound these impacts. Faunal integrity, as for the Oribi, relies on large, interconnected grassland habitats. Operational impacts are therefore considered in this context.

As wind farms may result in the loss of habitat needed to sustain faunal SCC, wind farm projects should consider compensation measures. Such measures should include the preservation of high-quality habitat, restoration of degraded habitat, funding of off-sets and long-term conservation programs, and management plans for specific faunal SCC.

Management of high sensitive areas to reduce impacts and possibly add biodiversity benefits through alien plant clearing are therefore likely to be a key compensatory aspect for this project during the operational phase and potentially represent a positive impact. Management plans should also include implementing a grazing and fire management programme for intact grassland habitats. In addition, the high sensitive grassland habitats would ideally need a long-term conservation strategy to be implemented. If high sensitive areas are to be developed, then an off-set would be required.

Considering that the proposed layout falls over high sensitive areas, key to understanding and mitigating operational impacts, especially considering the lack of empirical data around impacts on non-volant species in South Africa, will involve an Oribi monitoring programme beginning before and continuing after the operational phase of a wind farm, ideally over several years. The planned Oribi management plan would represent a strong mitigation measure to reduce impacts on this highly threatened antelope species. Mitigation measures will certainly be able to reverse or ameliorate several impacts; however, the noise and visual disturbances of turbines are an innate

aspect of wind farms and some noise and visual disturbances of turbines will remain. Continued monitoring will allow for adaptive management of impacts.

Overall, the impact significance during the operational phase of the proposed development is considered moderate (-) on faunal SCC, after mitigation. To ensure that impacts are kept moderate during this phase, various operational control measures should be considered, mostly related to land management measures (e.g. alien plant removal, fire regime), Oribi management plan, and modifying some physical aspects of the development, such as modifying security perimeter fencing and outside lighting.

The No-go alternative option would potentially see high sensitive grassland habitats of the project area becoming increasingly disturbed through agricultural activities and alien plants, as currently seen in parts of the project area. The no-go alternative with mitigation, would likely see a long-term positive impact on faunal SCC and grassland habitats. However, it is highly unlikely that these would be implemented and therefore the moderate positive score must be treated with circumspection.

One indirect impact that should be considered for insects is the effect of artificial light at night (ALAN), which can potentially have long-term negative impacts on local insect fauna (Deichmann *et al.*, 2021; Owens *et al.*, 2020; Stewart, 2021). The Katydid species flagged may be susceptible to ALAN, as katydids are known to be attracted to artificial lights. The impact of ALAN during the operational phase of the project should be considered as certain facility infrastructure components may require outside lights which may attract insects from surrounding areas of natural vegetation. The use of artificial lights may extend the area of influence of the project site and mitigation measures should therefore be considered in this regard. There are several mitigation options to reduce the impact and attraction of artificial lights on insects (See Table below).

Impact Phase: Operation					
Nature of the impact: Habitat fragmentation, noise and visual disturbances, affecting animal behaviour and changes in their movement and distribution patterns across landscapes.					
Description of Impact: Detailed description of impact Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can fragment populations and isolate species; and noise and visual disturbances, affecting animal behaviour and their habitat choice and use. Some animal species will actively avoid areas near turbines, leading to their displacement or changes in their movement and distribution patterns across landscapes. Increased vehicle movement on access roads related to turbine maintenance, increased human activities around turbines and other project infrastructure, could further compound these impacts. Consequences of such impacts can result in the loss of populations of faunal SCC; restrict movement of fauna through ecological corridors; and the fragmentation of sub-populations of faunal SCC across high sensitive grassland habitats.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long Term	Recoverable	High	Definite
Score	3	4	3	4	5
With Mitigation	Regional	Medium Term	Recoverable	High	Highly Probable

Score	3	3	3	4	4
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	**High (-) Impact (70)**		**Moderate (-) Impact (52)**		
Was public comment received?	NO				
Has public comment been included in mitigation measures?	NO				

Mitigation measures to reduce residual risk or enhance opportunities:

- If high sensitive areas are to be developed, then off-sets will be required.
- Implementation of continued surveying and an Oribi management plan for project area.
- Implementation of a grazing and fire management plan for the high sensitive areas.
- Ongoing eradication of alien invasive plants across the project area as part of an alien plant management plan.
- Vegetation management in accordance with the recommendations from the botanist.
- Modifications to any fencing to facilitate animal movement can include leaving a gap at reasonable intervals between the base of the fence and the ground of approx. 30 cm in height. This can occur across the full extent of the fence, or at regular intervals.
- Possible options to mitigate the negative impacts of artificial lights could include:
    - Fixtures on lights to cover the light bulb and direct the light to where it is needed.
    - Use timers and motion sensors
    - An outdoor lighting plan should be developed that includes an overall reduction of nocturnal lighting.
- Limiting the number and speed of vehicle movements within the project area to and from turbines. Speed bumps should be installed on internal roads and speed limits and animal crossing warning signs should be erected.
- Providing toolbox talks to onsite personnel to ensure that they are aware of the biodiversity mitigation measures for the operational phase of the project.

Residual impact	*Some of the grassland habitat found at the project site is found outside of the project area, and the removal and rehabilitation of areas infested with alien plants may create new grassland habitat. However, with only approx. 33% of Eastern Highveld Grassland habitat remaining, irreplaceable loss of habitat is a possibility.*

Impact Phase: Operation -- No-go alternative

Nature of the impact: Disturbance and habitat loss associated with continued alien plant infestation and agricultural landuse practices (ploughing, over-grazing).

Description of Impact:

Loss of local populations of faunal SCC through continued loss of remaining patches of grassland habitat from alien plants, over-grazing, and agriculture. Consequences of such impacts can result in the loss of populations of SCC; Further fragmentation of sub-populations of SCC across grassland habitats.

Impact Status: Negative

	E	**D**	**R**	**M**	**P**
Without Mitigation	Regional	Long Term	Recoverable	High	Definite
Score	3	4	3	4	5
With Mitigation	Regional	Long Term	Recoverable	Moderate	High Probable
Score	3	4	3	3	4
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	**High (-) Impact (65)**		**Moderate (+) Impact (52)**		
Was public comment received?	NO				

Has public comment been included in mitigation measures?	NO
Mitigation measures to reduce residual risk or enhance opportunities: • Alien invasive vegetation found on the project area should be removed; invasive alien plants are seen as a significant threat to faunal SCC. • Management plans for grassland habitats (e.g. alien plant removal, fire regime plan) can be implemented to favour maintaining functioning grassland ecosystems and faunal habitat.	
Residual impact	*Yes, potentially positive in terms of restoration and management of sensitive grassland habitats and associated faunal SCC. However, it is unlikely any of these mitigation measures would be implemented.*

Decommissioning Phase Impacts

Impacts associated with decommissioning are likely to be similar to that of the construction phase, from a faunal perspective. New and increased noises and disturbances would likely impact faunal SCC using habitats near, or in and around turbines, including new restored habitats created during the operation phase of the project. However, the duration of impacts should be of relatively short duration.

Of importance is that any landuse management plans (alien plant clearing, Oribi management plan, any conservation areas established) implemented should ideally continue at the end-of-life of the project, otherwise any biodiversity benefits of the project development will potentially be reduced in effect.

Mitigation measures at the decommissioning phase should follow avoidance, minimisation, and restoration and rehabilitation (Bennun et al., 2021; WindEurope, 2020). Once the WEF is decommissioned, the restoration of project sites should be undertaken with the least disturbance and impacts on faunal SCC and their habitats. As with the construction phase, careful control of the such works would be required, including a phased approach (e.g. see Bennun et al., 2021; WindEurope, 2020).

Overall, the restoration and rehabilitation of original vegetation, together with any biodiversity benefits from the operation phase, and if the management and conservation of high sensitive areas are set-up to continue, then there are likely to be overall positive impacts for faunal SCC at the end-of-life of the project.

Impact Phase: Decommissioning					
Nature of the impact: Noise and visual disturbances, affecting animal behaviour and changes in their movement and distribution patterns across landscapes.					
Description of Impact: Detailed description of impact Noise and visual disturbances, affecting animal behaviour and their habitat choice and use. Some animal species will actively avoid areas near decommissioning activities, leading to their displacement or changes in their movement and distribution patterns across landscapes. Increased vehicle movement on roads related to decommissioning, increased human activities, would further compound impacts. Consequences of such impacts could result in the loss of faunal SCC; restrict movement of some fauna through ecological corridors; and the fragmentation of sub-populations of faunal SCC across grassland habitats.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**

Without Mitigation	Local	Short Term	Recoverable	Moderate	Probable
Score	2	2	3	3	3
With Mitigation	Local	Short Term	Recoverable	Low	Probable
Score	2	2	3	2	3

Significance Calculation	**Without Mitigation**	**With Mitigation**
S=(E+D+R+M)*P	**Moderate (-) Impact (30)**	**Low (-) Impact (27)**
Was public comment received?	NO	
Has public comment been included in mitigation measures?	NO	

Mitigation measures to reduce residual risk or enhance opportunities:

- The smallest possible working corridor, particularly close to sensitive habitats, must be used.
- A ~5 m buffer zone should also be considered for any decommissioning activities close to any high sensitive areas.
- No construction vehicles are allowed within no-go areas.
- Limiting the number and speed of vehicle movements to, from, and within the project area.
- All temporary/permanent security fences will need to be modified (e.g. maintaining a gap, at reasonable intervals, between the base of the fence and the ground of approx. 30 cm) to allow small and medium-sized animals to move freely through and to not act as a barrier to dispersal.
- Revegetation of disturbed areas (turbine placement areas, access roads, etc.) as they become available, using topsoil and indigenous plants from the site where possible.
- Reinstatement of original vegetation, as far as feasible, after decommissioning.
- Continuation of alien plant monitoring and clearing, Oribi monitoring programme, and ensuring any conservation areas are retained.
- Providing toolbox talks to onsite personnel to ensure that they are aware of the biodiversity mitigation measures for decommissioning phase of the project.

Residual impact	*Some vegetation and soil disturbance are likely to remain even after restoration of developed areas afrer decommissioning, with low negative impacts.*

Cumulative Impacts

Although the development is considered as overall moderate (-) significance for faunal SCC, it may become more significant if added to existing or future impacts from other activities in the area. Wind farms, in combination with other renewable energy developments, can increase habitat fragmentation, create barriers for faunal species movement, and potentially cause cumulative impacts on faunal SCC populations.

According to ERM, no renewable energy projects occur within a 35 km radius of the proposed Emvelo WEF. However, at least one other recently proposed renewable energy project, a large solar farm, that is proposed for an area that falls within a 35 km radius of Emvelo WEF.

The Emvelo project site is situated in a degraded mosaic of areas of intact grassland habitats, heavily transformed areas of agriculture, and existing overhead powerlines. The project site itself is divided into pieces amongst this mosaic. The proposed development will therefore occur in a broader area of natural vegetation and habitat that is fragmented and/or disturbed.

Avoiding high sensitive grassland habitats, retaining ecological corridors, removing alien plants, monitoring Oribi populations, and implementing potential conservation programs could have an overall positive conservation impact for faunal SCC within the broader area of the WEF development. In this regard, a compromise between the loss of mostly degraded habitat with the conservation of areas of high grassland sensitivity and habitat for the Oribi should be considered as a positive component of this proposed development.

However, the current, and future developments in and around the Ermelo area, would need to be considered in the broader context of conservation strategies around the identification and establishment of a network of protected areas to help offset the cumulative negative impacts of renewable energy projects (and other developments) on faunal SCC, such as for highly threatened Oribi.

If enhancement measures, such as avoiding or off-setting high sensitive areas, implementing an alien plant and Oribi management plan, form part of the development, then it is unlikely that the addition of the proposed development will contribute to a cumulative negative impact on the long-term viability of the populations of faunal SCC and their persistence in the area. The high sensitive areas of grassland habitat should be incorporated into a longer-term and formalised conservation programme to off-set any cumulative impacts.

Cumulative Impact: Name of impact					
Description of Cumulative Impact: Contributing to further habitat fragmentation, noise and visual disturbances, affecting animal behaviour and changes in their movement and distribution patterns across grassland landscapes. Habitat fragmentation, disrupting ecological corridors and altering ecosystems which can further fragment populations and isolate species; and further noise and visual disturbances, affecting animal behaviour and their habitat choice and use. Some animal species will actively avoid areas near turbines, leading to their further displacement or changes and limiting their movement and distribution patterns across grassland landscapes. Increased vehicle movement on access roads, increased human activities, could further compound these impacts. Consequences of such impacts can result in the loss of populations of faunal SCC; restrict movement of fauna through ecological corridors; and the fragmentation of sub-populations of faunal SCC across high sensitive grassland habitats.					
Impact Status: Negative. Potentially Low positive impacts if enhancement measures, such as avoiding high sensitive areas, alien plant and Oribi management plans are successfully implemented.					
	E	**D**	**R**	**M**	**P**
Without Enhancement	Regional	Long Term	Recoverable	High	Highly Probable
Score	3	4	3	4	4
With Enhancement	Local	Medium Term	Recoverable	High	Low Probability
Score	2	3	3	4	2
Significance Calculation	**Without Enhancement**		**With Enhancement**		
S=(E+D+R+M)*P	Moderate (-) Impact (56)		Low (+) Impact (24)		
Can Impacts be Enhanced?	YES/NO				
Enhancement: • If high sensitive areas are to be impacted through cumulative impacts, then off-sets will be required. Implementation of an Oribi management plan for project area.					

• Implementation of a grazing and fire management plans for the high sensitive areas. • Ongoing eradication of alien invasive plants across the project area as part of an alien plant management plan. • Vegetation management in accordance with the recommendations from the botanist. • Modifications to any fencing to facilitate animal movement can include leaving a gap at reasonable intervals between the base of the fence and the ground of approx. 30 cm in height. This can occur across the full extent of the fence, or at regular intervals. • Possible options to mitigate the addition of artificial light pollution in grassland habitats could include: o Fixtures on lights to cover the light bulb and direct the light to where it is needed. o Use timers and motion sensors o An outdoor lighting plan should be developed that includes an overall reduction of nocturnal lighting.	
Residual impact	*The noise and visual disturbances of turbines are an innate aspect of wind farms, and some noise and visual disturbances of turbines will always remain. This is likely true of other renewable energy projects; therefore, if other renewable energy projects are developed, the cumulative impacts of these residual impacts could potentially be large.*

Impact Statement

The proposed wind farm development should not generate significant negative impacts on any of the faunal SCC flagged for this project once mitigation is followed. It is the specialists' opinion that the proposed development will have overall moderate negative impacts on the faunal SCC assessed, with some potential positive impacts, and therefore the proposed development can be approved in terms of this terrestrial animal species assessment: on the condition that all mitigation measures are implemented, including the avoidance of high sensitive areas, off-setting of high sensitive areas that are developed, and the implementation of an alien plant and Oribi management plans as stipulated here and in various other EMPrs (See Terrestrial Biodiversity and Botanical Impact Reports).

Activities for Inclusion in draft EMPr

From a faunal perspective, and specific to this development, several key management aspects to help reduce impacts and add biodiversity benefits are required:

- Off-set areas to be determined for any high faunal sensitive areas that are to be developed; these should form part of a long-term conservation programme and to be determine by an off-set specialist.
- An alien plant management plan that would involve the continued removal and monitoring of alien plant growth within the project sites, starting at the construction phase and continuing into the operational and decommissioning phases.
- Oribi management plan to be developed by a faunal specialist that could involve, amongst other aspects, identifying important Oribi habitat within the project areas, monitoring of Oribi numbers pre-construction, during construction, operational, and the decommissioning phases. Monitoring should ideally continue at least once a year at an appropriate time of year throughout the operation phase. In addition, populations should

also be monitored for 1–3 years post- decommissioning. Other aspects could include establishing a local Oribi working group, linking in with the national Oribi Working Group (OWG) and with the Endangered Wildlife Trust (EWT) (see Patel et al., 2021; Shrader et al., 2016). An Oribi management plan would be a strong mitigation measure to reduce impacts on this highly threatened antelope species.

- In conjunction with the above two management plans and considering that the grassland system is a fire-driven ecosystem, a fire management plan should be implemented.
- Any high faunal sensitive grassland habitat, or off-set areas, should be incorporated as part of a long-term conservation strategy, such as a stewardship programme. This would ensure that at the end-of-life of the project, positive biodiversity measures that have been implemented do not suddenly come to an end.

Numerous detailed measures, often at the site-level for individual turbines, for inclusion into the EMPr during the different phases are listed in the Terrestrial Biodiversity and Botanical Impact reports; these are supported here and recommended for inclusion.

References

Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G., 2021. Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy.

Colville, J.F., Cohen, C., 2023. Faunal Scoping Report: Site Sensitivity verification and Compliance Statement for Proposed Mulilo Cluster WEF, Ermelo, Mpumalanga Province: Emvelo WEF. Prepared for Arcus Consultancy Services South Africa (Pty) Limited (an ERM Group Company), 12 July 2023.

Deichmann, J.L., Ampudia Gatty, C., Andía Navarro, J.M., Alonso, A., Linares-Palomino, R., Longcore, T., 2021. Reducing the blue spectrum of artificial light at night minimises insect attraction in a tropical lowland forest. Insect Conserv. Divers. 14, 247–259. https://doi.org/10.1111/icad.12479

Docrat, N., 2023. The negative impact of wind turbines on wildlife in South Africa. WITS.

Helldin, J.O., Jung, J., Neumann, W., Olsson, M., Skarin, A., Fredrik, W., 2012. The impacts of wind power on terrestrial mammals - A synthesis. Swedish Environmental Protection Agency Report 6510.

Klich, D., Kawka, J., Łopucki, R., Kulis, Z., Yanuta, G., Budny, M., 2024. The contingent impact of wind farms on game mammal density demonstrated in a large-scale analysis of hunting bag data in Poland. Sci. Rep. 14, 1–12. https://doi.org/10.1038/s41598-024-76999-2

Lopucki, R., Mróz, I., 2016. An assessment of non-volant terrestrial vertebrates response to wind farms—a study of small mammals. Environ. Monit. Assess. 188, 1–9. https://doi.org/10.1007/s10661-016-5095-8

Owens, A.C.S., Cochard, P., Durrant, J., Farnworth, B., Perkin, E.K., Seymoure, B., 2020. Light pollution is a driver of insect declines. Biol. Conserv. 241, 108259. https://doi.org/10.1016/j.biocon.2019.108259

Patel, T., Stears, K., Little, I.T., Shrader, A.M., 2021. Assessing the Performance of Oribi Antelope Populations at Multiple Scales: The Limitations of Citizen-Led Oribi Conservation. African J. Wildl. Res. 51, 127–135. https://doi.org/10.3957/056.051.0127

Schöll, E.M., Nopp-Mayr, U., 2021. Impact of wind power plants on mammalian and avian wildlife species in shrub- and woodlands. Biol. Conserv. 256. https://doi.org/10.1016/j.biocon.2021.109037

Shrader, A.M., Little, I., Coverdale, B., Patel, T., 2016. A conservation assessment of Ourebia ourebi ourebi, in: Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D., Davies-Mostert, H.T. (Eds.), The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

South African National Biodiversity Institute, 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. V.

Stewart, A.J.A., 2021. Impacts of artificial lighting at night on insect conservation. Insect Conserv. Divers. 14, 163–166. https://doi.org/10.1111/icad.12490

Tolvanen, A., Routavaara, H., Jokikokko, M., Rana, P., 2023. How far are birds, bats, and terrestrial mammals displaced from onshore wind power development? – A systematic review. Biol. Conserv. 288. https://doi.org/10.1016/j.biocon.2023.110382

Tyler, N., Stokkan, K.A., Hogg, C., Nellemann, C., Vistnes, A.I., Jeffery, G., 2014. Ultraviolet vision and avoidance of power lines in birds and mammals. Conserv. Biol. 28, 630–631. https://doi.org/10.1111/cobi.12262

Voigt, C.C., 2021. Insect fatalities at wind turbines as biodiversity sinks. Conserv. Sci. Pract. 3, 1–5. https://doi.org/10.1111/csp2.366

Weschler, M., 2023. Wind energy and insects, reviewing the state of knowledge and identifying potential interactions. MS thesis. https://doi.org/10.7717/peerj.18153

WindEurope, 2020. Decommissioning of Onshore Wind Turbines. Industry Guidance Document.

Appendix-1 – CV Dr Jonathan Colville

CURRICULUM VITAE – JONATHAN F. COLVILLE

EDUCATION

PhD (Zoology): University of Cape Town, 2009. Thesis title: "*Understanding the evolutionary radiation of the megadiverse monkey beetle fauna (Scarabaeidae: Hopliini) of South Africa*".

Postdoctoral research fellowship: South African National Biodiversity Institute, 2009-2010.

PRIOR EMPLOYMENT

National Research Foundation Research Career Advancement Fellow: South African National Biodiversity Institute (2014-2019).

Researcher, South African National Biodiversity Institute, GEF/UNEP/FAO Global Pollination Project – South Africa (2010-2014).

PUBLICATIONS

Books edited:

- Allsopp, N., **Colville, J.F.**, Verboom, G.T. (2014). *Fynbos: Ecology, Evolution, and Conservation of a Megadiverse Region* (16 chapters; pp 1-377). Oxford University Press.

Book chapters:

- Forest F., **Colville J.F.**, Cowling R.M. (2018). Evolutionary diversity patterns in the Cape Flora of South Africa. In: *Phylogenetic Diversity: Applications and challenges in biodiversity science*. R. Scherson, D. Faith (Eds), Springer International Publishing.
- Lebuhn, G., Connor, E.F., Brand, M., **Colville, J.F.**, Keday, D., Resham, B.T., Muo, K., Ravindra, K.J. (2015). Monitoring pollinators around the world. In: *Pollination services to agriculture*. B. Gemmill-Herren (Ed), Routledge.
- **Colville, J.F.**, Potts, A.J., Bradshaw, P.L., Measey, G.J., Snijman, D., Picker, M.D., Procheş, Ş., Bowie, R.C.K., Manning, J.C. (2014). Floristic and faunal Cape biochoria: do they exist? In: *Fynbos: Ecology, Evolution, and Conservation of a Megadiverse Region*. N. Allsopp, J.F. Colville, G.A. Verboom (Eds), Oxford University Press.
- Lach, L., Picker, M.D., **Colville, J.F.**, Allsopp, M.H., and Griffiths, C.L. (2002). Alien invertebrate animals in South Africa. In: *Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species*. D. Pimentel (Ed), CRC Press, London.

Journal articles:

- Barraclough, D.A., and **Colville, J.F**. (2022). The first species of Nemestrinidae (Diptera) endemic to Madagascar: A remarkable new species of *Atriadops* Wandolleck, 1897. *Zootaxa*. 5196 (1): 145–150.
- Dombrow, H., **Colville, J.F.**, Bowie, R.C.K. (2022). Review of the genus *Amblymelanoplia* Dombrow, 2002 (Coleoptera: Scarabaeidae: Melolonthinae: Hopliini) with the description of ninety-three new species from South Africa and observations on its biogeography and phylogeny. *Zootaxa*. 5163 (1): 1-278.
- Melin, A., and **Colville, J.F**. (2022). Description of the male of *Rediviva steineri* Kuhlmann 2012 (Hymenoptera: Melittidae), an endemic oil-collecting bee species from South Africa. *African Entomology*. 30: e11178.
- Allen-Perkins, A., Magrach, A., Dainese, M., Garibaldi, L., … **Colville, J.F**., *et al.* (2022). CropPol: A dynamic, open, and global database on crop pollination. *Ecology*. 103, 3, e3614.

- Dorchin, N.; van Munster, S.; Klak, C.; Bowie, R.C.K.; **Colville, J.F**. (2022). Hidden diversity – A new speciose gall midge genus (Diptera: Cecidomyiidae) associated with succulent Aizoaceae in South Africa. *Insects*. 13, 75. https://doi.org/10.3390/insects13010075
- Cohen, C., Liltved, W.R., **Colville, J.F**., Shuttleworth, A., Weissflog, J., Svatos, A., Bytebier, B., Johnson, S.D. (2021). Sexual deception of a beetle pollinator through floral mimicry. *Current Biology*. 31: 1–8.
- Krenn, H.W., Karolyi, F., Lampert, P., Melin, A., **Colville, J.F**. (2021). Nectar uptake of a long-proboscid *Prosoeca* fly (Nemestrinidae) – Proboscis morphology and flower shape. *Insects*. 12(371): 1–13.
- McLeod, L., and **Colville, J.F.** (2021). Observations on unusual feeding and mating behaviour of a monkey beetle genus *Amblymelanoplia* Dombrow (Coleoptera: Scarabaeidae: Hopliini). *African Entomology*. 29(1): 301–306.
- **Colville, J.F**., Beale, C.M., Forest, F., Altwegg, R., Huntley, B., Cowling, R.M. (2020). Plant species richness, turnover and evolutionary diversity track gradients of stability and ecological opportunity in a megadiversity centre. *Proceedings of the National Academy of Sciences (PNAS)*. 117 (33): 20027–20037.
- Dombrow, H. & **Colville, J.F.** (2020). Review of the genus *Beckhoplia* Dombrow with the description of fifteen new species from South Africa and observations on its biogeography (Coleoptera: Scarabaeidae: Melolonthinae: Hopliini). *Zootaxa*. 4823(1): 1-64.
- Melin, A., Altwegg, R., Manning, J.C., and **Colville, J.F.** (2020). Allometric relationships shape foreleg evolution of long-legged oil bees (Melittidae: *Rediviva*). *Evolution*. https://doi.org/10.1111/evo.14144.
- Melin, A. & **Colville, J.F**. (2020). A nesting aggregation of *Rediviva intermixta* (Melittinae: Melittidae) with males sleeping together in nests (Namaqualand, South Africa). *The Journal of the Kansas Entomological Society*. 92 (3): 561–568.
- Melin, A., **Colville, J.F**., Duckworth, G.D.; Altwegg, R.; Slabbert, R.; Midgley, J.J.; Rouget, M.; Donaldson, J.S. (2020). Diversity of pollen sources used by managed honeybees in variegated landscapes. *Journal of Apicultural Research*. Doi10.1080\00218839.2020.1750757.
- Melin, A., Krenn, H.W., Manning, J.C., **Colville, J.F.** (2019). The allometry of proboscis length in Melittidae (Hymenoptera: Apoidae) and an estimate of their foraging distance using museum collections. *PLoS ONE*. 14(6): e0217839.
- Melin, A. & **Colville, J.F.** (2019). A review of 250 years of Southern African bee taxonomy and exploration (Hymenoptera: Apoidea: Anthophila). *Transactions of the Royal Society of South Africa*. 74:1, 86-96. [**Featured on Cover Page**]
- Rink, A.R., Altwegg, R., Edwards, S., Bowie, R.C.K., **Colville, J.F.** (2019). Contest dynamics and assessment strategies in combatant monkey beetles (Scarabaeidae: Hopliini). *Behavioural Ecology*. 40: 713–723.
- Barraclough, D., **Colville, J.F.**, Karolyi, F., Krenn, H.W. (2018). A striking new species of *Prosoeca* Schiner, 1867 (Diptera: Nemestrinidae): An important pollinator from the Bokkeveld Plateau, Northern Cape Province, South Africa. *Zootaxa* 4497: 411–421.
- **Colville, J.F.**, Picker, M.D., Cowling, R.M. (2018). Feeding ecology and sexual dimorphism in a speciose flower beetle clade (Hopliini: Scarabaeidae). *PeerJ*: 6:e4632.
- Melin, A., Mathieu, R., **Colville, J.F**., Midgley, J.J., Donaldson, J.S. (2018). Quantifying and evaluating distributed floral resources for managed honeybee pollination using an expanded concept of supporting ecosystem services. *PeerJ*: e5654.
- Cowling, R.M, Bradshaw, P.L., **Colville, J.F.**, Forest, F. (2017). Levyns' Law: Explaining the evolution of a remarkable longitudinal gradient in Cape plant diversity. *Transactions of the Royal Society of South Africa*. 72: 184-201.

- Treurnicht M., **Colville J.F.**, Joppa L.N., Huyser O., Manning J.C. (2017) Counting complete? Finalising the plant inventory of a global biodiversity hotspot. *PeerJ*: 5:e2984.
- Janion-Scheepers, C., Measey, G.J., Braschler, B., Chown, S.L., Coetzee, L., **Colville, J.F.**, Dames, J., Davies, A.B., *et al.* (2016). Soil biota in a megadiverse country: Current knowledge and future research directions in South Africa. *Pedobiologia*. 59: 129-174.
- Karolyi F., Hansal T., Krenn H.W., **Colville J.F.** (2016). Comparative morphology of the mouthparts of the megadiverse South African monkey beetles (Scarabaeidae: Hopliini): Feeding adaptations and guild structure. *PeerJ*: 4:e1597.
- Bradshaw, P.L., **Colville, J.F.**, Linder, H.P. (2015). Optimising regionalisation techniques: Identifying centres of endemism in the extraordinarily endemic-rich Cape Floristic Region. *PLoS ONE*. 10: e0132538.
- Cowling, R.M., Potts, A.J., Bradshaw, P.L., **Colville, J.F.**, Arianoutsou, M., Ferrier, S., Forest, F., Fyllas, N.M., Hopper, S.D., Ojeda, F., Procheş, Ş., Smith, R.J., Rundel, P.W., Vassilakis, E., Zutta, B.R. (2015). Variation in plant diversity in Mediterranean-climate ecosystems: The role of climatic and topographical stability. *Journal of Biogeography*. 42: 552-564.
- Kleijn, D., Winfree, R., Bartomeus, I., Carvalheiro, L.G., Henry, M., Isaacs, R., Klein, A-M., Kremen, C., M'Gonigle, L.K., Rader, R., Ricketts, T., Williams, N.M, Adamson, N-L., Ascher, J.S., Baldi, A., Batary, P., Benjamin, F., Biesmeijer, J.C., Blitzer, E.J., Bommarco, R., Brand, M.R., Bretagnolle, V., Button, L., Cariveau, D.P., Chifflet, R., **Colville, J.F.**, Danforth, B.N., Elle, E., Garratt, M.P.D., Herzog, F., Holzschuh, A., Howlett, B.G., Jauker, F., Jha, S., Knop, E., Krewenka, K.M., Le Feon, V., Mandelik, Y., May, E.M., Park, M.G., Pisanty, G., Reemer, M., Riedinger, V., Rollin, O., Rundlof, M., Sardinas, H.S., Scheper, J., Sciligo, A.R., Smith, H.G., Steffan-Dewenter, I., Thorp, R., Tscharntke, T., Verhulst, J., Viana, B.F., Vaissiere, B.E., Veldtman, R., Westphal, C., Potts, S.G. (2015). Delivery of crop pollination services is an insufficient argument for wild pollinator conservation. *Nature Communications*. 6: 7414**.**
- Manning, J.C., Goldblatt, P., **Colville, J.F.**, Cupidoa, C.N. (2015). Hopliine beetle pollination in annual *Wahlenbergia* species (Campanulaceae) from western South Africa, and the new species *W. melanops*. *South African Journal of Botany*. 100: 58-62.
- Mecenero, S., Altwegg, R., **Colville, J.F.**, Beale, C.M. (2015). Roles of spatial scale and rarity on the relationship between butterfly species richness and human density in South Africa. *PLoS ONE*. 10: e0124327.
- Forest, F., Goldblatt, P., Manning, J.C., Baker, D., **Colville, J.F.**, Devey, D.S., Jose, S., Kaye, M., Buerki, S. (2014). Pollinator shifts as trigger of speciation in painted petal irises (*Lapeirousia*: Iridaceae). *Annals of Botany*. 113: 357-71.
- Karolyi, F., **Colville, J.F.**, Handschuh, S., Metscher, B.D., Krenn, H.W. (2014). One proboscis, two tasks: Adaptations to blood-feeding and nectar-extracting in long-proboscid horse flies (Tabanidae, *Philoliche*). *Arthropod Structure & Development*. 43: 403-413.
- Karolyi, F., Morawetz, L., **Colville, J.F.**, Handschuh, S., Metscher, B.D., Krenn, H.D. (2013). Time management and nectar flow: Flower handling and suction feeding in long-proboscid flies (Nemestrinidae: *Prosoeca*). *Naturwissenschaften*. 100: 1083-1093. [**Featured on Cover Page**]
- Ryan, P.G., **Colville, J.F.**, Picker, M.D. (2013). Juvenile African Pipit feeding on monkey beetles. *Ornithological Observations*. 4: 6-8.
- Karolyi, F., Szucsich, N.U., **Colville, J.F.**, Krenn, H.W. (2012). Adaptations for nectar-feeding in the mouthparts of long-proboscid flies (Nemestrinidae: *Prosoeca*). *Biological Journal of the Linnean Society*. 107: 414-424.
- Picker, M.D., **Colville, J.F.**, Burrows, M. (2012). A cockroach that jumps. *Biology Letters*. 8: 390-392.
- **Colville, J.F.** (2009). Understanding the evolutionary radiation of the mega-diverse monkey beetle fauna (Scarabaeidae: Hopliini) of South Africa. *Frontiers in Biogeography*. 1: 24-29.
- Bohn, H., Picker, M.D., Klaus-Dieter, K. & **Colville, J.F.** (2010). A jumping cockroach from South Africa, *Saltoblattella montistabularis*, gen. nov., spec. nov. (Blattodea: Blattellidae). *Arthropod*

Systematics & Phylogeny. 68: 53-69. **[Featured as a "Top 10 New Species discovery" by the International Institute for Species Exploration**].

- **Colville, J.F.**, Picker, M.D., Cowling, R.M. (2002). Species turnover of monkey-beetles (Scarabaeidae: Hopliini) along environmental and disturbance gradients in the Namaqualand region of the Succulent Karoo, South Africa. *Biodiversity and Conservation*. 11: 243–264.
- Picker, M.D., **Colville, J.F.**, van Noort, S. (2002). Mantophasmatodea now in South Africa. *Science*. 297: 1475.

Technical reports:

- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Grace Rock Equestrian Farm. Prepared for Delta Ecology and Legacy Environmental Management Consulting.
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Dana Bay Access Road. Prepared for Sharples Environmental Services cc (SES).
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Biodiversity Specialist Assessment. Duyker Eiland Prospecting Rights. Prepared for Elemental Sustainability (Pty) Ltd.
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Proposed mixed use housing development. Prepared for EcoSense CC.
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Proposed agricultural development. Prepared for McGregor Environmental Services.
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Blue Sky's Project Prepared for Doug Jeffery – Environmental Consultants.
- **Colville, J.F.**, and Cohen, C. (2022). Terrestrial Animal Species Specialist Assessment. Proposed Expansion of Nature's View Dam near Citrusdal. Prepared for Earth Grace Environmental Consultancy.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Proposed enlargement of existing Kleigat Dam. Prepared for Earth Grace Environmental Consultancy.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Moorreesburg Wastewater Treatment Works Upgrade Project. Prepared for Zutari (Pty) Ltd.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Maxnau Citrus Development. Prepared for Charl de Villiers Environmental Consulting.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Gletwyn Estate Mixed Use Development. Prepared for Johan Neethling Environmental Services cc.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Moorreesburg Wastewater Treatment Works Upgrade Project. Prepared for Zutari (Pty) Ltd.
- **Colville, J.F.** (2021). Terrestrial Animal Species Specialist Assessment. Proposed Development of Solar Photo-Voltaic Renewable Energy Power Station. Prepared for Resource Management Services (RMS).
- **Colville, J.F.** & Picker, M.D. (2009-2010). *Invertebrate impact assessment – Oudekraal, Table Mountain*. Prepared for Doug Jeffery Environmental Consultants.
- Picker, M.D. & **Colville, J.F.** (2007). *Invertebrate impact assessment: Worcester Island Development*. SRK Environmental impact report for Consulting Engineers and Scientists, Cape Town.
- Picker, M.D. & **Colville, J.F.** (2006). *Baseline faunal investigation for proposed development at Altona, Worcester, Western Cape Province*. Environmental impact report for SRK Consulting Engineers and Scientists, Cape Town.
- **Colville, J.F.** & Picker, M.D. (2005). *Scoping Phase II: The impact of development of Worcester on the insect and scorpion fauna*. Environmental impact report for Chand Environmental Consultants, Cape Town.
- **Colville, J.F.** (2001) *Scoping and faunal assessment for proposed housing development, Skapenberg, Somerset West*. Prepared for Design consultants CNdV Africa.

MEMBERSHIPS/RESEARCH ASSOCIATE

- Membership of Entomological Society of Southern Africa (2007-current).
- Membership of Lepidopterists Society of Southern Africa (2014-current).
- Honorary Research Associate (HRA), Statistics in Ecology, Environment and Conservation (SEEC), Department of Statistical Sciences, UCT (2014-current).
- SACNASP registration for Ecological Science (Professional Natural Scientist) (member#: 134759).

PROFESSIONAL SERVICES

- Editorial board *African Entomology* (2010-current).
- Editorial board *Metamorphosis* (2017-current).
- Editorial board *PeerJ* (2019-current).
- CAPE Invasive Alien Animal (IAA) Working Group (2016-2018).

Appendix-2 – CV Dr Callan Cohen

ABRIDGED CURRICULUM VITAE DR CALLAN COHEN

Education

PhD in Ornithology (Zoology), University of Cape Town, 2011.

Positions held:

Director: Birding Africa. 1997 – present.

Research Associate: FitzPatrick Institute of African Ornithology, Department of Biological Sciences, University of Cape Town. 2012 – present.

Experience

Acknowledged expert on African birds, based on over 1000 field trips, research studies and surveys from 1990 to present, in over 25 African countries, but focused largely across South Africa. First author of 2 books on African birds, and contributor to almost 10 others. Also publications and reports on Odonata, Lepidoptera, Herpetology and Botany.

Selected Books

Cohen, C., Spottiswoode, C. & Rossouw, J. 2006. **Southern African Birdfinder: where to find 1400 species in southern Africa and Madagascar**. Cape Town: Struik New Holland Publishers, 456 pp. Reprinted 2007, 2012, 2022.

Cohen, C. & Spottiswoode, C. 2000. **Essential Birding in Western South Africa: Key routes from Cape Town to the Kalahari.** Cape Town: Struik New Holland Publishers, 136 pp. Reprinted 2001.

Klaas-Douwe B. Dijkstra & **Callan Cohen**. 2021. **Dragonflies and Damselflies of Madagascar and the western Indian Ocean Islands**. Association Vahatra Antananarivo, Madagascar. 198 pages.

Contributed 20 species accounts in: Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (Eds). 1997. **The Atlas of Southern African Birds**. Johannesburg: BirdLife South Africa.

Contributed 10 species accounts in: Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (Eds). 2005. **Roberts' Birds of Southern Africa**. Seventh edition. Cape Town: John Voelcker Bird Book Fund.

Contributor to Red Data Book on Birds: BARNES, K.N. (ed.) 2000. **Threatened Birds of South Africa, Lesotho and Swaziland**. Johannesburg: BirdLife South Africa.

Species account written: African Marsh Harrier

Other Publications

About 100 journal articles and over 50 reports, e.g. most recent:

Cohen, C. 2021. **Deciphering South Africa's first Crested Honey Buzzard**. African Birdlife 9(4): 26-29.

Cohen, C., N. J. Collar, A. Dagnee, L. D. C. Fishpool, S. J. Marsden, C. N. Spottiswoode & S. R. Wotton. 2021. **Status of Taita Falcon Falco fasciinucha in Ethiopia and the identification problem posed by African Hobby F. cuvierii**. Bull ABC Vol 28 No 2: 225-233

Mills, Michael S. L., Julian Francis, Nik Borrow, Nigel Redman, Washington Wachira and **Callan Cohen**. 2021. **English bird names in common use: a framework to achieve a stable world list despite ongoing taxonomic changes, and a call to establish a broad-based African Bird Names Committee.** Bull ABC Vol 28 No 1: 93-98.

Appendix-3 – Project Details

As provided by ERM:

Error! Use the Home tab to apply DocTitle to the text that you want to appear here.

Error! Use the Home tab to apply DocSubtitle to the text that you want to appear here.

October 2024

Project No.: **Error! Use the Home tab to apply DocRef to the text that you want to appear here.**

1.1 Technical Details

The proposed technical details of each WEF are presented in the table below:

Developer / Applicant		Sheepmoor Wind Energy Facility (Pty) LTD	Emvelo Wind Energy Facility (Pty) LTD
DFFE Reference		To be confirmed	To be confirmed
WEF Generation Capacity		Up to 260 MW	Up to 260 MW
Site Access		Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3m width for underground 33 kV reticulation.	Locality to be confirmed. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3m width for underground 33 kV reticulation.
Number of Turbines		Up to 40	Up to 40
Hub Height from ground level		Up to 150 m	Up to 150 m
Blade Length		Up to 110 m	Up to 110 m
Rotor Diameter		Up to 220 m	Up to 220 m
Length of internal roads		Unknown at this point.	Unknown at this point.
Width of internal roads		Up to 12 m to be rehabilitated to up to 9 m.	Up to 12 m to be rehabilitated to up to 9 m.
On-site substation capacity		Up to 132 kV	Up to 132 kV
Proximity to grid connection		Approximately 25 km	Approximately 30 km
Grid Connection Capacity		Up to 132 kV	Up to 132 kV
Temporary turbine construction laydown and storage areas.		Crane platforms and hardstand laydown area up to 40 ha (Up to 1 ha per turbine)	Crane platforms and hardstand laydown area up to 40 ha (Up to 1 ha per turbine)
Permanent footprint area dimensions, including roads, turbine hardstand areas, O&M buildings and battery pad.		O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha	O&M: Up to 1 ha Hardstand areas: Up to 1 ha Total area of final footprint (including roads): up to 180 ha
Operations and maintenance buildings (O&M building) with parking area		Up to 1 ha	Up to 1 ha

Appendix-4 – Impact Assessment Methodology

As provided by ERM:

IMPACT ASSESSMENT METHODOLOGY

The purpose of the assessment of impacts in an EIA is to evaluate the likely extent and overall significance that a potential impact may have on an identified receptor or resource. Another important aspect of the assessment of impacts is to quantify those impacts that are not scientific-based or evidence-based and include the opinions of others (i.e., the involvement and comment from I&APs).

A successful assessment of the potential significance of impacts will include the description and development of 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.

A 7-step approach for the determination of significance of potential impacts was developed by ERM to align with the requirements of Appendix 3 of the EIA Regulations, 2014 (as amended). The approach is both objective and scientific based to allow appointed specialists and EAPs to retain independence throughout the assessment process.

ERM has adapted this 7-step approach from standard ranking metrics such as the Hacking Method, Crawford Method etc. The ERM 7-step approach complies with the method provided in the EIA guideline document (GN 654 of 2010) and considers international EIA Regulatory reporting standards such as the newly amended European Environmental Impact Assessment (EIA) Directive (2014/52/EU).

The 7-Step approach for determining the significance of impacts pre, and post mitigation, is described below:

Step 1: Predict potential impacts by means of an appraisal of:
- Site Surveys,
- Project-related components and infrastructure,
- Activities related with the project life-cycle,
- The nature and profile of the receiving environment and potential sensitive environmental features and attributes,
- Input received during public participation from all stakeholders, and
- The relevant legal framework applicable to the proposed development

Step 2: Determination of whether the potential impacts identified in **Step 1** will be *direct* (caused by construction, operation, decommissioning or maintenance activities on the proposed development site or immediate surroundings of the site), *indirect* (not immediately observable or do not occur on the proposed development site or immediate surroundings of the site), *residual* (those impacts which remain after post mitigation) and *cumulative* (the combined impact of the project when considered in conjunction with similar projects in proximity).

Step 3: Description and determination of the significance of the predicted impacts in terms of the criteria below to ensure a consistent and systematic basis for the decision-making process. Significance is numerically quantified on the basis score of the following impact parameters:

1. ***Extent*** **(E)** of the impact: The geographical extent of the impact on a given environmental receptor.
2. ***Duration*** **(D)** of the impact: The length of permanence of the impact on the environmental receptor.

3. ***Reversibility*** **(R) of the impact**: The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change
4. ***Magnitude*** **(M)** of the impact: The degree of alteration of the affected environmental receptor.
5. ***Probability*** **(P)** of the impact: The likelihood of the impact actually occurring.

A widely accepted numerical quantification of significance is the formula:

$$\underline{\mathbf{S=(E+D+R+M)*P}}$$

Where: *Significance=(Extent+Duration+Reversibility+Magnitude) * Probability*

The following has also been considered when determining the significance of a potential impact.

6. **Nature (N)** of the impact: A description of what causes the effect, what will be affected, and how it will be affected.
7. **Status (S)** of the impact: described as either positive, negative or neutral
8. **Cumulative impacts**.
9. Inclusion of **Public comment.**

The significance of environmental impacts is determined and ranked by considering the criteria presented in **Table 1** below. All criteria are rank according to 'Very Low', 'Low', 'Moderate', 'High' and 'Very High' and are assigned scores of 1 to 5 respectively.

Table 1: Defining the significant in terms of the impact criteria.

Impact Criteria	Definition	Score	Criteria Description
Extent (E)	Site	1	Impact is on the site only
	Local	2	Impact is localized inside the activity area
	Regional	3	Impact is localized outside the activity area
	National	4	Widespread impact beyond site boundary. May be defined in various ways, e.g. cadastral, catchment, topographic
	International	5	Impact widespread far beyond site boundary. Nationally or beyond
Duration (D)	Immediate	1	On impact only
	Short term	2	Quickly reversible, less than project life. Usually up to 5 years.
	Medium term	3	Reversible over time. Usually between 5 and 15 years.
	Long term	4	Longer than 10 years. Usually for the project life.
	Permanent	5	Indefinite
Magnitude (M)	Very Low	1	No impact on processes
	Low	2	Qualitative: Minor deterioration, nuisance or irritation, minor change in species/habitat/diversity or resource, no or very little quality deterioration. Quantitative: No measurable change; Recommended level will never be exceeded.
	Moderate	3	Qualitative: Moderate deterioration, discomfort, Partial loss of habitat /biodiversity /resource or slight or alteration. Quantitative: Measurable deterioration; Recommended level will occasionally be exceeded.
	High	4	Qualitative: Substantial deterioration death, illness or injury, loss of habitat /diversity or resource, severe alteration or disturbance of important processes.

Impact Criteria	Definition	Score	Criteria Description
			Quantitative: Measurable deterioration; Recommended level will often be exceeded(e.g. pollution)
	Very High	5	Permanent cessation of processes
Reversibility (R)	Reversible	1	Recovery which does not require rehabilitation and/or mitigation.
	Recoverable	3	Recovery which does require rehabilitation and/or mitigation.
	Irreversible	5	Not possible, despite action. The impact will still persist, and no mitigation will remedy or reverse the impact.
Probability (P)	Improbable	1	Not likely at all. No known risk or vulnerability to natural or induced hazards
	Low Probability	2	Unlikely; low likelihood; Seldom; low risk or vulnerability to natural or induced hazards
	Probable	3	Possible, distinct possibility, frequent; medium risk or vulnerability to natural or induced hazards.
	Highly Probable	4	Highly likely that there will be a continuous impact. High risk or vulnerability to natural or induced hazards
	Definite	5	Definite, regardless of prevention measures.

The *significance* (s) of potential impacts identified according to the criteria above has been colour coded for the purpose of comparison. This colour coding will be used in impact tables.

Significance is deemed Negative (-)			Significance is deemed Positive (+)		
0 - 30	**31 - 60**	**61 - 100**	**0 - 30**	**31 - 60**	**61 - 100**
Low	**Moderate**	**High**	**Low**	**Moderate**	**High**

Step 4: Determination of practical and reasonable mitigation measures based on specialists' inputs and field observations following the mitigation hierarchy (avoid, minimise, manage, mitigate, or rehabilitate).

Step 5: Evaluation of predicted residual impacts after implementation of mitigation measures.

Step 6: Determination of the significance of the impact taking into consideration the predicted residual impacts after implementation of mitigation measures.

Step 7: Based on an acceptable significance of the impact, determination of the need and desirability of the proposed development and an opinion as to whether the development should proceed or not.

The Assessment of the significance of potential impacts is then populated in an Impact Summary Table.

IMPACT SUMMARY TABLE

Please copy the below table into your reports for any impact assessments required.

Impact Phase: Detail if the impact will take place during Construction/ Operation/Decommissioning
Nature of the impact: Name of impact
Description of Impact: Detailed description of impact xxxx …

Impact Status: Detail of the impact is Positive, Neutral or Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Medium Term	x	x	x
Score	2	3	x	x	x
With Mitigation	Site	Short Term	x	x	x
Score	1	2	x	x	x
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (42)		Low Negative Impact (25)		
Was public comment received?	YES/NO. If yes, provide a bullet summary of main concerns.				
Has public comment been included in mitigation measures?	YES/NO, if NO then WHY? If YES then HOW/WHERE				
Mitigation measures to reduce residual risk or enhance opportunities: *List and describe* *Aaa* *Aaa* *Aaa* *Aaa* *Aaaa* …					
Residual impact	*Describe the impact.*				

ASSESSMENT OF CUMULATIVE IMPACTS

In relation to an activity, cumulative impact means *"the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities"* (NEMA EIA Reg GN R982 of 2014).

Specialists are required to assess cumulative impacts associated with similar developments within a 35 km radius of the proposed developments. The purpose of the cumulative assessment is to test if such impacts are relevant to the proposed developments in the proposed locations (i.e. whether the addition of the proposed project in the area will increase the impact). In this regard, specialist studies considered whether the construction of the proposed development will result in:
Unacceptable risk
Unacceptable loss
Complete or whole-scale changes to the environment or sense of place
Unacceptable increase in impact

Cumulative Impacts will be assessed and populate in a cumulative impact summary table.

Please copy the below table into your reports for any impact assessments required.

Cumulative Impact: Name of impact					
Description of Cumulative Impact: Detailed description of cumulative impact xxxx …					
Impact Status: Detail of the impact is Positive, Neutral or Negative					
	E	**D**	**R**	**M**	**P**
Without Enhancement	Local	Medium Term	x	x	x
Score	2	3	x	x	x
With Enhancement	Site	Short Term	x	x	x

Score	1	2	x	x	x
Significance Calculation	**Without Enhancement**		**With Enhancement**		
S=(E+D+R+M)*P	Moderate Negative Impact (42)		Low Negative Impact (25)		
Can Impacts be Enhanced?	YES/NO and HOW/WHY				
Enhancement: *List and describe* *Aaa* *Aaa* *Aaa* *Aaa* *Aaaa* …					
Residual impact	*Describe the impact.*				

HERITAGE SURVEY MULILO EMVELO WEF & OHL

FOR ERM & MULILO

REVISED DATE: 19 NOVEMBER 2023

REVISED DATE: 5 DECEMBER 2024

REVISED DATE: 20 MAY 2025

By Gavin Anderson & Louise Anderson

Umlando: Archaeological Surveys and Heritage Management

PO Box 10153, Meerensee, 3901

Phone: 035-7531785 Cell: 0836585362

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. Umlando reserves the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field or pertaining to this investigation.

Although Umlando exercises due care and diligence in rendering services and preparing documents Umlando accepts no liability, and the client, by receiving this document, indemnifies Umlando against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Umlando and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

COPYRIGHT

Copyright on all documents, drawings and records, whether manually or electronically produced, which form part of the submission and any subsequent report or project document, shall vest in Umlando.

The client, on acceptance of any submission by Umlando and on condition that the client pays to Umlando the full price for the work as agreed, shall be entitled to use for its own benefit:

- • The results of the project;
- • The technology described in any report; and
- • Recommendations delivered to the client.

Should the applicant wish to utilise any part of, or the entire report, for a project other than the subject project, permission must be obtained from Umlando to do so. This will ensure validation of the suitability and relevance of this report on an alternative project.

TABLE OF CONTENT

LIST OF TABLES 4
INTRODUCTION 6
ASSUMPTIONS AND LIMITATIONS 6
TERMS OF REFERENCE 7
NATIONAL HERITAGE RESOURCES ACT OF 1999 12
METHOD 14
Defining significance 15
DESKTOP STUDY 18
FIELD SURVEY 24
EMVELO WEF 25
EMVE06 27
EMVE07 28
EMVE08 28
EMVE09 31
EMVE012 32
ROCH01 33
ROCH02 35
ROCH03 36
ROCH04 37
ROCH05 39
DESKTOP PALAEONTOLOGICAL ASSESSMENT 42
OVERHEAD LINES 45
MANAGEMENT PLAN 45
SIGNIFICANCE OF IMPACT 48
CUMULATIVE IMPACTS 57
REFERENCES 66
EXPERIENCE OF THE HERITAGE CONSULTANT 67
DECLARATION OF INDEPENDENCE 67
APPENDIX A 68
PIA DESKTOP 68
APPENDIX B 88
RECORDED SITES FROM THE ORIGINAL SURVEY THAT ARE NOT PART OF THE FINAL REPORT 88
APPENDIX C 99
CHANCE FIND PROTOCOL 99

TABLE OF FIGURES

FIG. 1 GENERAL LOCATION OF THE EMVELO WEF & OHL 8
FIG. 2: AERIAL OVERVIEW OF THE EMVELO WEF TURBINE LOCATIONS 9
FIG. 3: TOPOGRAPHICAL MAP OF THE EMVELO WEF 10
FIG. 4: SCENIC VIEWS OF THE STUDY AREA 11
FIG. 5: LOCATION OF RECORDED SITES IN THE GENERAL AREA 20
FIG. 6: SURVEYOR GENERAL MAP OF ZWARTWATER 1876 21
FIG. 7: SURVEYOR GENERAL MAP OF ONVERWACHT 287 (1914) 22
FIG. 8: LOCATION OF DESKTOP SITES FOR THE WEF AND OHL 23
FIG. 9: LOCATION OF RECORDED SITES FOR THE EMVELO WEF IN RELATION TO THE TURBINES 26
FIG. 10: CEMETERY AT EMVE06 27
FIG. 11: FEATURES AT EMVE07 29

FIG. 12: BUILDINGS AT EMVE08 30
FIG. 13: STONE WALLED KRAAL AT EMVE09 31
FIG. 14: CEMETERY AT EMVE012 32
FIG. 16: BOTHMA FAMILY CEMETERY 34
FIG. 17: HOUSE FOUNDATIONS AT ROCH02 35
FIG. 18: SETTLEMENT AT ROCH03 36
FIG. 19: BUILT STRUCTURES AT ROCH04 38
FIG. 20: BUILT STRUCTURES AT ROCH05 41
FIG. 21: LOCATION OF HIGH SENSITIVE PALAEONTOLOGICLA AREAS 44

LIST OF TABLES

TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES 17
TABLE 2: LOCATION OF DESKTOP SITES 18
TABLE 3: ESTIMATED FAMILY TREE 25
TABLE 4: ESTIMATED FAMILY TREE 33

Abbreviations

HP	Historical Period
IIA	Indeterminate Iron Age
LIA	Late Iron Age
EIA	Early Iron Age
ISA	Indeterminate Stone Age
ESA	Early Stone Age
MSA	Middle Stone Age
LSA	Late Stone Age
HIA	Heritage Impact Assessment
PIA	Palaeontological Impact Assessment

INTRODUCTION

Emvelo WEF is proposed to comprise up to 40 turbines with a maximum output capacity of up to 260 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 25-30 years. The final design which will be requested for approval in the EA, will be determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design.

It is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels, be constructed to connect the proposed WEF to the proposed new Camden B substation.

ASSUMPTIONS AND LIMITATIONS

The main assumptions in the study were:

1. the various features noted in the desktop study would still be visible.
2. The various tracks noted on Google Earth would be accessible via 4x4
3. The black wattle plantations would not hinder access to sites
4. Vegetation would be low and thus site visibility would be good.
5. Wind turbines would not be located on low lying land, and thus not all of these areas required assessment unless affected by transmission lines

The limitations to the study were:

1. Black wattle plantations had exceeded in size as per Google Earth imagery and restricted access to areas. The plantations were at some times impenetrable.

2. Some of the access tracks no longer existed
3. Heavy rains had resulted in dense/tall vegetation. While the desktop and other sites were visible, the details of features were often obscured. This is especially the case for human graves at older settlements.

TERMS OF REFERENCE

The terms of reference for the project are:

- Undertake a desktop study for previous HIA studies in the footprint
- Undertake a desktop study using historical maps and databases for known sites
- Undertake desktop palaeontological survey to note sensitive areas
- Undertake field survey to record heritage sites
- Assess the significance of each heritage site in relation to the type of development
- Suggest mitigation and provide a management plan
- Provide a kml, or shape, file of the recorded sites.
- Provide a significance of impact for each type of site

SENSITIVITY SCREENING

The screening report states that the affected area is of low significance. I disagree with this as there have been no previous surveys in the general area with which the screening tool can compare. Just because an area does not have known sites, does not mean it is of low significance. It means that there have probably been no previous survey heritage.

The survey results indicate the area is of low, medium and high significance.

FIG. 1 GENERAL LOCATION OF THE EMVELO WEF & OHL

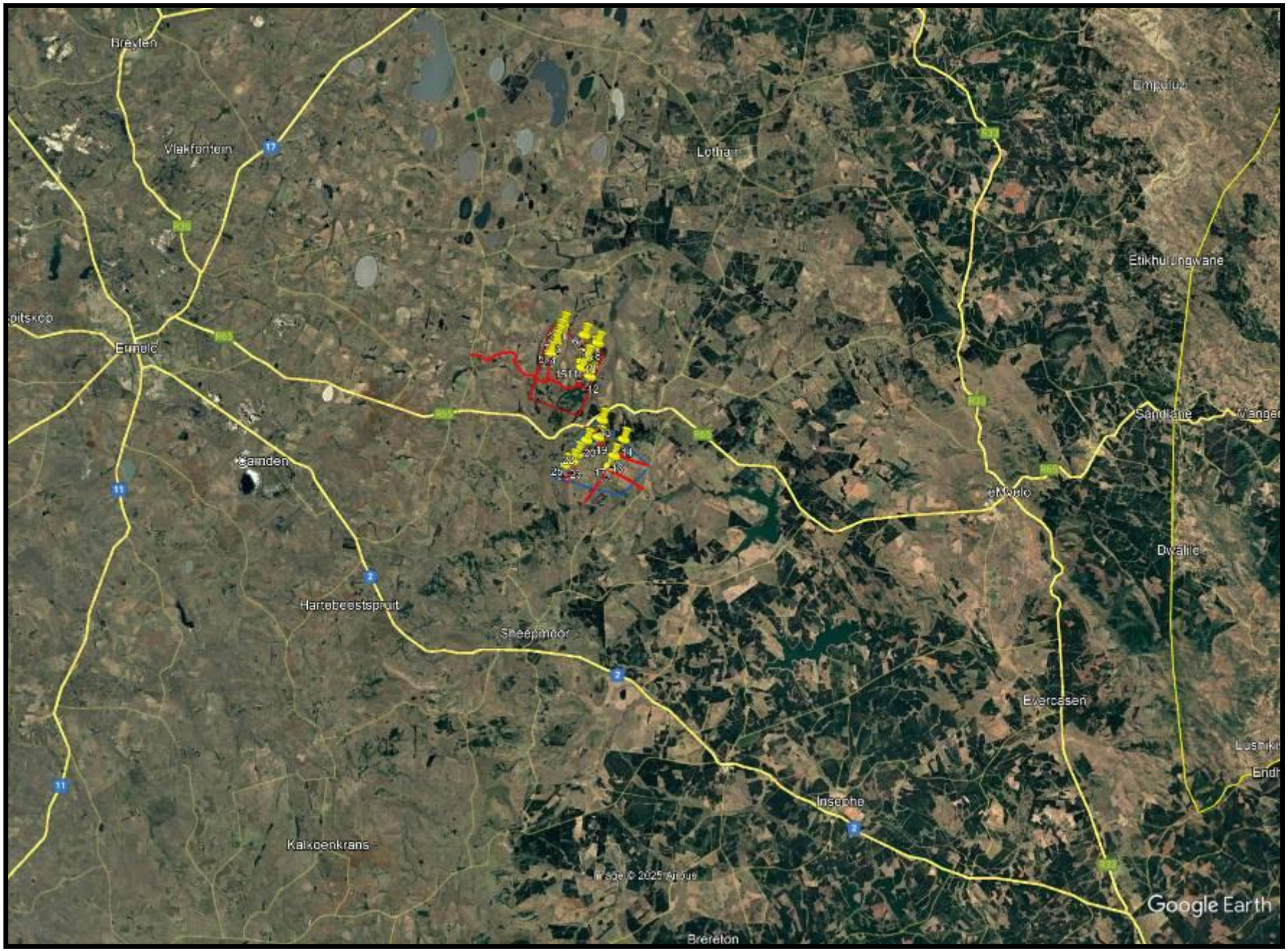


FIG. 2: AERIAL OVERVIEW OF THE EMVELO WEF TURBINE LOCATIONS



FIG. 3: TOPOGRAPHICAL MAP OF THE EMVELO WEF

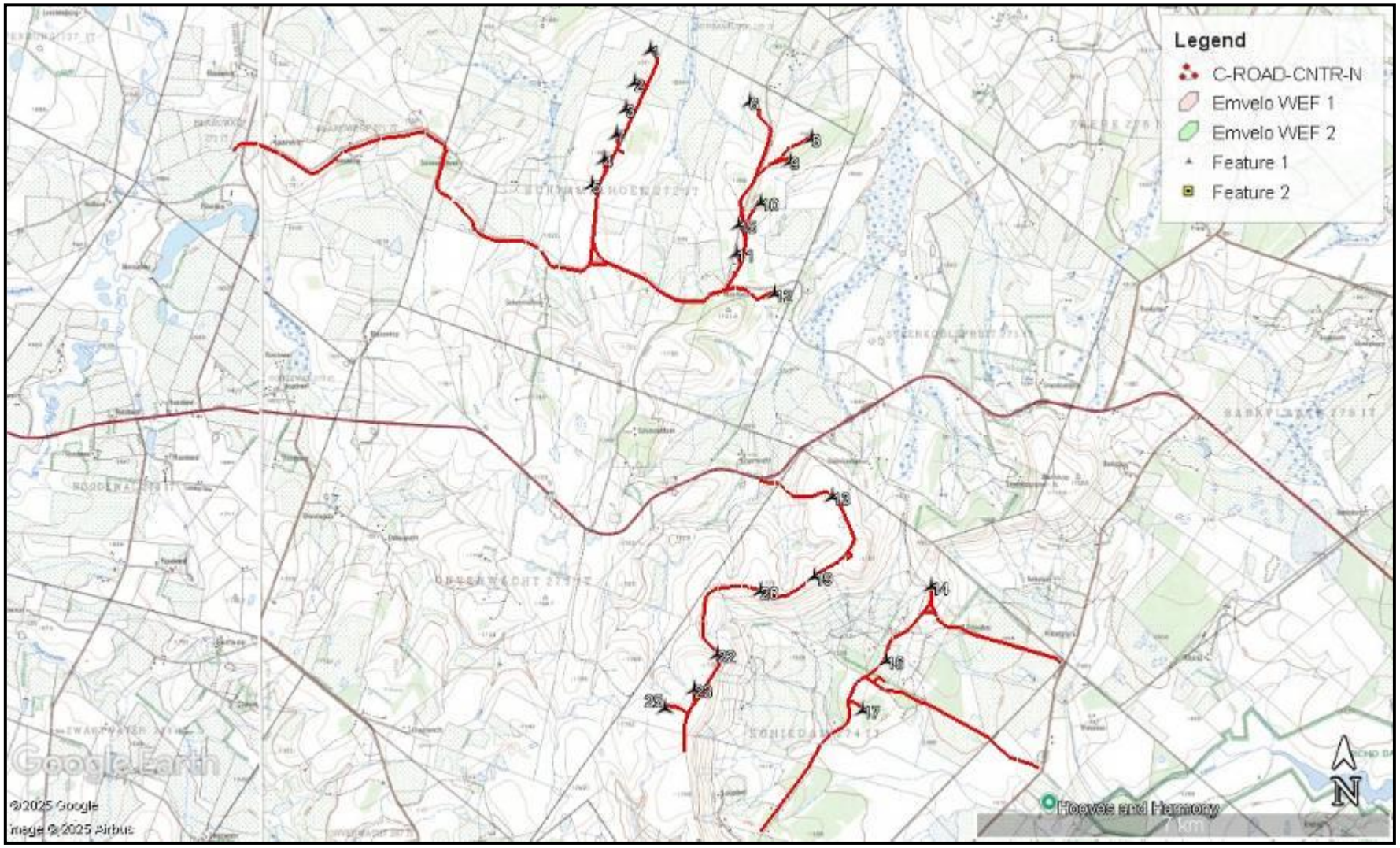


FIG. 4: SCENIC VIEWS OF THE STUDY AREA






NATIONAL HERITAGE RESOURCES ACT OF 1999

The National Heritage Resources Act of 1999 (pp 12-14) protects a variety of heritage resources. This are resources are defined as follows:

1. **"**For the purposes of this Act, those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities.

2. Without limiting the generality of subsection (1), the national estate may include—

2.1. Places, buildings, structures and equipment of cultural significance;

2.2. Places to which oral traditions are attached or which are associated with living heritage;

2.3. Historical settlements and townscapes;

2.4. Landscapes and natural features of cultural significance;

2.5. Geological sites of scientific or cultural importance;

2.6. Archaeological and palaeontological sites;

2.7. Graves and burial grounds, including—

2.7.1. Ancestral graves;

2.7.2. Royal graves and graves of traditional leaders;

2.7.3. Graves of victims of conflict;

2.7.4. Graves of individuals designated by the Minister by notice in the Gazette;

2.7.5. Historical graves and cemeteries; and

2.7.6. Other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

3. Sites of significance relating to the history of slavery in South Africa;

3.1. Movable objects, including—

4. Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

4.1. Objects to which oral traditions are attached or which are associated with living heritage;

4.2. Ethnographic art and objects;

4.3. Military objects;

4.4. objects of decorative or fine art;

4.5. Objects of scientific or technological interest; and

4.6. books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

5. Without limiting the generality of subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—

5.1. Its importance in the community, or pattern of South Africa's history;

5.2. Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

5.3. Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

5.4. Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;

5.5. Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

5.6. Its importance in demonstrating a high degree of creative or technical achievement at a particular period;

5.7. Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

5.8. Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and

5.9. sites of significance relating to the history of slavery in South Africa"

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. These database contain archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (http://www.vuvuzela.com/googleearth/monuments.html) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1st and 2nd edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a quick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or

features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

Defining significance

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

1. State of preservation of:

1.1. Organic remains:

1.1.1. Faunal

1.1.2. Botanical

1.2. Rock art

1.3. Walling

1.4. Presence of a cultural deposit

1.5. Features:

1.5.1. Ash Features

1.5.2. Graves

1.5.3. Middens

1.5.4. Cattle byres

1.5.5. Bedding and ash complexes

2. Spatial arrangements:

2.1. Internal housing arrangements

2.2. Intra-site settlement patterns

2.3. Inter-site settlement patterns

3. Features of the site:

3.1. Are there any unusual, unique or rare artefacts or images at the site?

3.2. Is it a type site?

3.3. Does the site have a very good example of a specific time period, feature, or artefact?

4. Research:

4.1. Providing information on current research projects

4.2. Salvaging information for potential future research projects

5. Inter- and intra-site variability

5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?

5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

6. Archaeological Experience:

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

7. Educational:

7.1. Does the site have the potential to be used as an educational instrument?

7.2. Does the site have the potential to become a tourist attraction?

7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

8. Other Heritage Significance:

8.1. Palaeontological sites

8.2. Historical buildings

8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites

8.4. Graves and/or community cemeteries

8.5. Living Heritage Sites

8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts.

The above significance ratings allow one to grade the site according to SAHRA's grading scale. This is summarised in Table 1.

TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

DESKTOP STUDY

Two HIA studies have occurred near Camden power station. Celliers (2013) recorded isolated graves, stone walling and cemeteries. Fourie (2020) did not record any sites. Figure 5 shows the location of recorded heritage sites in the general area. Only the cemetery has been previously recorded.

Only two of the original Surveyor general maps are available online. These two maps indicate that the farms were surveyed in 1876 and probably leased shortly thereafter (fig. 6 - 7). This does not mean that the farms were not occupied by farmers before hand, as Quit Rent system was in place,

The 1969 topographical map indicated that there were several settlements, or homesteads, kraals, farm buildings and a cemetery within the WEF (fig, 8). The location of these features is given in Table 2.

Most of the footprint is in low lying areas that will not have turbines.

TABLE 2: LOCATION OF DESKTOP SITES

Name	Latitude	Longitude	Description
b3	-26.640665712	30.327446730	x3 buildings
grave 2	-26.681198422	30.274383144	Farm complex
Klipfontein	-26.678342368	30.275034825	Ruins
Ruin 2	-26.599368725	30.330021317	Settlement
s100	-26.636570931	30.334739544	Settlement
s101	-26.635711061	30.332109871	Settlement
s102	-26.637451756	30.331193625	Settlement
s103	-26.639661600	30.333515978	Settlement
s104	-26.647710561	30.332237747	Settlement
s105	-26.643247938	30.341596121	Settlement
s110	-26.650501094	30.297549771	Settlement
s111	-26.660156644	30.287908760	Settlement
s112	-26.653408968	30.303691633	Settlement
s113	-26.652708409	30.306501460	Settlement
s114	-26.654157681	30.309541751	Settlement
s115	-26.649673976	30.304992340	Settlement

s116	-26.649505012	30.307741190	Settlement
s117	-26.647307506	30.308791820	Settlement
s118	-26.654845029	30.315730873	Settlement
s119	-26.665123584	30.323506922	Settlement
s120	-26.667121108	30.322537975	Settlement
s121	-26.659690265	30.327324019	Settlement
s122	-26.670791341	30.339073928	Settlement
s123	-26.670809663	30.314997199	Settlement
s124	-26.671738201	30.315441812	Settlement
s125	-26.671584396	30.316806433	Settlement
s126	-26.672525547	30.316040585	Settlement
s127	-26.673151715	30.317056854	Settlement
s128	-26.675320398	30.316640348	Settlement
s129	-26.674418608	30.309944117	Settlement
s130	-26.678738377	30.310450537	Settlement
s131	-26.683728375	30.309304911	Settlement
s132	-26.684661093	30.308869568	Settlement
s133	-26.687754382	30.306788377	Settlement
s134	-26.677011576	30.283832328	Settlement
s135	-26.677094294	30.276020313	Settlement
s136	-26.679390115	30.279017203	Settlement
s137	-26.680928494	30.280291623	Settlement
s138	-26.682865716	30.281596283	Settlement
s85	-26.590055083	30.356997554	Settlement
s86	-26.594189893	30.347581605	Settlement
s87	-26.595401123	30.356571780	Settlement
s88	-26.601591650	30.351617715	Settlement
s89	-26.599316656	30.354747029	Settlement
s9	-26.665729385	30.253675394	Settlement
s90	-26.604452269	30.359642660	Settlement
s91	-26.600755077	30.340588990	Settlement
s92	-26.599524169	30.337789290	Settlement
s93	-26.599001249	30.336415729	Settlement
s94	-26.608182121	30.311326411	Settlement
s95	-26.618507233	30.325722515	Settlement
s96	-26.619520016	30.336307016	Settlement
s97	-26.612646444	30.344751312	Settlement
s98	-26.611433518	30.356244103	Settlement
s99	-26.631169495	30.344360123	Settlement
Schiedam	-26.598693910	30.366039405	Farm complex
Schiedam	-26.623959900	30.326098113	Farm complex
Schiedam 2	-26.631370375	30.328491814	Farm complex
Vaalbank	-26.656182983	30.343781954	Farm complex
Waaihoek 2	-26.650089921	30.315988681	Farm complex
Waaihoek 3	-26.660901196	30.301811980	Farm complex
Waaihoek 3	-26.675712020	30.324095510	Farm complex
Waaihoek 4	-26.670065460	30.307322003	Farm complex

FIG. 5: LOCATION OF RECORDED SITES IN THE GENERAL AREA

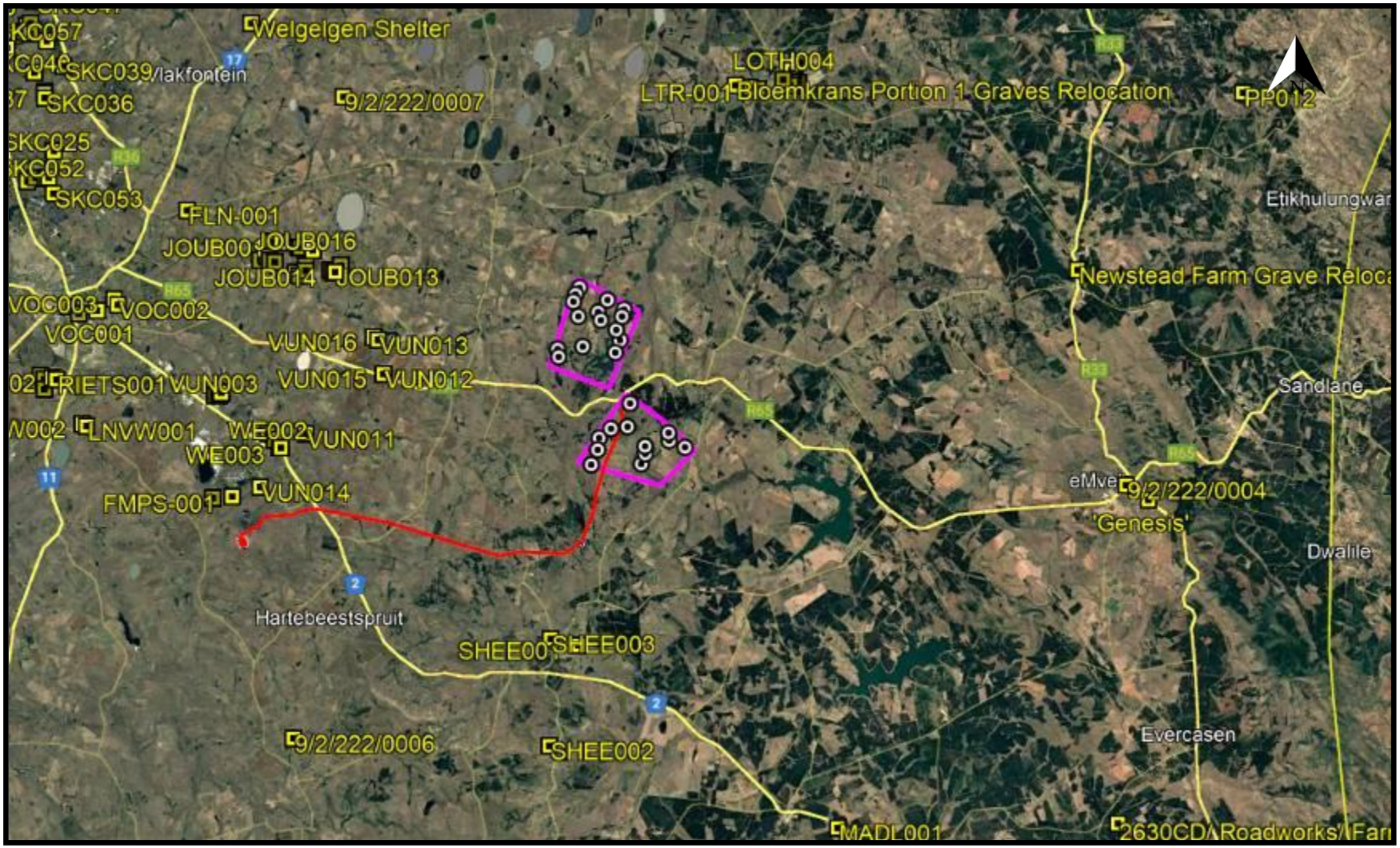


FIG. 6: SURVEYOR GENERAL MAP OF ZWARTWATER 1876

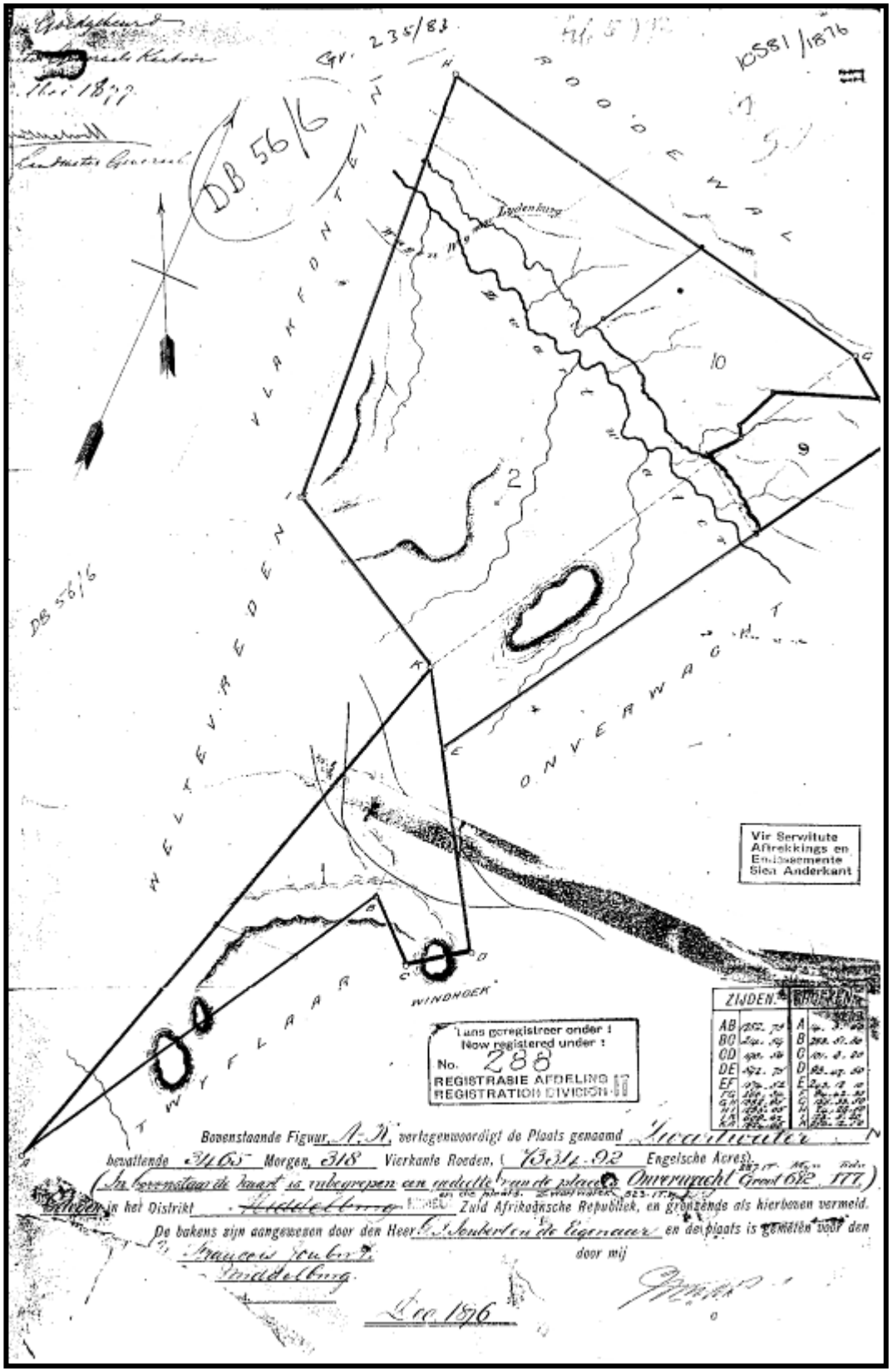


FIG. 7: SURVEYOR GENERAL MAP OF ONVERWACHT 287 (1914)

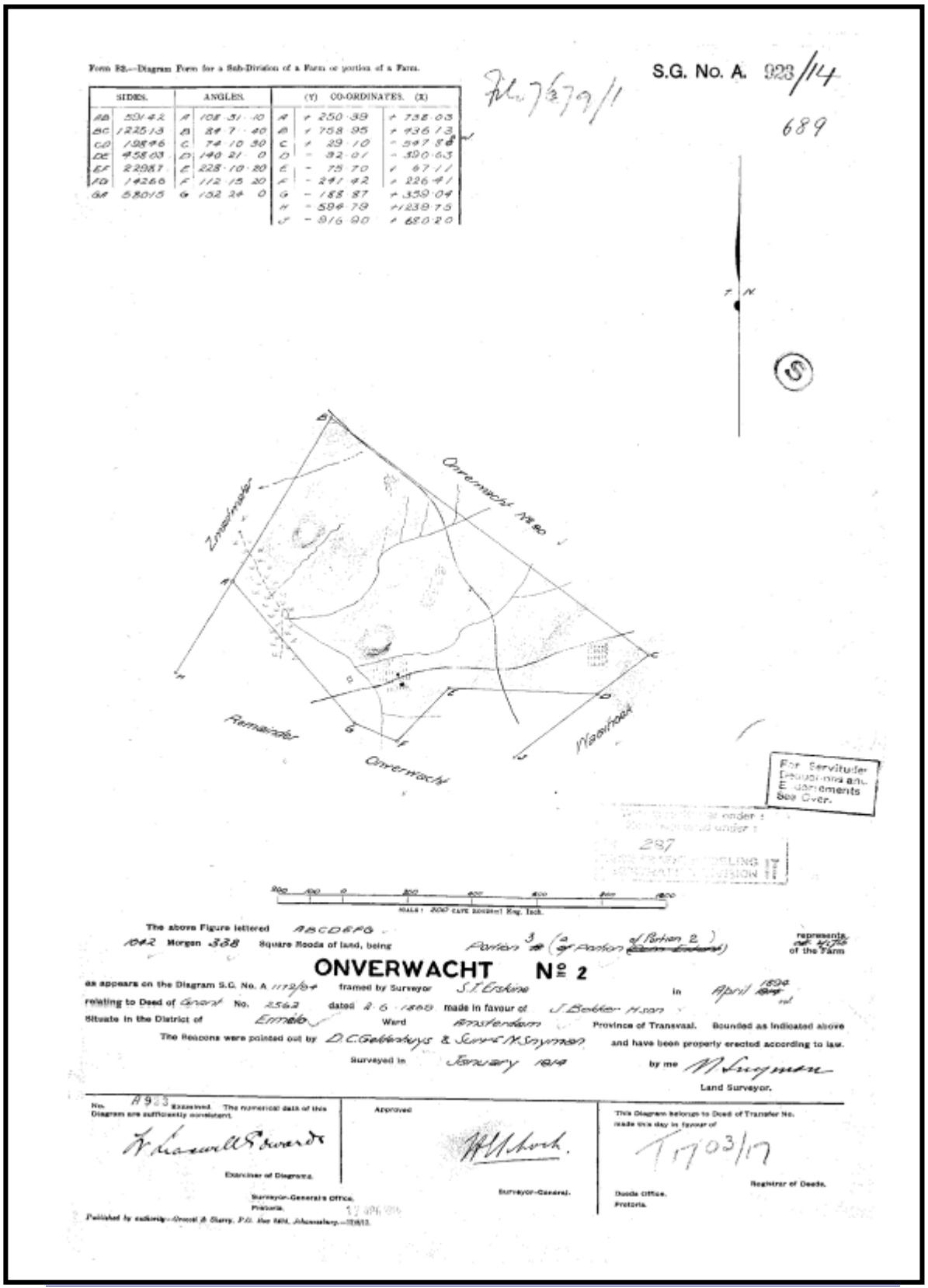
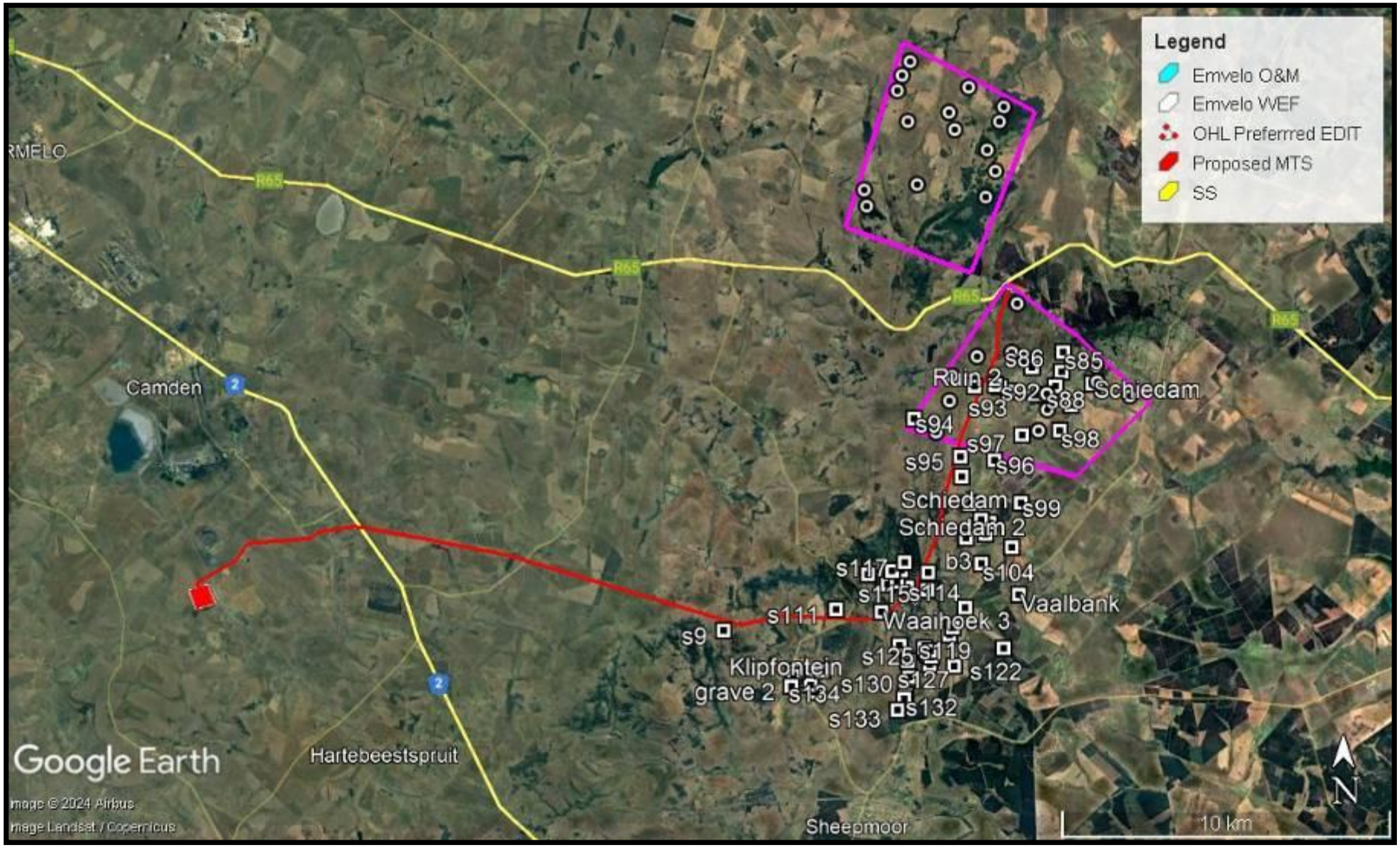


FIG. 8: LOCATION OF DESKTOP SITES FOR THE WEF AND OHL



FIELD SURVEY

The field survey was undertaken in mid-May 2023. Ground visibility varied from good to poor. Sites in the grassland were visible as general features and sometimes specific features were noted. This was dependent on the type and length of grass.

The black wattle woodlots have greatly expanded and covered many of the settlements form the desktop study. There was no evidence of these settlements where access through the woodlots was possible. The Black Wattle has literally destroyed the sites and any potential graves. The situation is exacerbated by the current program of removing the black wattle being removed by bulldozers in some areas.

Many of the desktop sites are also in fields that have been converted to agricultural activity. While several areas have kept known graves intact, within these fields, others have not. In this way, large wattle woodlots and agricultural fields were omitted from the survey. Grasslands were not omitted.

A general statement regarding settlements and graves can be made from the survey. Those settlements that were surveyed tend to have human graves associated with them. The desktop settlements that could not be surveyed for various reasons, many still have graves associated with them. They would be subsurface and in various states of preservation. These latter settlements should be treated as sensitive for potential graves, but do not need to be treated as a red flag.

The report deals with the WEF and all of the sites within the latest property boundaries. There have been several changes to the designs since the original inception. Those sites that are now omitted, but were recorded, are in Appendix B.

EMVELO WEF

The Emvelo WEF consisted of large maize fields at the base and in the valley, and steep hills. The hills have been overgrown with black wattle and many of the access roads/tracks are now covered. This made site access a problem in a few areas. These sites can be re-assessed if they are to be affected during the final site walkthrough. Table 3 lists the recorded sites in the development footprint. Fig. 9 show the location of these sites

TABLE 3: LOCATION OF RECORDED SITES INSIDE THE DEVELOPMENT FOOTPRINT

NAME	LATITUDE	LONGITUDE	DESCRIPTION
EMVE006	-26.602617800	30.330840200	modern cemetery
EMVE007	-26.600501450	30.330320888	Graves, walling
EMVE008	-26.599500959	30.330142801	House ruins
EMVE009	-26.590699717	30.355348755	Kraal
EMVE012	-26.608061255	30.355924805	Cemetery
ROCH01	-26.552153366	30.296971172	Cemetery
ROCH02	-26.529418294	30.333862690	House floors?
ROCH03	-26.539703196	30.331149323	House still used
ROCH04	-26.548868529	30.323932706	Mooifontein walling and houses
ROCH05	-26.549668938	30.297065110	Schimmelhoek

FIG. 9: LOCATION OF RECORDED SITES FOR THE EMVELO WEF IN RELATION TO THE TURBINES[1]



[1] White = turbine; yellow = heritage site

EMVE06

The site is located on the slopes of the hill. The site consists of recent cemetery with 30+ graves (fig. 10). The graves are stone cairns in an east-west orientation.

Significance: The site is of high significance.

Mitigation: It is unlikely that the cemetery will be affected. A 50m buffer needs to be placed around the site. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the grave.

SAHRIS: 3A

FIG. 10: CEMETERY AT EMVE06



EMVE07

The site is located near the base of the main hill. The site consist of several depressions that could be house floors, parts of stone walling and terracing and four stone cairns that are probably graves (fig. 11). There are two small stone walled kraals further up the hill.

The transmission line will occur ~20m south of the main site, but pass over the small kraal uphill.

Significance: The site is of significance.
Mitigation: The site will not be affected by the WEF.
SAHRIS: 3A

EMVE08

The site is located at the base of the hill 30m north of EZEM07. The site consists of the ruins of what appears to be the original Schiedam farm, or Ruin 2 from the desktop (fig. 12). The site consists of two rectangular farm buildings with a circular structure between them. The buildings are 12m x 10m in size. There is some terracing to the south.

The vegetation was too dense to note any middens that would occur. The site is to the north of the transmission line and in the footprint.

Significance: The site is of medium significance due to potential 19th century middens.
Mitigation: The site will not be affected by the WEF.
SAHRIS: 3B

FIG. 11: FEATURES AT EMVE07








FIG. 12: BUILDINGS AT EMVE08





EMVE09

The site is located on the top of the hill and was not accessible during the survey. The site consists of two stone walled kraals that are visible on the Google Earth map (fig. 13). The kraals may be related to S85 that occurs 150m to the east.

Significance: The site is of low significance.

Mitigation: If the kraals are to be affected, then they will need to be mapped and photographed prior to construction.

SAHRIS: 3C

FIG. 13: STONE WALLED KRAAL AT EMVE09



EMVE012

The site is located near the base of a hill and next to the road. The site consists of fifteen graves in an informal cemetery (fig. 14). The area is~20m x 30m in size and the graves are in an east-west orientation. The cemetery appears to be more recent in age. The site is in the current road footprint. The road will need to be moved away from the cemetary.

Significance: The site is of high significance.

Mitigation: The cemetery will be affected in the current footprint. The road will have to be realigned. The site will need to be visibly demarcated before construction phase commences. The demarcation should be 10m from the graves. There needs to be at least a 20m buffer between the edge of the graves and the edge of the footprint. Proof of demarcation must be sent to the project heritage consultant and the heritage authority.

SAHRIS: 3A

FIG. 14: CEMETERY AT EMVE012



ROCH01

The site is located beside the road 200m south of Schimmelhoek. The site consist of the Bothma family cemetery and dates from at least 1881 to 1935 (fig. 16). There are at least seven marked graves. The five infants share two graves. The cemetery shows the hardships of the 19th century where the parents lost five infants all under the age of two years.

TABLE 4: ESTIMATED FAMILY TREE

Name	Date	Age	Relationship
Jan Hendrik Bothma	1830 - 1907	77	Grandparents
JIO Bothma	1836 - 1914	78	Grandparents
Catharina Elizabeth Maria Marais	1858 - 1925	67	Daughter
SJM Bothma	1864 - 1940	76	Son
CEM Bothma	1869 - 1935	66	Daughter-in-law
Magdelena Bothma	1879 - 1881	1.6	Granddaughter
Frans Bothma	1883 - 1884	0.6	Grandson
Jan Hendrik Bothma	1891 - 1892	1.7	Grandson
Stephanus Johnanes Mathias Bothma	1900 - 1901	0.7	Grandson
Stephanus Johnanes Bothma	1908 - 1909	1.5	Grandson
Judith Buitendag (nee Bothma)	1903 - 1936	33	Granddaughter

Significance: The site is of high significance.

Mitigation: A 50m buffer needs to be placed around the site. The site needs to be clearly demarcated before construction begins. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the cemetery.

SAHRIS: 3A

FIG. 16: BOTHMA FAMILY CEMETERY



ROCH02

The site is located on the top of the hill on the edge of a black wattle thicket. ROCH02 relates to S38 from the desktop. The site consists of three small circular features that could be the remains of house floors (fig.17). Any other features that could occur have been covered by the black wattle.

Significance: The site is of low significance.

Mitigation: The site should be noted as being sensitive for possible human graves. If any human graves are uncovered during construction then the human grave protocol needs to be followed (discussed below)

SAHRIS: 3C

FIG. 17: HOUSE FOUNDATIONS AT ROCH02



ROCH03

The site is located on the top of a broad hill and is related to S39 from the desktop. The site is still in use and consists of several buildings and a kraal (fig. 18). There was no-one at the settlement when I recorded it, thus I did not enter it, nor take photos.

Significance: The site is of high significance since it is still being used since the 1960s.

Mitigation: The people from the site need to be included in the PPP and queried regarding human graves.

SAHRIS: pending

FIG. 18: SETTLEMENT AT ROCH03



ROCH04

The site is at the base of the hill overlooking the valley. The site is Mooifontein from the desktop study. The site consists of a farmhouse, a large kraal and several sandstone and/or dolerite buildings that have been added through time (fig. 19).

The site probably dates to the late 19th century or early 20th century and thus the buildings are protected.

Significance: The site is of possible medium to high significance for the buildings and vernacular architecture.

Mitigation: If the buildings are to be affected, then the site requires a Built Environment assessment. A general 100m radius around the site should be placed for potential historical middens.

The access road passes through ROCH4. There are stone walled gate posts that will probably be affected. A permit to damage these walls will be required. If the walls are damaged then they should be rebuilt with the same material after construction. Before and after road construction photographs need to be taken of the undamaged walling if no permit application is submitted.

SAHRIS: 3B for middens while the buildings need an assessment.

FIG. 19: BUILT STRUCTURES AT ROCH04









ROCH05

The site is located near the base of the hill and is associated with Schimmelhoek from the desktop, even though the farm was incorrectly placed on the topographical map. The site is also directly related to ROCH01 as that is the family cemetery. Schimmelhoek is also the farm where the Boer forces rested the night before the Battle of Onverwacht, and thus the Bothma's were probably pro-Bittereinders, as they had given permission for the Boer encampment. The cemetery at ROCH01 directly relates to the people who lived at this farm.

The term "Schimmel perd" refers to: "Dapple Horse". The farm is thus probably named after the types of horses that were bred here, and used by the Voortrekkers and then Boer Forces during the 2nd Anglo-Boer War.

The site consists of three main houses that appears to have been built at different times and probably relates to the growing family (fig. 20). The earliest building could date to around 1876 when the farm was first surveyed and sold. South of the houses is the garden area with fruit trees and a sheep dip. The main kraal is 60m x 20m in diameter. No middens were visible but would occur as there is at least 70 year of occupation.

All of the structures are older than 60 years in age and are protected by the heritage legislation

Significance: The site is of high significance. This is one of the first farms of the area and several structures remain. While the buildings are in ruin, it still has significance for vernacular architecture. The site is related to the oral history of the area with its reference to the Battle of Onverwacht. Any middens related to

his area would be of high significance as it would give detailed information about the lives of the people who lived here.

Mitigation: The site cannot be affected without mitigation and a Built Environment assessment needs to be undertaken.

The site will not be affected by the WEF and its servitudes.

SAHRIS: 3A

FIG. 20: BUILT STRUCTURES AT ROCH05









DESKTOP PALAEONTOLOGICAL ASSESSMENT

The area is of very high palaeontological sensitivity (fig. 21). Dr Alan Smith undertook a desktop PIA for the proposed Emvelo WEF (Appendix A). He states:

"The SAHRIS Palaeosensitivity Map ... considers the Vryheid Formation as a Very High Palaeosensitivity Zone... In practise, no vertebrate fossils have been recorded from the Vryheid Formation in this area, however invertebrate trace fossils are common (Tavener Smith et al, 1989; Mason and Christie, 1985; Hastie et al., 2019), but these are of no particular value, in this area.

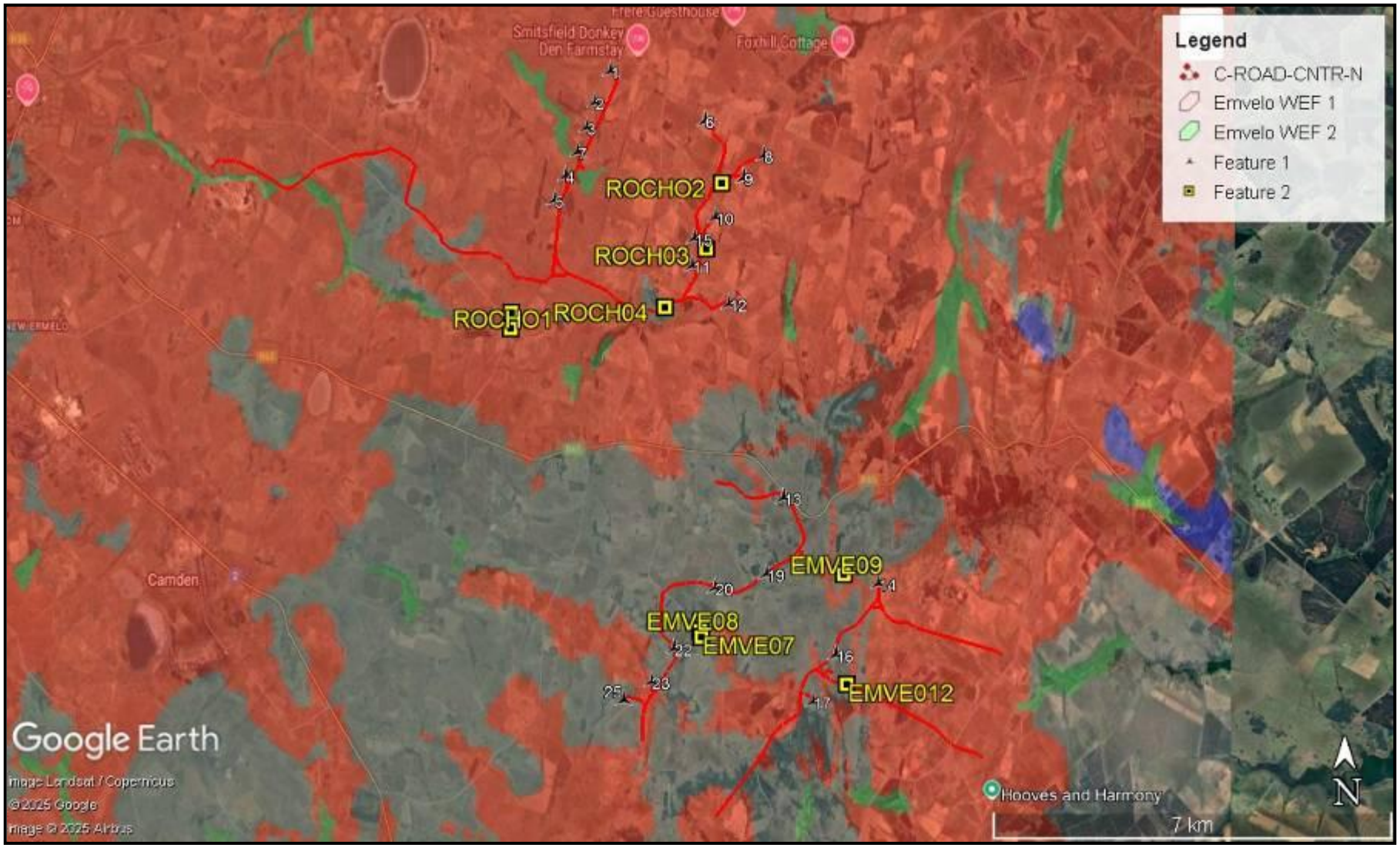
Groenewald (2018) pointed out that the aquatic marine reptile, *Mesosaurus* (earliest known reptile from the Karoo Basin), as well as the fish, *Palaeoniscus capensis*, have been recorded in the Whitehill Formation in the southern part of the basin (MacRae, 1999), which is correlated with the Vryheid Formation... The Vryheid Formation in this area has its provenance in the north (Tavener Smith, 1982). The Whitehill Formation source is in the south. There is also a southerly source to the lower Vryheid Formation (Hastie et al., 2019), but this regime does not extend north of Vryheid. The Vryheid Formation is generally believed to be marine (Hastie et al., 2019) but no significant fossils have been discovered. The lack of vertebrate fossils is problematic. In the marine case it may be due to the water being heavily silted but this is speculation."

This area is mostly non-fossiliferous Karoo Dolerite and no further mitigation is required.

The chance of significant fossils being found on this site are **Low,** but not **Zero. Consequently a "Chance Find Protocol"** has been included to cover this eventuality.

No further palaeontological work is required, unless triggered by the "**Chance Find Protocol**", which must form part of the Environmental Management Programme (EMPr) for the site'

FIG. 21: LOCATION OF HIGH SENSITIVE PALAEONTOLOGICLA AREAS



OVERHEAD LINES

The current footprint does not affect any recorded sites.

MANAGEMENT PLAN

Any activity within 50m of a heritage site that cannot be affected will require that site to be clearly demarcated before any construction activity occurs. Demarcation: Demarcation is a physical high visibility demarcation that occurs 20m from the edge of the site. Normally demarcations is 5m from the edge; however since there will be heavy equipment involved, this needs to be increased to lessen possible impacts. Demarcation needs to occur before construction activity begins and they type of demarcti0n should be part of the site Safety, Health, Environment and Quality (SHEQ) course. This needs to be the standard approach to all sites with variation allowed in a few cases.

Many of the settlements from the desktop no longer exist as they have been abandoned, overgrown by black wattle thickets and/or are now part of the agricultural fields. Where graves are known to the landowners, they tend to be buffered and omitted from farming activity. All of the old settlements that were recorded had graves associated with them. One could assume that those settlements that no longer exist, or were not accessible, could have graves. These graves will not be marked, as the cairns would be disturbed. All settlements from the desktop study should thus be treated has being sensitive for potential graves. Those that will be affected could re-assessed after the area has been cleared of wattle and/or the vegetation has been thinned out at the end of winter or burnt.

All possible graves should be treated as graves until proven otherwise. Any activity within 50m of a grave will require that grave to be clearly demarcated before any construction activity occurs. EMVE012 is a cemetery next to the

existing road. The road will need to be re-aligned so that it is moved westwards. There needs to be at least 20m buffer between the edge of the road footprint and the westernmost grave. Wind turbine roads are very wide and will probably affect the graves if there is not a wide enough buffer. There needs to be a clear demarcation 5m – 10m from the graves. This will need high visibility netting and also high enough for HMVs to see, Before, during and after construction photographs need to be taken and submitted to the heritage authority,.

Isolated stone kraals may be removed/demolished after they have been mapped and photographed. Any stone walled feature that is to be damaged will require a permit.

Ruins and old farmhouses should preferably not be damaged and will require an assessment by a Built Environment specialist. They would also require a permit of they are to be (partially) damaged. Old farmhouses will have historical middens associated with them. These middens would need to be excavated/sampled if exposed. ROCH04 may have some walls that will be affected.

While the palaeontology is of very high sensitivity as it forms [part of the Vryheid formation, very few significant vertebrate fossils have been found in it. A Chance Find Protocol was initiated for the construction phase.

No sites will be affected by the wind turbines. An access road passes adjacent to EMVE012.. The road will have to move and a 50m buffer needs to be placed around the site. The site will need to be visibly demarcated before construction phase commences.The demarcation should be 20m from the graves. Proof of demarcation must be sent to the project heritage consultant.

If any built structures are to be affected, then they require further assessment by a Built Environment specialist.

All heritage sites within 50m of any infrastructure related to the windfarm needs to be clearly demarcated. Photographic evidence needs to be submitted to the heritage authority.

A final heritage walkthrough needs to be undertaken after all necessary sites have been demarcated, and before construction begins. Recent audits of several windfarms in the Eastern Cape and Northern Cape have shown a clear lack of management of heritage sites. Some sites have been damaged, or nearly damaged as a result. My suggested management plans for those sites that I had audited was that all windfarms be audited before and after construction.

In case random artefacts and/or subsurface graves are encountered, a Chance Find Protocol needs to form part of the EMPr (Appendix C). Awareness of cultural heritage remains should also form part of the site induction.

SIGNIFICANCE OF IMPACT

The significance of impact will be ow for all sites, as none of the sites will be affected.

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: Graves/Cemeteries • Any construction activity near human graves has the possibility of disturbing the remains. • There may be more subsurface graves with no demarcation.							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	H	H	Negative	High	High	High
With Mitigation	Low	Low	Low	Positive	Low	Low	Low
Can the impact be reversed?			No. they are a finite resource				
Will impact cause irreplaceable loss or resources?			Yes. they are a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • *List and describe* • Cannot be affected.50m buffer from the edge. 20m visible demarcation if within 100m							
Residual impact	high negative impact if no mitigation occur						

Impact Phase: Construction/ Operation/Decommissioning

Potential impact description: 20th century settlements without graves Abandoned settlements with no visible structures are destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	Low	Neutral	Low	Low	High
With Mitigation	Low	Low	Low	Neutral	Low	Low	High
Can the impact be reversed?			No.				
Will impact cause irreplaceable loss or resources?			YES. No. They are a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • *List and describe* • Once no graves are confirmed, then may be destroyed if the PPP has been approved …							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: 20th century settlements with graves • Abandoned settlements with graves and no visible structures are destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	Medium	High
With Mitigation	Low	Low	low	Positive	low	low	High
Can the impact be reversed?			No. They are finite resource				
Will impact cause irreplaceable loss or resources?			YES. They are finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • Graves cannot be affected • .50m buffer from the edge • 20m visible demarcation if within 100m…							
Residual impact	Yes, but acceptable as of low negative significance,						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: Late Iron Age settlements Detailed description of impact Archaeological site may be destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Medium	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			NO. Finite resource				
Will impact cause irreplaceable loss or resources?			YES. Finite resource				
Can impact be avoided, managed or mitigated?			YES. Salvage excavations				
Mitigation measures to reduce residual risk or enhance opportunities: • Sites may be excavated • PPP to ensure there are no claimants							
Residual impact	Yes, but acceptable as of low positive significance						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: Ruins • Ruins are protected by the NHA if they are older than 60 years in age. • Loss of vernacular architecture • Loss of historical middens							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			NO. It is a finite resource				
Will impact cause irreplaceable loss or resources?			YES. It is a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • Should not be affected. • Middens may need to be sampled or excavated • Buildings need to be assessed by Built Environment specialist to determine architectural value • Will require mapping, photography if affected							
Residual impact	Yes, but acceptable as of medium negative significance						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: isolated stone walled kraals Built structure to be damaged							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			YES, Rebuild the structure elsewhere				
Will impact cause irreplaceable loss or resources?			YES. If is a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • mapped and photographed • requires a permit							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: farm buildings • Cultural landscape • Vernacular architecture • Historical buildings • Historical middens • Requires assessment by built environment specialist if to be damaged.							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			YES. Buildings could be rebuilt				
Will impact cause irreplaceable loss or resources?			YES. It is a finite resource				
Can impact be avoided, managed or mitigated?			YES. Avoid the buildings and mitigate				
Mitigation measures to reduce residual risk or enhance opportunities: • Should not be affected. • Middens may need to be sampled or excavated • Mapped and photographed • Requires assessment from Built Environment specialist • Will require a permit if to be damaged.							
Residual impact	Yes, unacceptable high negative impact if not mitigated						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: Paeolontology • Fossils could be disturbed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	High	Negative	Low	Low	High
With Mitigation	Low	Low	High	positive	Low	Low	High
Can the impact be reversed?			YES. Fossils could be reconstructed				
Will impact cause irreplaceable loss or resources?			YES. Fossils could be reconstructed				
Can impact be avoided, managed or mitigated?			YES. Chance Find Protocol				
Mitigation measures to reduce residual risk or enhance opportunities: • Chance Find protocol.							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Construction/ Operation/Decommissioning							
Potential impact description: Paeolontology • Fossils could be disturbed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	High	Negative	Low	Low	High
With Mitigation	Low	Low	High	positive	Low	Low	High
Can the impact be reversed?			YES. Fossils could be reconstructed				
Will impact cause irreplaceable loss or resources?			YES. Fossils could be reconstructed				
Can impact be avoided, managed or mitigated?			YES. Chance Find Protocol				
Mitigation measures to reduce residual risk or enhance opportunities: • Chance Find protocol.							
Residual impact	Yes, but acceptable as of low negative significance						

CUMULATIVE IMPACTS

Impact Phase: Cumulative							
Potential impact description: Graves/Cemeteries • Any construction activity near human graves has the possibility of disturbing the remains. • There may be more subsurface graves with no demarcation.							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	H	H	Negative	High	High	High
With Mitigation	Low	Low	Low	Positive	Low	Low	Low
Can the impact be reversed?			No. they are a finite resource. reburial is not an option				
Will impact cause irreplaceable loss or resources?			Yes. they are a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • Cannot be affected. • 50m buffer from the edge. • 20m visible demarcation if within 100m •							
Residual impact	high negative impact						

Impact Phase: Cumulative							
Potential impact description: 20th century settlements without graves Detailed description of impact Abandoned settlements with no visible structures are destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	Low	Neutral	Low	Low	High
With Mitigation	Low	Low	Low	Neutral	Low	Low	High
Can the impact be reversed?			No.				
Will impact cause irreplaceable loss or resources?			YES. No. They are a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • *List and describe* • Once no graves are confirmed, then may be destroyed if the PPP has been approved …							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Cumulative							
Potential impact description: 20th century settlements with graves Detailed description of impact • Abandoned settlements with graves and no visible structures are destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	Medium	High
With Mitigation	Low	Low	low	Positive	low	low	High
Can the impact be reversed?			No. They are finite resource				
Will impact cause irreplaceable loss or resources?			YES. They are finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • Graves cannot be affected • .50m buffer from the edge • 20m visible demarcation if within 100m…							
Residual impact	*(for example: Yes, but acceptable as of low negative significance, or Yes, unacceptable high negative impact)*						

Impact Phase: Cumulative							
Potential impact description: Palaeontology • Fossils could be disturbed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	High	Negative	Low	Low	High
With Mitigation	Low	Low	High	positive	Low	Low	High
Can the impact be reversed?			YES. Fossils could be reconstructed				
Will impact cause irreplaceable loss or resources?			YES. Fossils could be reconstructed				
Can impact be avoided, managed or mitigated?			YES. Chance Find Protocol				
Mitigation measures to reduce residual risk or enhance opportunities: • Chance Find protocol.							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Cumulative							
Potential impact description: Late Iron Age settlements Detailed description of impact Archaeological site may be destroyed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Medium	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			NO. Finite resource				
Will impact cause irreplaceable loss or resources?			YES. Finite resource				
Can impact be avoided, managed or mitigated?			YES. Salvage excavations				
Mitigation measures to reduce residual risk or enhance opportunities: • Sites may be excavated • PPP to ensure there are no claimants							
Residual impact	(Yes, but acceptable as of low positive significance						

Impact Phase: Cumulative							
Potential impact description: Ruins • Ruins are protected by the NHA if they are older than 60 years in age. • Loss of vernacular architecture • Loss of historical middens							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			NO. It is a finite resource				
Will impact cause irreplaceable loss or resources?			YES. It is a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • Should not be affected. • Middens may need to be sampled or excavated • Buildings need to be assessed by Built Environment specialist to determine architectural value • Will require mapping, photography if affected							
Residual impact	Yes, but acceptable as of medium negative significance						

Impact Phase: Cumulative							
Potential impact description: isolated stone walled kraals Built structure to be damaged							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			YES, Rebuild the structure elsewhere				
Will impact cause irreplaceable loss or resources?			YES. If is a finite resource				
Can impact be avoided, managed or mitigated?			YES				
Mitigation measures to reduce residual risk or enhance opportunities: • mapped and photographed • requires a permit							
Residual impact	Yes, but acceptable as of low negative significance						

Impact Phase: Cumulative							
Potential impact description: farm buildings • Cultural landscape • Vernacular architecture • Historical buildings • Historical middens • Requires assessment by built environment specialist if to be damaged.							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	High	Low	High	Negative	High	High	High
With Mitigation	Low	Low	High	positive	High	Medium	High
Can the impact be reversed?			YES. Buildings could be rebuilt				
Will impact cause irreplaceable loss or resources?			YES. It is a finite resource				
Can impact be avoided, managed or mitigated?			YES. Avoid the buildings and mitigate				
Mitigation measures to reduce residual risk or enhance opportunities: • Should not be affected. • Middens may need to be sampled or excavated • Mapped and photographed • Requires assessment from Built Environment specialist • Will require a permit if to be damaged.							
Residual impact	Yes, acceptable low negative impact						

Impact Phase: Cumulative							
Potential impact description: Palaeontology • Fossils could be disturbed							
	Severity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	Low	Low	High	Negative	Low	Low	High
With Mitigation	Low	Low	High	positive	Low	Low	High
Can the impact be reversed?			YES. Fossils could be reconstructed				
Will impact cause irreplaceable loss or resources?			YES. Fossils could be reconstructed				
Can impact be avoided, managed or mitigated?			YES. Chance Find Protocol				
Mitigation measures to reduce residual risk or enhance opportunities: • Chance Find protocol.							
Residual impact	Yes, but acceptable as of low negative significance						

REFERENCES

Maps

2630CA Camden 1968, 2000

2630 CA Sheepmore 1968, 2000

235/83

A 9231/14

Database

SAHRIS

Umlando

EXPERIENCE OF THE HERITAGE CONSULTANT

Gavin Anderson has a M. Phil (in archaeology and social psychology) degree from the University of Cape Town. Gavin has been working as a professional archaeologist and heritage impact assessor since 1995. He joined the Association of Professional Archaeologists of Southern Africa in 1998 when it was formed. Gavin is rated as a Principle Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

DECLARATION OF INDEPENDENCE

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



Gavin Anderson
Archaeologist/Heritage Impact Assessor

APPENDIX A

PIA DESKTOP

DESKTOP PALEONTOLOGICAL ASSESSMENT FOR A PROPOSED WEF POWER STATION NEAR CAMDEN, MPUMALANGA

FOR

UMLANDO: Archaeological Surveys & Heritage Management
PO Box 102532, Meerensee, KwaZulu-Natal 3901
phone (035)7531785 fax: 0865445631
cell: 0836585362 / 0723481327
Email:umlando@gmail.com

by

Dr Alan Smith
Alan Smith Consulting
29 Browns Grove, Sherwood, Durban, 4091, South Africa
Telephone: 031 208 6896
asconsulting@telkomsa.net

19 June, April 2023

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

EXECUTIVE SUMMARY

Alan Smith Consulting was appointed by Umlando to conduct a desk-top assessment of the potential impacts to **Palaeontology Resources** that might occur through the proposed development of a WEF Power Station, near Camden, Mpumalanga. This project is to be constructed on Vryheid Formation rocks. Although zoned red by SAHRIS these rocks are unlikely to contain any significant palaeontological material.

Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), requires a Palaeontological Impact Assessment (PIA) to assess any potential impacts to palaeontological heritage.

The chances of encountering fossils are **Low,** but N**ot Zero**; consequently a ***"Chance Find Protocol"*** has been included.

ACRONYMS

BA:	Basic Assessment
EDTEA:	(Department of) Economic Development, Tourism and Environmental Affairs
HIA:	Heritage Impact Assessment
PIA;	Palaeontological Impact Assessment
SAHRA:	South African Heritage Resource Agency
SAHRIS:	South African Heritage Resources Information System

1. BACKGROUND

It is proposed that a WEF Power Station be erected near Camden, Mpumalanga (Figure 1 & 2)

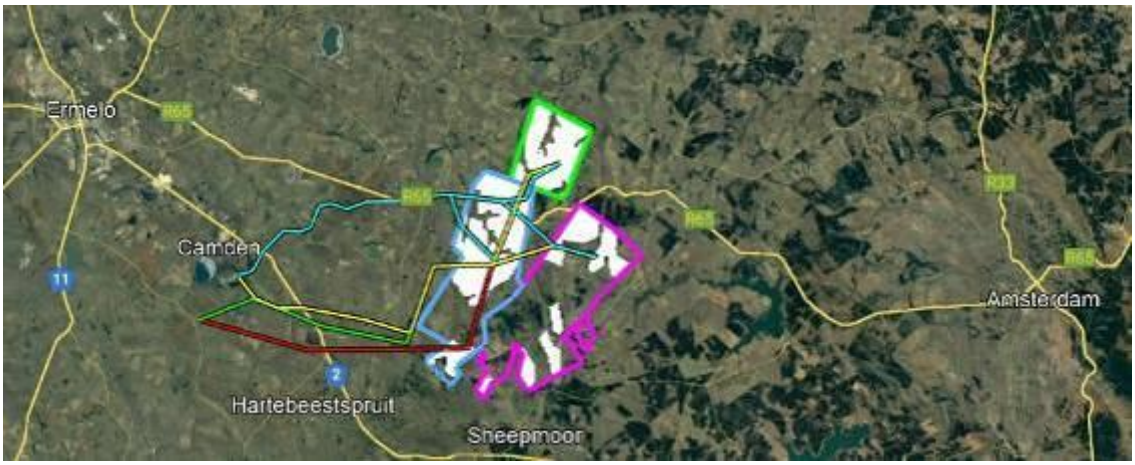


Figure 1: Location map of the proposed Camden WEF Power Station Project.

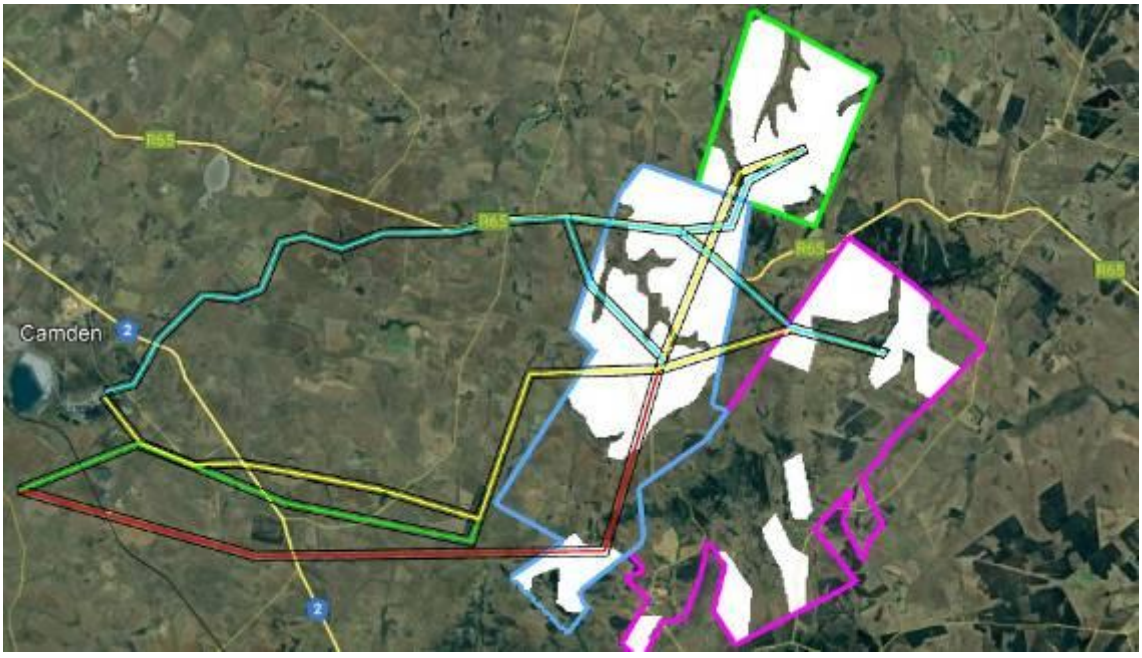


Figure 2: Proposed Camden WEF Power Station sites and power gridlines zoomed. The white colour indicates areas classified as high palaeosensitive by SAHRIS.

2. TERMS OF REFERENCE

Alan Smith Consulting was requested by UMLANDO: Archaeological Surveys & Heritage Management to provide a Desk-Top Palaeo Impact Assessment for the proposed WEF Power Station near Camden (Figure 1 &2). The work was to be based on the knowledge gained from desktop review. This report is to meet the requirements of the National Environmental Management Act (Act 107 of 1998) [as amended] Environmental Impact Assessment (EIA) regulations, Appendix 6.

3. SCOPE AND PURPOSE OF REPORT

A Palaeontological Impact Assessment (PIA) is a means of identifying any significant palaeontological material before development begins, so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. The Desk-Top PIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation, should this be granted.

4. METHODOLOGY

Geological maps, a literature review and personal experience (see section 10) were used in this research.

5. GEOLOGY

Some of this site is underlain by Vryheid Formation and the rest by Karoo Dolerite (Figure 3).

Vryheid Formation

The Permian aged Vryheid Formation (Kungurian Stage ¬ 260Ma: Green and Smith, 2012) comprises predominantly coarse-grained sandstone and siltstones, interbedded by dark shales and coal beds. The Formation is interpreted as mainly fluvial, in this area. Here rivers built deltas which prograded into the ancient Karoo Sea, which was a cratonic sea located in the Gondwana Supercontinent. This body of water was either an inland sea, or partially connected to the ancient ocean which surrounded the Gondwana Supercontinent (Johnson et al, 2009). Economic coal seams are known from the Vryheid Formation in this region and are actively mined.

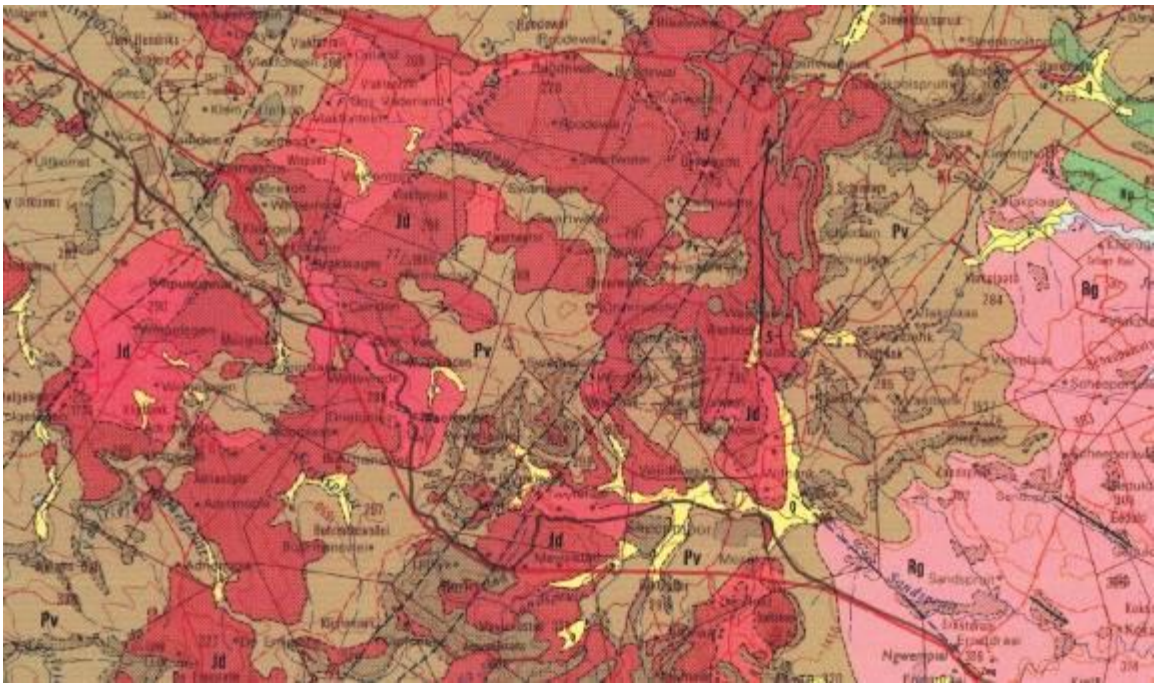


Figure 3: Extract from the Mbabane (2630) 1:250 000 Geological map. According to this map, the proposed Camden WEF Development site is underlain by Vryheid Formation (Pv: grey) and Karoo Dolerite (Jd: red).

6. PALAEONTOLOGY

Vryheid Formation

The SAHRIS Palaeosensitivity Map (Figure 4) considers the Vryheid Formation as a Very High Palaeosensitivity Zone (Table 1). In practise, no vertebrate fossils have been recorded from the Vryheid Formation in this area, however invertebrate trace fossils are common (Tavener Smith et al, 1989; Mason and Christie, 1985; Hastie et al., 2019), but these are of no particular value, in this area.

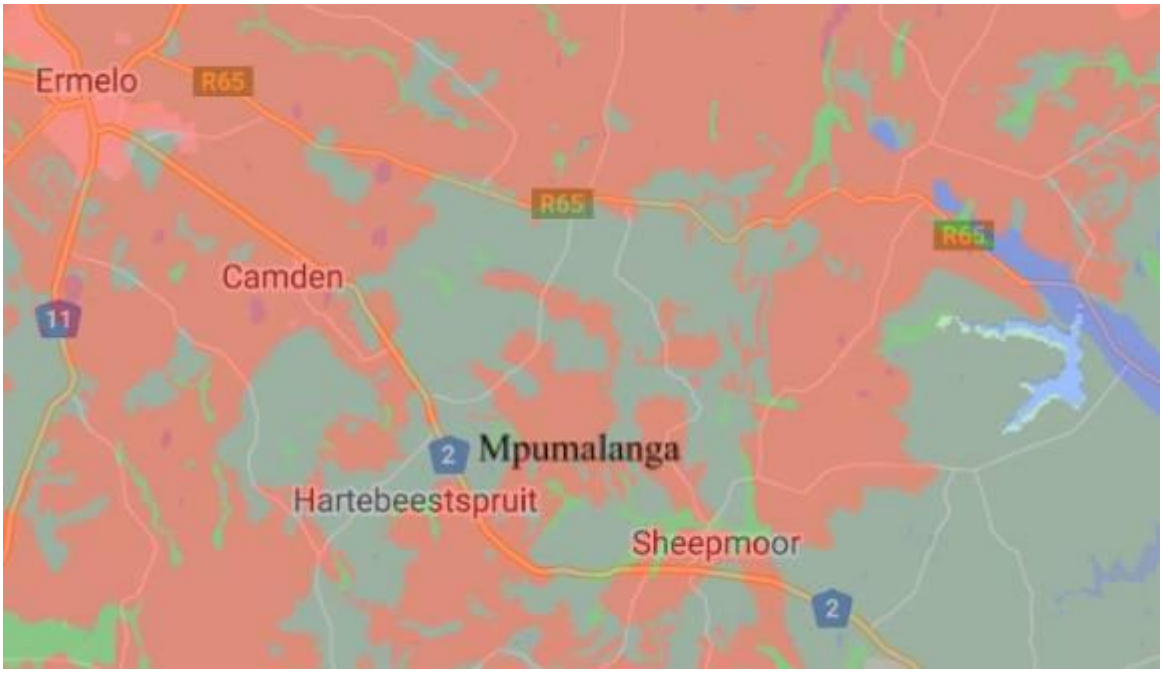


Figure 4: Palaeosensitivity of the Camden proposed WEF Power Station site. Vryheid Formation is indicated in red and Karoo Dolerite in grey.

Groenewald (2018) pointed out that the aquatic marine reptile, *Mesosaurus* (earliest known reptile from the Karoo Basin), as well as the fish, *Palaeoniscus capensis*, have been recorded in the Whitehill Formation in the southern part of the basin (MacRae, 1999), which is correlated with the Vryheid Formation. The Whitehill Formation is interpreted as marine. The Whitehill Formation (1000 km to the southwest), within the

Main Karoo Basin, *may* be a correlative of the Vryheid Formation, however these two rock units are not physically connected and this has never been proved. The Vryheid Formation in this area has its provenance in the north (Tavener Smith, 1982). The Whitehill Formation source is in the south. There is also a southerly source to the lower Vryheid Formation (Hastie et al., 2019), but this regime does not extend north of Vryheid. The Vryheid Formation is generally believed to be marine (Hastie et al., 2019) but no significant fossils have been discovered. The lack of vertebrate fossils is problematic. In the marine case it may be due to the water being heavily silted but this is speculation.

Table 1: Summary of SAHRIS categories

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required

Economic coal seams are known from the Vryheid Formation in Mpumalanga (Tavener Smith et al., 1989). Coal is carbon produced by compressed plant material and thus itself constitutes a fossil deposit. Plants such as *glossopteris*, *gangamopteris* and *sigillaria* can be recognized. Although these are significant on a continental scale for correlation between the present continents and general dating, they are very common. Coal is routinely burned in power stations. Animals must have grazed on these plants, but they are not found.

Proposed Locations

Three proposed locations and their associated gridlines are illustrated (Figure 5).

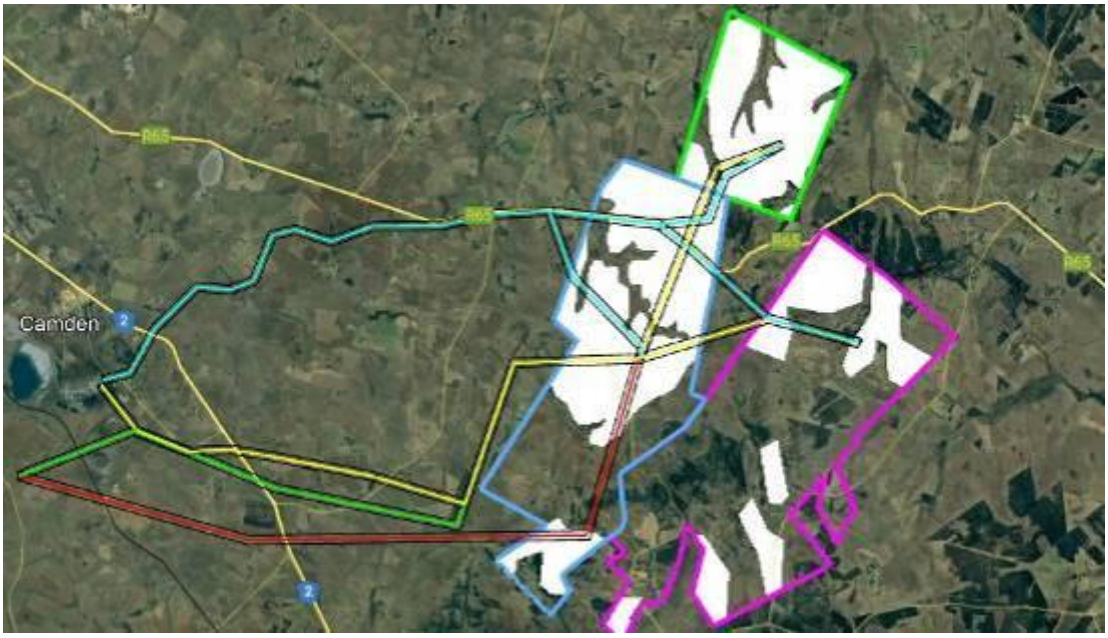


Figure 5: This image shows the different possible WEF locations. Note the white colouration indicates SAHRIS the red highly sensitive zone (see Figure 4 and Table 1).

Rochdale WEF (Figure 5). This area is mostly red (Vryheid Formation)'

Sheepmoor WEF (Figure 5). This area is about 60% red (Vryheid Formation) in the north with the rest being non-fosilliferous Karoo Dolerite.

Emvelo WEF (Figure 5). This area is mostly non-fossiliferous Karoo Dolerite.

The transmission lines (Figure 5). The gridlines will have shallow foundations so will have little palaeosensitivity impact.

The purple outlined are contains the least "high palaeosensitivity". However no significant body fossils have been found in the Vryheid Formation. Theoretically body fossils should be encountered but they are not.

7. CONCLUSIONS

The chance of significant fossils being found on this site are **Low,** but not **Zero. Consequently a "Chance Find Protocol"** has been included to cover this eventuality.

No further palaeontological work is required, unless triggered by the "**Chance Find Protocol**", which must form part of the Environmental Management Programme (EMPr) for the site'

8. CHANCE FIND PROTOCOL

This Chance Find Protocol must be included in the site EMPr.

If any fossils are found, a Palaeontologist must be notified immediately by the ECO and/or EAP and a site visit must be arranged at the earliest possible time with the Palaeontologist.

In the case of the ECO or the Site Manager becoming aware of suspicious looking palaeo-material:

- The construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.

- Mitigation will involve the attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labeled, and boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure that a representative archive of palaeontological samples and other records is assembled to characterize the palaeontological occurrences affected by the excavation operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting

areas, removal of overburden if necessary, and the return of discarded material to the disposal areas.

3. Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological sections, and by providing aid in the surveying of positions where significant fossils are found.

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities for a work area for sorting, labeling and boxing/bagging samples.

6. Costs of basic curation and storage until collected. Documentary record of palaeontological occurrences must be done.

7. The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.

8. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

9. Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

9. REFERENCES

Green, A.N., Smith, A.M. (2012). Can ancient shelf sand ridges be mistaken for Gilbert-type deltas? Examples from the Vryheid Formation, Ecca group, KwaZulu-Natal, South

Africa. J. Afr. Earth Sci. 76, 27–33.

Groenewald (2018). Desktop Palaeontological Assessment and for the Proposed Sibaya Node 6 Development in the Ithekwini Metropolitan Municipality in the Kwazulunatal Province, FOR Umlando. DATE: 6 June 2018.

Hastie, W; Watkeys, MK; Smith, AM, (2019). Tectonic significance of the sedimentary and palaeocurrent record at the eastern edge of the Karoo Basin. Journal of African Earth Sciences 158 (2019) 103543.

Johnson MR, Anhaeusser CR and Thomas RJ (Eds). (2009). The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.

MacRae C. (1999). Life Etched in Stone. Geological Society of South Africa, Linden, South Africa.

Mason, TR and Christie AC, (1986). Palaeoevironmental significance of Ichnogenus Diplocraterion torell from the Permian Vryheid Formation of the Karoo Supergroup, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology, 52.

SAHRIS Palaeosensitivity Map: https://SAHRIS.sahra.org.za/map/palaeo

Tavener Smith, (1982). Prograding coastal facies associations in the Vryheid formation (Permian) at Effingham quarries near Durban, South Africa. Sedimentary Geology

Volume 32, Issues 1–2, May 1982, Pages 111-14

Tavener Smith R; Mason, TR; Christie, ADM; Roberts, DL; Smith AM; van der Spey, A (1989). Sedimentary models for coal formation, Northern Natal. Geological Survey Bulletin 94, 46pp.

. .

10. DETAILS OF SPECIALIST

Dr Alan Smith
Private Consultant: ***Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091***

&

Honorary Research Fellow: ***Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban***.

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- MSc in Stromatolites (paleontological subject).
- Scientific Research experience includes:
  1. Stromatolites (9 peer reviewed journal articles and one in review)
  2. Fluvial geomorphology
  3. Palaeoflood hydrology
- Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published + 50 journal articles with +620 citations (detailed CV available on request).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.

- Fieldwork PIA: Mpungoze water supply scheme, Empangeni. Client: Enviropro.
- Fieldwork PIA: Helpmekaar Dam. Client: Afzelia environmental consultants.
- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.
- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.

APPENDIX B

CV AND QUALIFICATIONS

Name: Gavin Craig Anderson

Current Employment: Member of Winter Night Investments cc, T/A Umlando: Archaeological Surveys & Heritage Management

Registered with South African Heritage Resources Agency and KZN Heritage as a Principle Investigator with expertise status in Iron Age, Stone Age and Rock Art

B.A.(Soc.Sci), U.C.T. Majors: Archaeology, Psychology, Sociology. 1990.

B.A.(Hons) in Archaeology, 1991, U.C.T.

Masters of Philosophy in Archaeology/Social Psychology: 1996, UCT.

Various Health & Occupational Safety courses related to specific companies.

PROFESSIONAL EXPERIENCE:

a) CEO for Institute for Cultural Resource Management, Natal Museum (1995 – 2004)

b) Co-owner of Umlando: Archaeological surveys and heritage Management (2004-2013)

c) Surveys and/or excavations of:

(1) Proposed aquaculture farms, Eastern Cape
(2) Dube Trade Port: Agrizone 2 and Support Zone 2
(3) Dams:
(4) Richards Bay Minerals
(5) Tronox mines
(6) Eskom transmission lines
(7) Water reticulations lines
(8) Sewer lines
(9) Game Reserves: Phinda, Huluhluwe-Mfolozi, iSimangaliso Wetland Park
(10) Tongaat-Hulett (Moreland) Pty. Ltd properties
(11) Low Cost Housing projects
(12) Upmarket housing estates
(13) Afforestation permit applications
(14) uShaka Marine World
(15) Cellular Phone masts
(16) Harbour expansions: Durban, Richards Bay & East London
(17) Quarries & Borrow pits
(18) Living Heritage Study: Drakensberg buffer zone

(19)Wind Energy Farm developments

(20)Photovoltaic farm developments

(21)Cemeteries

(22)Roads: National, Provincial, and District

From 2004 onwards Gavin has undertaking Heritage Impact Assessments as opposed to only archaeological impact assessments. Heritage Impact Assessments includes archaeology, palaeontology, historical buildings, living heritage sites, cultural landscapes, and human graves. In these HIA's Gavin has subcontracted various people related to the field of study, and produced overall HIA reports.

Gavin received his M. Phil (Archaeology & Social Psychology) in 1994. He was head of the Institute for Cultural Resource Management at the Natal Museum from 1994 – 2004. Gavin and Louise Anderson formed Umlando: Archaeological Surveys and Heritage Management cc in 2004. Gavin is rated by the Association of Southern African professional Archaeologists as a Principle Investigator with expertise in the Stone Age, Rock Art and Iron Age.

Gavin has recorded over 3000 heritage sites in his professional career. These sites span the entire heritage spectrum.

APPENDIX B

RECORDED SITES FROM THE ORIGINAL SURVEY THAT ARE NOT PART OF THE FINAL REPORT.

NAME	LATITUDE	LONGITUDE	DESCRIPTION
EMVE001	-26.659232578	30.287890668	Grave
EMVE002	-26.656614731	30.278515784	Windhoek 2 graves
EMVE010	-26.623959900	30.326098113	Schiedam
EMVE011	-26.631370375	30.328491814	Schiedam 2
EMVE003	-26.678342368	30.275034825	Klipfontein farm
EMVE004	-26.681143700	30.274493393	Cemetery
EMVE005	-26.640561011	30.327702841	Farmhouse
SHMO028	-26.665684000	30.254872200	Kraal

EMVE01

The site is located near the base of the hill and corresponds with S111 from the desktop study. According to the landowner there is a grave near this site. The grave has apparently been opened at some stage in the past (fig. 10). The site was surrounded by black wattle and not accessible.

Significance: The site is of high significance.

Mitigation: It is unlikely that the grave will be affected. A 50m buffer needs to be placed around the site. The site needs to be clearly demarcated before construction begins. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the grave.

SAHRIS: 3

APPROXIMATE LOCATION OF THE GRAVE AT EMVE02



EMVE02

The site is located halfway up the hill just above the maize fields. The site is one of the Windhoek farms dating to the 1930s and 1940s. The site consists of a stone walled house with a rondavel behind it (fig. 11). There is a grave for the five year old son in front of the house, and it dates to 30 January 1939. There is no name on the grave.

Significance: The site is of high significance due to the grave. The buildings may have significance due to its vernacular architecture. They will need to be assessed by a Built Environment specialist if they are to be affected.

Mitigation: It is unlikely that the grave will be affected. A 50m buffer needs to be placed around the site. The site needs to be clearly demarcated before construction begins. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the grave.

SAHRIS: 3A

FEATURES AT EMVE02









EMVE03

The site is located near the river at the base of the hill. The site is the original Klipfontein farm complex (fig. 10). The farm dates to the 1890s and some of the original housing Historical middens would occur in the general area.

The farm complex will not be affected by the WEF

Significance: The buildings would need to be assessed by a Built Environment specialist if they were to be affected.

Mitigation: Currently no mitigation is required.

SAHRIS: pending

FIG. 10: FARM COMPLEX AT EMVE03



EMVE04

The site is located next to the maize fields and beside the road. The site is a cemetery to the Senekal and Joubert families that lived at Klipfontein (fig. 11). The graves date from 1892 to 1968 and are all of adults, except for one child.

Significance: The site is of high significance.

Mitigation: It is unlikely that the cemetery will be affected. A 50m buffer needs to be placed around the site. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the grave.

SAHRIS: 3A

FIG. 11: EMVE04





EMVE05

The site is located near the base of the hill amongst the black wattle trees. The site consists of a single building that appears to be a farmhouse (fig. 12). The building relates to B3 from the desktop. The window frames are made from wood and thus the building probably pre-dates the 1960s.

Significance: pending

Mitigation: The building will need to be assessed by a Built Environment specialist. It is unlikely that the building will be affected by the WEF.

SAHRIS: 3C

FIG. 12: BUILDING AT EMVE05



EMVE010

The site is located in a black wattle thicket with limited visibility and accessibility. The site is one of the Schiedam farm houses consist of a stone walled kraal and buildings (fig. 17). This may be the original Schiedam farm and thus predate the 1900s.

Significance: The site is of significance.

Mitigation: Mitigation

SAHRIS: 3

FIG. 17: AERIAL VIEW OF EMVE010



EMVE011

The site is located on the top of a small hill. The site consists of a main farmhouse that is referred to as Schiedam 2 on the desktop. The farmhouse appears to post-date the 1960s due to the types of air vents near the roof and the lack of wooden frames (fig. 18)

Significance: The site is of low/no significance.

Mitigation: No further mitigation is required.

SAHRIS: N/A

FIG. 18: EVEM011



SHMO028

The site is located near the top of a hill. The site consists of a single large stone walled kraal 20m x 30m in size (fig. 32). The entrance faces southwest.

The kraal dates to the Historical Period

Significance: The site is of low significance.

Mitigation: While the site is of low significance it should not be affected unless necessary. A 50m buffer needs to be placed around the site. The site needs to be clearly demarcated before construction begins. The site will need to be visibly demarcated before construction phase commences if any activity occurs within 50m of it. The demarcation should be 20m from the kraal.

SAHRIS: 3C

FIG. 32: KRAAL AT SHMO028





APPENDIX C

CHANCE FIND PROTOCOL

CHANCE FIND PROTOCOL – HERITAGE RESOURCES

PURPOSE

Potential impacts on heritage resources can occur during construction as a result of unearthing during construction. This protocol outlines the procedures to be followed in the event that a heritage resource is uncovered.

Palaeontological finds

Monitoring Programme for Palaeontology is to commence once the excavations for all structures and infrastructure begin. The following procedure is only required if fossils are seen on the surface and when excavations commence.

1. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (silicified wood, plants, insects, bone, shells) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
2. Where possible, photographs of similar fossils must be provided to the contractor to assist in recognizing the fossil plants and bones that might be encountered on site. This information must be built into the EMPr's training and awareness plan and procedures.
3. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
4. If there is any possible fossil material found by the Contractor/environmental officer then a qualified palaeontologist should visit the site to inspect the selected material and check the excavations where feasible.
5. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made

available for further study. Before the fossils are removed from the site, a South African Heritage Resources Agency (SAHRA) permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

6. If no good fossil material is recovered, then any site inspections by the palaeontologist will not be necessary.

7. If no fossils are found and the excavations have finished, then no further monitoring is required.

Archaeological finds

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

1. The heritage resource must be avoided and all activities in the immediate vicinity temporarily ceased.

2. A suitably qualified specialist must be informed and commissioned to consider the heritage resource, either via communicating with the Environmental Officer via telephone or email, or based on a site visit.

3. Appropriate measures are to be provided by a qualified specialist towards immediate management of the heritage resource.

Should the specialist conclude that the find is a heritage resource protected in terms of the NRHA (1999) Sections 34, 36, 37 and NHRA (1999) Regulations (Regulation 38, 39, 40), the specialist must notify SAHRA on behalf of the Developer.

If required by SAHRA, the specialist must conduct a HIA in terms of NHRA Section 38 that must include rescue actions/excavations.

Graves

Should any unmarked human burials/remains be found during the course of construction:

1. Work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist, or the South African Heritage Resources Agency (SAHRA).
2. Where human remains are part of a burial they would need to be exhumed under a permit from SAHRA (for pre-colonial burials as well as burials later than about AD 1500).
3. For newer graves, should the specialist conclude that the find is a heritage resource protected in terms of the NHRA (1999) Section 35 and NHRA (1999) Regulations (Regulation 38, 39, 40) SAHRA may require that an identification of interested parties, consultation and /or grave relocation take place;
4. Consultation must take place in terms of NHRA (1999) Regulations 39, 40, 42;
5. Grave relocation must take place in terms of NHRA (1999) Regulations 34.
6. These measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions, laws and by-laws pertaining to human remains.

If required by current, relevant legislation, a full social consultation process should occur in conjunction with the mitigation of cemeteries and burials.
Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.

ORIBI CONSERVATION STRATEGY AND MANAGEMENT PLAN FOR THE PROPOSED MULILO EMVELO WIND ENERGY FACILITY, MPUMALANGA



Prepared by:

Aliénor Brassine

Rare Fauna Specialist

Pr. Sci. Nat. SACNASP registration: 116197

Email: alienor.brassine@gmail.com

Reviewed by:

Mr Brent Coverdale, Animal Scientist, Ezemvelo KZN Wildlife

Mr Athol Marchant, Ecologist, Member of the Oribi Working Group

Mr John Power, MSc, Pr. Sci. Nat. Terrestrial Ecology Scientist

June 2025

Table of Contents

SPECIALIST DECLARATION 5

LIST OF ACRONYMS 6

1 INTRODUCTION 7

1.1 Aim and Objectives 7

1.2 Background 8

2 ENVIRONMENTAL LEGISLATIVE REQUIREMENTS 9

2.1 National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act No. 10 of 2004). Threatened or Protected Species Regulations 9

2.2 Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) 9

2.3 Mpumalanga Nature Conservation Act (No. 10 of 1998) 9

3 LIMITATIONS AND ASSUMPTIONS 10

4 SITE DESCRIPTION 10

4.1 Geology and Soils 10

4.2 Topography and Vegetation 10

4.3 Climate 11

4.4 Land use and management practices 11

4.5 Fauna and habitat 11

4.6 Invaded, cultivated and transformed land 12

5 BIOLOGY AND ECOLOGY OF THE ORIBI 12

5.1 Status 12

5.2 Threats 13

5.3 Oribi Habitat 13

5.4 Population densities 14

5.5 Behaviour 14

5.6 Conservation Management 15

6 ORIBI OCCURRENCE IN THE GENERAL AREA 15

7 IDENTIFIED LIKELY THREATS ON ORIBI 16

7.1 Loss of habitat 16

7.2 Habitat fragmentation 16
7.3 Disturbance during construction and decommissioning phases of WEF 16
7.4 Noise and visual disturbances during operational phase 17
7.5 Organised illegal hunting (i.e. Taxi hunts) 17
7.6 Subsistence illegal hunting 17
7.7 Poor grazing management 17
7.8 Poor fire management 17
7.9 Alien invasive plant species 17
7.10 Free roaming domestic dogs 18
7.11 Inappropriate fence design and maintenance 18
7.12 Mesopredator predation (medium-sized predators) 18
7.13 Collision with vehicles 18
7.14 Human and livestock activity in grasslands 18
7.15 Small population size 18
7.16 Genetic isolation of subpopulations 18

8 KEY STAKEHOLDERS 19
8.1 Landowners and farmers' associations 19
8.2 Mpumalanga Tourism and Parks Agency (Act No. 5 of 2005) 19
8.3 Local Stock theft Unit 19
8.4 Oribi Working Group 19

9 MANAGEMENT PLAN 19
9.1 Management Objectives 19
9.1.1 Manage habitat to support the persistence of oribi subpopulation, including through: 20
9.1.2 Prevent increased mortality from anthropogenic sources, including through:..... 20
9.1.3 Minimise disturbance to subpopulation, especially: 20
9.1.4 Qualified and appropriately experienced fauna specialist to monitor the population status by establishing baseline parameters and conducting ongoing monitoring: 20
9.1.5 Contribute to broader oribi conservation initiatives: 20
9.2 Management Plan Design 20
9.2.1 Fire Management 20
9.2.2 Grazing Management..... 21
9.2.3 Invasive Alien Plant Control..... 21
9.2.4 Security 22
9.2.5 Fencing 22

9.2.6 Local Community Support 22
9.2.7 Disturbance 22
9.2.8 Predator Control 23
9.3 Oribi Monitoring 23
9.3.1 Population Monitoring 23
9.3.2 Baseline Population Status (i.e. Year 1-2): 23
9.3.3 Construction Phase (Year 2/3) 23
9.3.4 Operational Phase (Year 3-8) 23
9.3.5 Monitoring methods: 24
9.4 Monitoring Area 25
9.5 Research 25

10 ADAPTIVE MANAGEMENT 25

11 KEY PERFORMANCE INDICATORS (KPIS) 25
11.1 Workplan, roles and responsibilities 26
11.2 Management plan review 42

12 REFERENCES 43

APPENDIX 1: SPECIALIST CURRICULUM VITAE AND SACNASP CERTIFICATE 45

SPECIALIST DECLARATION

I, Aliénor Brassine, as the appointed independent specialist, declare that:

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

Signature of the specialist:



This document has been prepared in accordance with the scope of Aliénor Brassine's appointment and contains intellectual property and proprietary information that is protected by copyright in favour of Aliénor Brassine. The document may therefore not be reproduced, used or distributed to any third party without the prior written consent of Aliénor Brassine. This document is prepared exclusively for use by Aliénor Brassine's client. Aliénor Brassine accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared. No person other than the client may copy (in whole or in part), use or rely on the contents of this document, without the prior written permission of Aliénor Brassine. The document is subject to all confidentiality, copyright, trade secrets rules and intellectual property law and practices of South Africa.

LIST OF ACRONYMS

Acronym	Full Term
DARDLEA	Department of Agriculture, Rural Development, Land and Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EWEF	Emvelo Wind Energy Facility
GN	Government Notice
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
NGO	Non-Governmental Organization
NEMBA	National Environmental Management: Biodiversity Act
OHPL	Overhead Power Line
PA	Protected Area
SACNASP	South African Council for Natural Scientific Professions
SAPS	South African Police Service
SCC	Species of Conservation Concern
ToPS	Threatened or Protected Species Regulations
WEF	Wind Energy Facility

1 INTRODUCTION

1.1 Aim and Objectives

The oribi (*Ourebia ourebi*) is a small, graceful antelope native to sub-Saharan Africa, currently listed as *Endangered, C2a(ii)* in South Africa due to habitat loss, agricultural expansion, illegal hunting, illegal taxi dog hunting and fragmentation of populations. The Ermelo region supports a small number of oribi, often in isolated subpopulations. Their reliance on specific grassland habitats makes them particularly sensitive to land-use changes, including those associated with renewable energy developments.

Aliénor Brassine was appointed by Mulilo Renewable Project Developments (Pty) Ltd (Mulilo) to develop a management and monitoring program for the oribi of the area as part of the requirements for the Environmental Impact Assessment (EIA) of the proposed Emvelo Wind Energy Facility (Pty) LTD.

This conservation strategy and management plan is an important step to ensure the survival and recovery of oribi sub-populations, addressing and mitigating potential risks associated with the wind energy facility. The plan provides the basis for sustainable development, ensuring that the operation of the wind energy facility aligns with environmental conservation principles.

The main objective of the plan is to conserve the oribi on the site, ensuring that the development do not negatively impact them but allows the species to persist and thrive through sound management strategies. This is done through the following broad objectives:

1. **Habitat Protection and Restoration**: Identify and protect critical oribi habitats, while restoring areas that are degraded.
2. **Minimization of Disturbance**: Establish protocols to reduce human and facility-related disturbances, such as noise, human, or vehicle activities that could impact oribi behaviour or movement, particularly during sensitive periods such as lambing.
3. **Risk Mitigation**: Implement measures to lower the risks of mortality and movement patterns, such as vehicle collisions and fences.
4. **Monitoring**: Continuously monitor the population to track status, numbers, and movement, to inform adaptive management.
5. **Adaptive Management**: Create flexible strategies that can be modified based on monitoring data or unforeseen circumstances, promoting coexistence between oribi conservation and renewable energy developments.
6. **Threat Assessment and reduction**: Identify, assess and mitigate threats to oribi, including habitat degradation due to overgrazing, inappropriate fire regimes and woody invasive alien encroachment; disturbance from human activities including construction and maintenance of wind turbines, predation, illegal hunting and snaring.
7. **Research**: Facilitate research where feasible to improve understanding of the effect of WEFs on oribi
8. **Awareness and Training**: Educate facility staff and local stakeholders about the importance of the species and how to implement the management strategies effectively.

The plan also ensures compliance with regional and national regulations and meets national and international biodiversity guidelines and best practice.

1.2 Background

The proposed Mulilo Emvelo Wind Energy Facility is situated approximately 30km east of Ermelo, within the Msukaligwa Local Municipality, and Gert Sibande District Municipality, Mpumalanga Province. (Figure 1). The site is comprised of four farm portions with a total area of approximately 4640 hectares. The site is situated within a predominantly commercial farming area, generally comprising beef and sheep farming with dryland grazing and dryland pastures and crops including maize and soya beans. Several coal mines are present in the broader area, as well as coal fired power stations. The area falls within a moderate to high summer rainfall area

The proposed projects will require clearing of vegetation for the construction of the WEF facility including access roads and grid connections. The construction phase will also cause noise and disturbance which will be reduced but ongoing during the operational phase. The decommissioning phase will also cause disturbance from machinery and human activities.



Figure 1: Location of the proposed Mulilo Emvelo WEF in relation to Ermelo, Mpumalanga Province.

Emvelo Wind Energy Facility

Emvelo WEF is expected to have up to 24 turbines with a maximum output capacity of up to 260MW and will have an anticipated lifespan of 25 to 30 years. The WEF will also comprise of an on-site substation with a capacity of 132kV and up to 132kV Overhead Powerline (OHPL) of approximately 32km in distance with a 300m wide corridor. The OHPL will connect to the Eskom Uitkoms Substation. The WEF will also comprise of Medium Voltage (MV) cables (approximately 9km), access roads (38.31 km), tower laydown areas, operations and maintenance facilities.

The construction and operations of wind turbines may lead to unfavourable environmental impacts on oribi in the form of disturbance, mortality, change in behaviour and distribution, habitat loss and fragmentation which may, amongst other impacts, create barriers to geneflow. The effect of wind turbines can also have a cascade effect; changes in wildlife community due to ecological relationships,

where the effect on one species may in turn affect many other species. Potential impacts of renewable energy projects must be assessed and mitigated to avoid negative effect on remaining oribi subpopulations. Sound conservation strategies require accurate information on the distribution and status of oribi populations.

The status of the oribi on the site is unknown, thus a substantial component of this plan aims to establish baseline estimates of the size, characteristics, and distribution of the subpopulations on the site. Thus, a preconstruction strategy will be essential, this will consist of an initial pilot study and baseline monitoring (Year 1). This plan is thus presented as a preconstruction strategy and adaptive management framework, which involves developing and implementing a strategy as well as management actions, monitoring changes in the status of the subpopulation and the outcome of management actions, and then devising future actions based on the results of monitoring.

2 ENVIRONMENTAL LEGISLATIVE REQUIREMENTS

The EIA Regulations, 2014, published in Government Notice (GN) No. R. 982 as amended provide for the control of certain Listed Activities. These activities are listed in GN No. R. 983 (Listing Notice 1 - Basic Assessment), R. 984 (Listing Notice 2 - Scoping & EIA Process) and R. 985 (Listing Notice 3 - Basic Assessment) of 4 December and are prohibited to proceed until environmental authorisation has been obtained from the competent authority, in this case, the Department of Forestry, Fisheries and the Environment (DFFE).

Environmental impact assessment (EIA) is a tool to aid environmental decision making for proposed developments. It is a process that allows for the assessment of the proposed development where decisions are driven by a rational, scientific and objective approach to understand possible environmental impacts. EIA gathers detailed information on potential ecological consequences to ensure the decision-making process has ecological integrity by avoiding and/or mitigating potential negative impacts on the environment.

A condition for the application of Environmental Authorization for the Emvelo WEF is to develop an Oribi Management Plan.

2.1 National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act No. 10 of 2004). Threatened or Protected Species Regulations

The Threatened or Protected Species (ToPS) Regulations identifies restricted activities involving listed threatened or protected species. Oribi is a ToPS species, and ToPS permits will be required for any of the restricted activities, which generally include activities relating to the physical manipulation or possession of animals, such as hunting, capture, breeding, keeping in captivity, and trading or transport of protected animals or animal parts.

2.2 Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)

The Environmental Affairs program within the Department of Agriculture, Rural Development Land and Environmental Affairs promotes a well-managed, sustainable environment.

Through environmental planning and co-ordination, greener governance, environmental awareness and capacity building, integrated pollution and waste management, enforcing compliance to environmental legislation and promoting biodiversity management.

2.3 Mpumalanga Nature Conservation Act (No. 10 of 1998)

Oribi is listed under schedule 2 as a protected species. Under the Act, species listed as "Protected Game" are subject to specific regulations to ensure their conservation. Key provisions include:

Hunting Restrictions: Hunting of protected game is prohibited unless authorized by a permit issued by the relevant authority.

Permit Requirements: Activities such as possessing, selling, purchasing, donating, or transporting protected game require appropriate permits.

Penalties for Non-Compliance: Violations of these provisions can result in fines or imprisonment, as stipulated in the Act.

3 LIMITATIONS AND ASSUMPTIONS

The management plan may be susceptible to certain uncertainties and limitations, as it will depend on the most recent available information, such as literature, online resources, databases, and satellite imagery. Additionally, it incorporates findings from a brief site visit conducted in the early to mid-autumn season (April 2025), which is not the most ideal period to observe Oribi (Coverdale pers comm. 2025) The purpose of the site visit was to have a broad overview of habitats, identify current threats and aid in conceptualizing monitoring methodologies.

There are limitations on what is feasible and practical, particularly where a development may impact on a species that is locally rare and difficult to monitor. The rarity and previous exposure of the oribi population on the site will impact its detectability and habituation to a new development which will affect findings and statistical analyses. The management plan will therefore need to be flexible and adaptive to allow for these uncertainties as well as site specific environmental and human factors.

To reduce uncertainties an initial pilot study will be essential to evaluate the different survey techniques (e.g. camera traps, point counts, drone surveys) and to determine the appropriate sampling design (appropriate number and location of monitoring sites) as well as data collection feasibility ensuring that the chosen methods work in the field under the site-specific conditions. This will also provide more accurate costs, and time estimates to ensure appropriate budget, labour and time is allocated for the study. Importantly, a pilot study reduces the risk of failure for large scale monitoring and refine objectives and improve data quality.

4 SITE DESCRIPTION

The following site descriptions are reproduced from The Document prepared by ERM for the Proposed Emvelo Wind Energy Facility and Auxiliary Infrastructures, Mpumalanga, ERM Southern Africa (Pty) Ltd. (Barbeau & Gopaul 2025)

4.1 Geology and Soils

Msukaligwa Local Municipality is primarily underlain by arenite and dolerite intrusions associated with the Karoo Supergroup. Additional underlying rocks include quartz monzonite, granite, and basalt. The central-western portion of the study area is situated within the Ermelo Coalfield, where the dominant rock types are sedimentary, comprising sandstones, shales, and siltstones of the Ecca Group. This geological unit includes arenaceous strata of the coal-bearing Vryheid Formation.

Soils are predominantly shallow due to the underlying bedrock, clay, or hardpan, or the result of poor drainage. Deep well drained soils do occur, but these have generally been developed for agricultural crops

4.2 Topography and Vegetation

The lower-lying regions of the site and its surrounding landscape consist of gently to moderately undulating plains covered by dense, short grassland, classified as Eastern Highveld Grassland. This vegetation type has undergone varying degrees of disturbance, primarily due to agriculture and coal mining. The grassland is primarily composed of typical Highveld grass species, including *Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, and *Tristachya*, interspersed with small, scattered rocky outcrops

supporting wiry, sour grasses and some woody species such as *Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp. *lycioides*, *Parinari capensis*, *Protea caffra*, *Protea welwitschii*, and *Rhus magalismontanum*. Additionally, a variety of herbaceous species and forbs are common within this unit. The site also consists of rivers with floodplain wetlands, narrow stream alluvia with narrow riparian zones, valley bottom wetlands, seep wetlands and isolated pans.

The terrain consists of low mountains and undulating plains, where short montane grasslands, classified as Wakkerstroom Montane Grassland, dominate the plateaus and flat areas. Steeper, mainly east-facing slopes and drainage zones are characterized by patches of short forest and thickets of *Leucosidea sericea*. This woody pioneer species proliferates in response to grazing mismanagement. Additionally, past and current anthropogenic activities have led to thickets of *Acacia mearnsii* (Black wattle) and Eucalyptus are widespread, as well as commercial forestry operations further contributing to the landscape's vegetation composition.

Transformed areas, primarily cultivated lands constitute 27.6 %, Montane Grassland 25.1 %, intact Highveld Grassland only constitutes 16.8 % and 14.5 % comprises dense invaded thickets.

4.3 Climate

Msukaligwa Municipality is situated within the central Mpumalanga climatic zone, characterised by warm, wet summers and dry winters with frost occurrences. Rainfall is highly seasonal, with intense storms that can deliver up to 80 mm per day, often accompanied by lightning, strong winds, and occasional hail. The winter months experience drought-like conditions, with rainfall during June, July, and August collectively contributing only 3.9% of the annual precipitation, which averages 734 mm.

Temperature variation is notable, with the average daily maximum temperature reaching 25.2°C in January, the hottest month, and 16.7°C in July, the coldest month. Due to its proximity to the escarpment, the region is generally windier than the surrounding South-Eastern Mpumalanga Highveld. However, most winds remain light, with their direction predominantly influenced by local topography.

4.4 Land use and management practices

Current land use and localised impacts within the site include large scale crop farming, livestock grazing, small to large river impoundments and dams.

4.5 Fauna and habitat

The overall landscape provides habitat for a restricted assemblage of animal species. However, anthropogenic activities, particularly within grassland areas, have likely led to significant displacement of many species. In contrast, more generalist and adaptable species are expected to be less affected by these disturbances.

Highveld grassland is well-represented within the site, with some near-natural to pristine remnant patches still present. However, the majority of the area has undergone varying degrees of transformation or disturbance, including sections periodically mowed for hay and other fodder resources. More intact natural habitats are generally confined to slopes, where land use intensity is lower. Rocky outcrops and rocky habitats are relatively uncommon but do occur on certain slopes and occasionally in flat areas with shallow soils. These rocky areas do not exhibit the typically elevated species diversity associated with fire refuge outcrops, likely due to historical grazing pressure and fire management practices aimed at promoting grass growth.

Natural to near-natural Wakkerstroom Montane Grassland is primarily found at higher altitudes, particularly in rocky mountainous areas, where transformation levels are considerably lower. This vegetation type is well-represented on the site, with near-natural to pristine patches being common and favoured by the oribi. However, most areas exhibit some degree of historical grazing use, and

localized infestations of alien tree species are prevalent. Rocky habitats, including outcrops, occur frequently on slopes, plateaus, and along plateau edges, where poor or shallow soils support an increased abundance of shrub and herbaceous species. While the rocky shrub community is not well-represented across the site, it generally exhibits higher overall non-graminoid diversity and remains in a more pristine condition in less accessible areas and regions free from dense alien plant infestations.

Riparian vegetation along watercourses typically consists of a fringe of grasses and small trees that exhibit greater vigor compared to the surrounding habitat. This vegetation includes characteristic riparian elements such as sedges and reeds, particularly in areas where standing water or a perched water table persists for extended periods. Grassland species also display increased density along lower-order watercourses or in areas where moisture availability remains higher than in adjacent landscapes. The structure and composition of riparian zones vary, ranging from incised watercourses with a dense thicket fringe to shallow, poorly defined channels dominated by grasses and low shrubs.

4.6 Invaded, cultivated and transformed land

The prevalence of alien invasive species across the site is generally low in near-natural areas; however, disturbed areas exhibit significantly higher densities of invasive and weedy species. Notably, extensive and high-density infestations of Black Wattle (*Acacia mearnsii*) are present, particularly in the northern regions. At least 20% of the project area is characterized by elevated populations of alien invasive species and weeds (as per The Terrestrial Vegetation Sensitivity Assessment). Areas with dense alien plant infestations experience significant alterations to natural ecological processes, often leading to changes in soil properties. In these areas, native vegetation is typically limited to scattered grasses, herbs, or shrubs interspersed within dense thickets. In regions with lower invasion densities, the occurrence of grass fires tends to result in significantly higher burn temperatures. This process gradually modifies soil characteristics, facilitating the proliferation and eventual densification of invasive species.

The site exhibits extensive evidence of historical agricultural activities, including crops and inadequate land rehabilitation over time. Prominent remnants of historical terracing indicate past land modification, which has likely contributed to significant landscape alterations. Large portions of the area have been transformed for agricultural purposes, either as pastureland or cropland, with maize and soya bean being the primary crops, and are either actively cultivated or have been in the past. No irrigated pivots are present, and the absence of a substantial water supply suggests that agricultural activities predominantly rely on dryland farming. Formerly cultivated lands (old lands) remain present and may be subject to future use, as crop rotation appears to be a common practice in the region. Additionally, transformed areas are present, where all indigenous vegetation has been removed, this includes several dwellings, other infrastructure and access roads.

5 BIOLOGY AND ECOLOGY OF THE ORIBI

5.1 Status

The oribi (*Ourebia ourebi*) is a small, territorial antelope native to sub-Saharan Africa, where it predominantly inhabits open temperate grasslands (Skinner & Chimimba 2005). It occurs in fragmented populations ranging from Senegal to Ethiopia and extending through eastern and western Africa to Angola and the Eastern Cape in South Africa (Skinner & Chimimba 2005). Twelve subspecies are currently recognized, although *Ourebia ourebi kenyae* is now considered extinct. The South African subspecies (*O. ourebi ourebi*) is identified as genetically distinct from populations occurring further north (Phukuntsi et al. 2022). Consequently, oribi populations in South Africa should be managed as a separate conservation unit (van Vuuren et al. 2017).

The oribi is classified as Endangered C2a(ii) within the Regional Red List assessment and is considered to be the most threatened species of antelope in South Africa (Shrader et al. 2016). The IUCN Red List

globally categorises the oribi as Least Concern, but with a declining population trend (IUCN SCC 2016). Between 1996 and 2014, the Oribi population in South Africa declined by approximately 13%, with fewer than 2,500 mature individuals remaining, of which approximately 75% of them occur on private land (Shrader et al. 2016). Populations have become restricted to small and discontinuous populations in grasslands, occurring in the eastern half of South Africa in Limpopo, Mpumalanga, KwaZulu-Natal, and Eastern Cape provinces. Some sub-populations have also been recorded in the southern and north-eastern regions of the Free State (Skinner & Chimimba 2005). Surveys from KwaZulu-Natal indicate that most subpopulations in the region are in decline (Skinner & Chimimba 2005).

5.2 Threats

Illegal hunting, particularly with the use of domestic dogs, is recognised as a major threat to the oribi, with their lying-out behaviour making them particularly vulnerable to hunting dogs (Roberts 1986; Grey-Ross et al. 2010; Manqele et al. 2018; Louw et al. 2021). In KwaZulu-Natal a practice of "taxi hunts" has become prevalent, where mini-bus taxis transport poachers with dogs to private farms during the night (Louw et al. 2021). The dogs are released to hunt freely, and the activity often turns into a gambling event where participants bet on the outcomes. The first dog to bring down an animal determines the winner (Grey-Ross et al. 2010). These hunts are not driven by subsistence needs but are instead primarily for sport, with bushmeat serving as an additional incentive (Manqele et al. 2018). In some regions, hunting groups are well-equipped with weapons and have been known to intimidate landowners, law enforcement and conservation officials. While poverty and unemployment are often cited as factors contributing to poaching, Manqele et al. (2018) found that most illegal oribi hunters were employed or owned land and livestock, suggesting that employment may fund hunting activities, such as the cost of buying and keeping hunting dogs. The study also found no seasonal pattern in illegal hunting but noted an increase during timber harvesting, potentially linked to migrant labour. Among illegal hunting methods, hunting with dogs was the most common (93%), followed by snares (6%) and firearms (1%) (Manqele et al. 2018).

Additional identified main drivers of population decline are attributed to habitat loss due to commercial forestry, intensive agriculture, and mining. Additionally, the degradation of grasslands through inappropriate livestock management, inadequate fire management, fencing and erosion further reduces suitable habitat (Coverdale et al. 2006; Shrader et al. 2016).

5.3 Oribi Habitat

Oribi thrive in open grasslands with a high proportion of palatable sweet grasses. Due to their small size and high metabolic rates, they require high-quality forage and primarily select decreaser grasses, including *Themeda triandra* (red grass), *Eulalia villosa* (velvet grass), *Andropogon schirensis*, *Hyparrhenia hirta* (thatch grass)*, Panicum natalense,* and *Monocymbium ceresiiforme* (boat grass) (Shrader et al., 2016). In the Mpumalanga escarpment preferred grasslands consist primarily of both *Rendlia altera* and *Themeda triandra* (Skinner & Chimimba 2005). Oribi prefer open grasslands and hayfields while avoid pastures, croplands, and plantations (Perrin & Everett 1999). They have also been found to be associated where stony ground occurs and are water-independent (Skinner & Chimimba 2005). Oribi require a mosaic of tall and short grasses, using short grasslands for feeding and taller grass for cover and to conceal their lambs (Everett et al. 1991; Skinner & Chimimba 2005; Grey 2006). The trampling and cropping of grass by cattle can also provide suitable habitat for oribi (Skinner & Chimimba 2005), however inappropriate stocking rates of cattle can negatively impact oribi through the reduction in nutrient rich grass during the dry season (Stears and Schrader 2020) Oribi respond positively to recently burnt or mowed grasslands since older grasslands accumulate dry, moribund material, reducing access to green growth (Everett et al. 1991). Burning enhances forage quality by increasing crude protein, phosphate, and calcium levels while preventing shifts in species composition, typically a decrease in the abundance of palatable grasses and an increase in unpalatable grasses. Rowe-Rowe (1982) found oribi to show a preference for one-year-old grassland over two-year-old

grassland. During winter, colder temperatures, shorter daylight hours, and drier conditions reduce the nutritional quality of grasses. As crude protein and energy content decrease and fibre content increases, oribi must rely on fat reserves, making them more vulnerable to extreme weather conditions, predation, and disease (Everett et al. 1991; Skinner & Chimimba 2005). To compensate, they may travel greater distances in search of high-quality forage. Burning or mowing of grasslands in autumn can provide high-quality food during these critical winter months (Rowe-Rowe 1982).

Oribi also demonstrate habitat preferences related to topography. They favour north- and east-facing slopes (5–10° gradient), likely due to drier conditions and higher proportions of sweet grasses, while avoiding south- and southeast-facing slopes and flat (0-5^{o} slopes) or steep areas (> 15^{o} slopes) (Rowe-Rowe 1982; Reilly 1989; Perrin & Everett 1999). Oribi were also found to prefer gentle undulating plateaus, ridge terraces and spurs which may be linked to localised increase in soil minerals. Oribi tend to rest in slightly raised ground, possibly for increased field of vision as they lie with their heads erect (Skinner & Chimimba 2005).

Oribi can be found with other antelope species, possibly for increased vigilance of predators (Perrin & Everett 1999; Skinner & Chimimba 2005).

5.4 Population densities

Population densities vary based on habitat quality as well as rainfall patterns (Brashares & Arcese 2002; Skinner & Chimimba 2005). Previous estimates range from one oribi per 5.5 hectares to one oribi per 24.3 hectares (Everett 1991; Skinner & Chimimba 2005). Female home ranges varied from 0.12 – 0.95 km^2 (Brashares & Arcese 2002).

Post-release densities of translocated individuals have been observed at one oribi per hectare, suggesting high adaptability to suitable environments (suitable habitat and secure from poaching/predation) (Grey-Ross et al. 2009). However, these environmental variables make it difficult to estimate carrying capacity. Furthermore, the reported density estimates have been calculated using different monitoring techniques making it difficult to reliably compare density estimates.

5.5 Behaviour

Oribi are typically found as solitary adults, in pairs or small groups; usually a male, one or two females and their offspring (Skinner & Chimimba 2005). Sometimes an auxiliary male will also be part of the herd. Sometimes these small family herds will join up to form small parties.

In South Africa, oribi are typically monogamous, although polygyny is also observed, however polygynous groups appeared unstable and possibly correlated to seasonal food abundance, predation risk and altitude (Adamczak & Dunbar 2007). Polygyny has also been found to be correlated with ratio of adult female to males, population density and group size (Arcese et al. 1995). The social organisation and group sizes may be influenced by habitat quality, with larger groups found in optimum habitat whereas less suitable habitat forces oribi to be more widely dispersed and occur in smaller group sizes, usually only two adults (Rowe-Rowe et al. 1992; Skinner & Chimimba 2005). In montane regions, they are usually found as monogamous pairs or solitary individuals, whereas in lowland areas, they form larger groups (Rowe-Rowe et al. 1992). Mean group sizes range from 1.5 to 4.5 across Africa and are significantly larger in eastern Africa (3.23) than in South Africa (1.83) (Adamczak & Dunbar 2007). In Mpumalanga, group sizes averaged 1.84 (range = 1-6) and 1.72 (range = 1-5) in two localities, with group composition typically adult pairs, followed by solitary adults and harem herds (Skinner & Chimimba 2005). Sex ratios (females per adult male) varying from 0.78 to 2.13 (Adamczak & Dunbar 2007).

Oribi are typically territorial with territory and home range influenced by season, rainfall, availability of suitable habitat, forage quality, and management practices (Brashares & Arcese 2002; Grey-Ross 2009). Territories are typically found in the centre of large home ranges with adult males having home

ranges of 5–47 hectares, with some overlap (Skinner & Chimimba 2005). Adult males will mark grass stems with a black secretion from their preorbital glands. They will also defecate on established communal middens, marking sites will be found along borders of territories (Skinner & Chimimba 2005). Observations suggest that oribi do not compete for food, with no aggression observed when oribi have been found grazing in burnt or mowed fields (Grey-Ross 2009)

Oribi are diurnal, feeding primarily in the early morning and late afternoon while resting around midday (Tekaling & Bekele 2015). When they are suddenly disturbed, they give snorting whistle alarm call and bound off, in a stotting 'rocking horse' motion (Skinner & Chimimba 2005). Other anti-predator behaviour involves sinking to the ground and lying prone to avoid detection (Adamczak & Dunbar 2007) which can make them more vulnerable to poaching with dogs (Marchant pers comm. 2025).

Oribi are seasonal breeders with lambing occurring from October to December (Skinner & Chimimba 2005). Females hide their lamb in clumps of tall grass for up to 3-4 months after birth (Skinner & Chimimba 2005).

5.6 Conservation Management

Previous research on oribi management have recommended controlled block burns every two years in autumn, supplemented with mowing (Everett et al. 1991). Alternatively, controlled burns in late winter or early spring every two years, combined with mowing and autumn firebreaks, may be a better compromise for maintaining both grassland health and oribi populations (Coverdale et al. 2006). Burning for a "green bite" in autumn is discouraged due to its negative impact on plant diversity, basal cover, root reserves and soil stability (Trollope 2007). Burning in early Spring before the growing season is considered best practice.

Translocations have been conducted in South Africa, but few outcomes have been recorded. A study of 15 translocated oribi in KwaZulu-Natal found high survival rates (Grey-Ross et al. 2009). Oribi are tolerant of each other post-translocation and do not immediately establish exclusive territories. However, more recent assessment of past oribi translocations suggest that it is not an effective conservation tool for the species with 80% of translocations having decreasing populations post-release (Patel et al. 2021). In addition, negative impacts on donor populations have been observed after capture has taken place within an oribi population but this has not been researched (Marchant pers comm. 2025). Other conservation strategies should be explored, and the hierarchical decision-making framework should be used to assess the necessity, risk as well as the technical and logistical design of each translocation project before deciding and implementing a translocation.

6 ORIBI OCCURRENCE IN THE GENERAL AREA

Oribi have been confirmed present at the site by incidental observations from the bird monitoring team (Wienand pers comm. 2025) as well as information provided by landowners. Additionally, a short field trip was conducted in February and April 2025 where, A. Brassine, recorded four oribi sighting; two single male adults and two adult pairs, one of which consisted of two females and whilst the other group could not be reliable reliably sexed. This information is rudimentary and based on incidental observations; it serves only to confirm the presence of oribi on site and highlights the need for a formal baseline assessment to gather systematic and reliable data on the population. Incidental sightings and general areas where sightings have been seen are displayed in the map below (Figure 2). Besides the above, little is known about the status of the oribi and their distribution on the site and in the broader area. In order to develop detailed landscape conservation management plan for the oribi it is critical to identify priority habitat patches and corridors, to facilitate persistence of oribi both on the site and in the broader general area. Initial results from this long-term monitoring initiative will serve as the baseline, providing crucial insight into the current population status. As the management plan advances, it will generate data essential for tracking population trends, which is fundamental for effective conservation and management

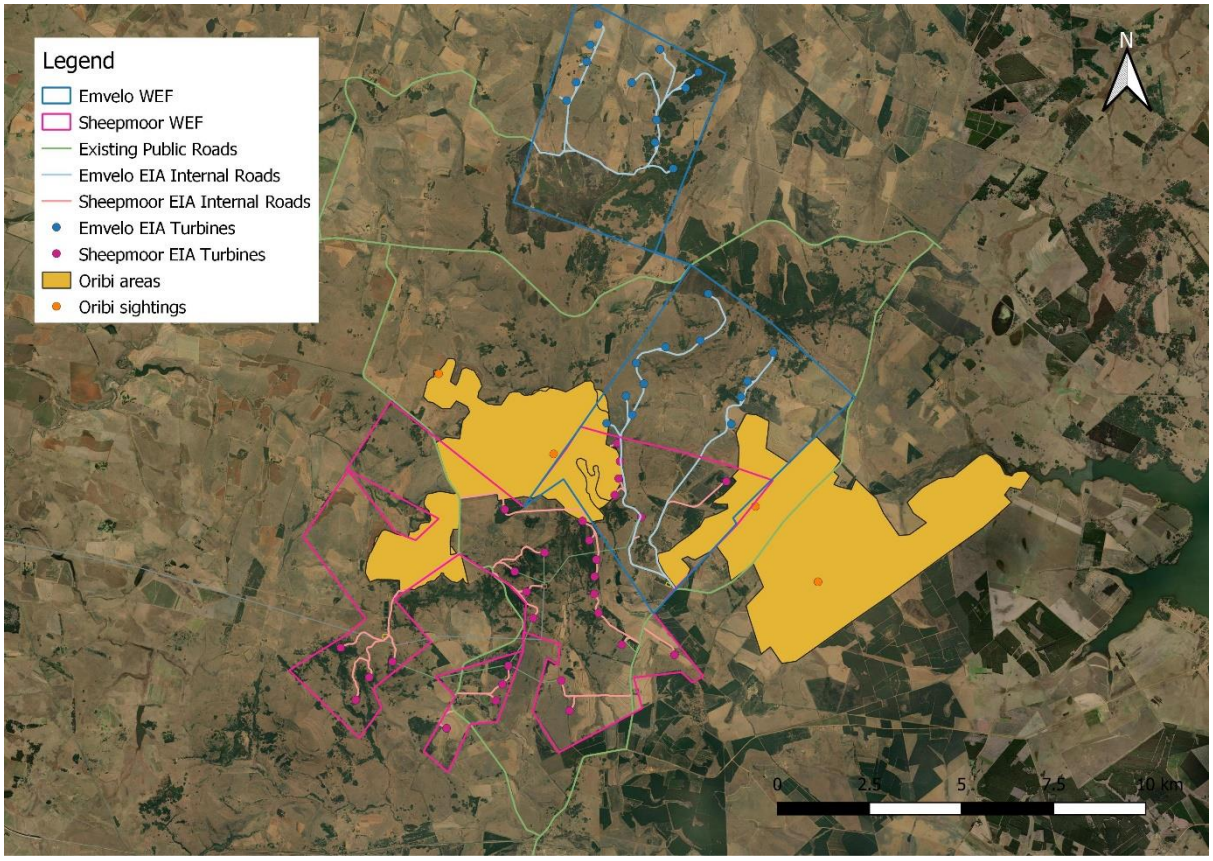


Figure 2: The general layout of the proposed Mulilo Emvelo and Sheepmoor WEFs and the two general areas (Yellow) that have been identified to support oribi. Importantly this does not represent all oribi habitats and an oribi baseline assessment will be required to understand the current status of the subpopulation, including distribution and population estimates.

7 IDENTIFIED LIKELY THREATS ON ORIBI

The identified threats have informed the development of management objectives for the conservation of oribi on the site and broader area.

7.1 Loss of habitat

Threat: Clearing of grassland habitat for WEF infrastructure.

Management action: Minimize clearing of grassland habitats used by oribi. WEF layout needs to minimise number of turbines and infrastructure (including laydown), as well as reduced width of access roads were feasible.

7.2 Habitat fragmentation

Threat: Habitat fragmentation can cause isolation of oribi groups.

Management action: Wildlife corridors utilised by oribi need to be identified and remain protected from disturbance to ensure connectivity of subpopulation.

7.3 Disturbance during construction and decommissioning phase of WEF

Threat: Noise and visual disturbance due to construction activities of the WEF can displace oribi and influence behaviour.

Management action: Limit construction during peak oribi activity periods of early morning and late afternoon. Qualified and appropriately experienced fauna specialist to monitor oribi during construction phase. Ensure construction and decommissioning phases are as short a period as possible and avoid lambing season where possible.

7.4 Noise and visual disturbances during operational phase

Threat: Turbine noise, flicker effect and human activity during operational phase of the WEF can influence oribi behaviour and distribution.

Management action: Qualified and appropriately experienced fauna specialist to monitor population to determine impact and tolerance to operational wind turbines. Adaptive management response based on how the species responds.

7.5 Organised illegal hunting (i.e. Taxi hunts)

Threat: Mortality due to organised hunting with dogs.

Management action: Improve access control and security on the site to reduce mortality.

7.6 Subsistence illegal hunting

Threat: Illegal hunting with the use of dogs and snares leads to increased mortality.

Management action: Improve Access control and security on the site. No hunting or wildlife disturbance is permitted on site, all on-site personnel, including contractors and subcontractors, are strictly prohibited in engaging in illegal hunting or any form of wildlife harassment. Staff must be made aware that any such activities will be considered a serious breach of environmental compliance and may result in disciplinary and/or legal action. Conduct anti-poaching patrols and snare removal operations.

7.7 Poor grazing management

Threat: Poor grazing by management by livestock or game impacts grass species composition, cover for refuge and overall grassland health (see Stears and Shrader 2020).

Management action: Implement dynamic grazing plan based on farmland condition assessment and sound management guidelines. Maintain conservative stocking rates. Provide exclusion zones (guided by Fauna Specialist) where grasses are left to grow to provide refuge for oribi.

7.8 Poor fire management

Threat: Unsuitable habitat structure and grass species composition

Management action: Implement a Fire Management Plan with appropriate burning regimes and fire breaks that support habitat health and biodiversity. Including as many internal firebreaks as possible to provide more 'autumn' grazing which further helps keep the oribi away from the property boundaries where they will be more vulnerable to poaching (Marchant pers. comm. 2025).

7.9 Alien invasive plant species

Threat: Invasive alien plants encroaching in oribi habitat causing loss of habitat and habitat fragmentation.

Management action: Implement an Invasive alien plant control management plan, focusing on spread in grassland habitats where oribi occur. Rehabilitation of areas where invasive plants have been removed. Ongoing monitoring and removal of new saplings in cleared areas.

7.10 Free roaming domestic dogs

Threat: Presence of domestic and feral dogs lead to increased mortality and create a landscape of fear causing loss of habitat and habitat fragmentation due to displacement.

Management action: Monitor presence of domestic dogs and mitigate threat of free-roaming dogs attacking and harassing wildlife (see Rowe-Rowe, 1975). Remove feral dogs. Provide fencing to enclose homesteads and farms to contain dogs. Fencing needs to be appropriate to ensure minimum maintenance and reduce the risk of supplying snaring material (e.g. Clear view fencing or similar).

7.11 Inappropriate fence design and maintenance

Threat: Fencing that stops oribi movement leads to habitat fragmentation and isolation of subpopulation. Barbed wire and loose wires can cause entanglements, injury and death.

Management action: Ensure fencing is wildlife friendly and porous to ensure oribi and other wildlife can move through fence. Monitor fence and maintain fence in good condition. Report animal entanglement and mortality, and ensure rehabilitation and re-release of any injured ones.

7.12 Mesopredator predation (medium-sized predators)

Threat: High density of mesopredator (black-backed jackal and caracal) due to large predator exclusion leads to unnaturally high predation on oribi.

Management action: Collect data on mesopredator abundance and ascertain threat.

7.13 Collision with vehicles

Threat: Mortality due to vehicle collisions from increased traffic.

Management action: Appropriate Faunal monitor to monitor roadkill and identify hotspots for mitigation. Induction of contractors and staff to include awareness of wildlife in the area and how to drive safely as well as reporting of any wildlife collisions. Speed reduction measures at identified hotspots and sensitive areas.

7.14 Human and livestock activity in grasslands

Threat: Cattle herders, livestock, and human presence on foot with or without dogs can influence behaviour and distribution of oribi.

Management action: Collect information on significance of this source of disturbance evaluating distribution of livestock, livestock presence with oribi and monitoring human activity.

7.15 Small population size

Threat: Low genetic diversity making them more vulnerable to genetic drift and inbreeding which can lead to reduced fertility, lower survival rates and susceptibility to stochastic events such as extreme weather, disease outbreaks or environmental changes.

Management action: Qualified and appropriately experienced Fauna Specialist to monitor oribi to establish population size and connectivity to enhance geneflow and recolonisation. This must include an evaluation of population status and threats to inform extinction risk and guide interventions. Possibly implement metapopulation translocations (in and out).

7.16 Genetic isolation of subpopulations

Threat: Small unconnected subpopulations cause genetic isolation and inbreeding.

Management action: Conservation efforts and management plan need to include a broader landscape and identify wildlife corridors for subpopulation connectivity. Ensure fences do not limit oribi movement (porous) and conduct research on population genetics.

8 KEY STAKEHOLDERS

8.1 Landowners and farmers' associations

Collaborate with local landowners and farmers to share information on oribi distribution, challenges faced by farming community and encourage oribi-friendly land practices. Conduct awareness campaigns on the legal protection of oribi and ecological value of grassland biodiversity.

8.2 Mpumalanga Tourism and Parks Agency (Act No. 5 of 2005)

The Mpumalanga Tourism and Parks Agency (MPTA) is a public entity that is responsible for biodiversity conservation and the management of protected areas. MPTA enforces nature conservation legislation, including wildlife crime prevention, issues permits related to hunting, keeping and transporting of wild animals and promotes eco-tourism in the province. The administration of MPTA is responsible for determining and enforcing sustainable utilization of natural resources, ensure the protection and survival of rare and endangered species, manage and control the spread of invasive alien species as well as problem animals, as well as ensure that natural systems, biodiversity and ecological functions and processes in the province are maintained.

8.3 Local Stock theft Unit

Collaborate with the local Stock Theft Unit for incursion and security measures implementations.

8.4 Oribi Working Group

The Oribi Working Group was established in 2000 to address the threats facing oribi and to foster collaboration with private landowners who serve as custodians of the species. The group includes members from Ezemvelo KZN Wildlife, prominent farmers, as well as representatives from forestry companies and non-governmental organizations (NGOs).

The primary mission of the Oribi Working Group is to promote the long-term persistence of the oribi within its natural grassland habitat by initiating and coordinating conservation efforts aimed at maintaining current populations and mitigating threats. A key objective is to support ongoing population monitoring through an annual citizen science-led census, with data consolidated into a central database. This information helps guide research initiatives and inform effective management plans.

9 MANAGEMENT PLAN

The optimal management approach is to minimize the loss of sensitive habitats. Where avoidance is not feasible, representative areas should be preserved as ecological corridors to maintain connectivity and ecosystem function.

9.1 Management Objectives

The primary goal of this plan is to conserve the oribi subpopulation on the Ermelo WEFs site, ensuring that the project does not negatively affect oribi and that sound management contributes to their persistence and potential growth (Net positive affect).

To achieve this goal, the following management objectives have been established:

9.1.1 Manage habitat to support the persistence of oribi subpopulation, including through:

a) Fire management
b) Livestock management.
c) Invasive alien plant management.
d) Monitor habitat condition indices annually to assess habitat quality.

9.1.2 Prevent increased mortality from anthropogenic sources, including through:

a) Proactive implementation of security measures (e.g. anti-poaching patrols and snare removal).
b) Effort to eliminate free roaming hunting dogs.
c) Appropriate responses to incursions.
d) Ensuring fencing is safe for oribi and other wildlife.
e) Efforts to reduce road mortality risks.

9.1.3 Minimise disturbance to subpopulation, especially:

a) Disturbance caused by the construction of the WEF.
b) Disturbance during the operational phase of the WEF.
c) Disturbance from other activities (e.g. predator control, invasive plant control).
d) Designate no-go areas during peak lambing season to prevent disturbance.
e) Training of WEF staff on oribi identification, reporting protocols and minimizing disturbance during operations.

9.1.4 Qualified and appropriately experienced fauna specialist to monitor the population status by establishing baseline parameters and conducting ongoing monitoring:

a) Initial monitoring to determine habitat use (occupancy) and estimate population size and demographics.
b) Ongoing monitoring (e.g. annual counts, space use and activity patterns) to track habitat use and population trends in response to WEF development and management actions.
c) Explore opportunities to expand monitoring program to incorporate other Fauna and identified SCC (black-footed cat, serval, crane species, Rudd's Lark, Botha's Lark etc.) from opportunistic observations as well as emerging technologies.
d) Roadkill monitoring and adaptive management to reduce this threat where hotspots have been identified.
e) Monitor snare and poaching incidents through regular patrols.

9.1.5 Contribute to broader oribi conservation initiatives:

a) Report monitoring results to iNaturalist / Oribi Working Group (participate in annual oribi census).
b) Register the site as an Oribi Custodian Site.
c) Support relevant research on oribi conservation and management.

9.2 Management Plan Design

9.2.1 Fire Management

To support oribi populations, fire management should aim to create a patchy landscape with post-fire heterogeneity, ensuring both short and long grass areas are available within oribi habitat.

General fire management for grasslands should be followed (see Lechmere-Oertel 2014, SANBI 2013) but these should be tailored to meet the specific requirements for oribi. The following recommendations are provided:

- The area should be protected from burning every year by unplanned fires entering the site
- Implement planned burns to ensure all grassland areas are burned every 2-4 years, adjusting frequency based on rainfall and fuel load; higher frequencies during high rainfall and fuel load conditions, lower frequencies during low rainfall and fuel load conditions.
- Burns should be > 30% but <60% of the grassland areas
- Conduct planned burns in late winter or early spring but before the start of growing season.
- Preferably use single-point ignitions to promote patchiness however designated block burns may provide safer control of fire.
- Create wide firebreaks, which should include internal firebreaks, for protection against wild-/unplanned fires and to provide winter grazing for oribi; prepare these in autumn.
- Monitor and record both planned and unplanned fire incidence

Given current practices differ markedly, engagement with landowners will be necessary to transition towards compatible fire management. The primary concern is reducing fire frequency to allow for long-grass patches. The Environmental Control Officer (ECO) should verify compliance.

Fire management requires continuous assessment of grassland conditions and fuel loads. If burns are planned, landowners should assess vegetation in mid-winter to inform late winter or early spring burns.

9.2.2 Grazing Management

Grazing should be managed to support oribi persistence (see Stears and Shrader 2020). This includes avoiding selective overgrazing, maintaining fire-supporting fuel loads, and retaining long grass areas, while minimising disturbance from livestock.

Recommendations:

- Engage farmers to co-develop a grazing plan that considers oribi needs
- Adopt conservative livestock and game stocking rates (~70% of agricultural capacity), adjusting based on climate and grasslands condition
- Prefer bulk grazers (cattle) over selective grazers (sheep)
- Prevent overgrazing in oribi habitats
- Implement rotational rest (at least one full growing season per camp)
- Avoid grazing on steep slopes in wet seasons to prevent erosion

As with fire, landowners must commit to compatible grazing practices. Compliance verification will be the ECO's responsibility.

9.2.3 Invasive Alien Plant Control

Invasive alien species currently reduce habitat availability and connectivity. Clearing efforts must be refocused to align with conservation objectives.

Recommendations:

- Implement strategic clearing with a goal of eradication
- Prioritize the containment of spread in grasslands area
- Prioritise drainage lines to restore habitat connectivity
- Prioritise clearing dense stands that bisect oribi habitat
- Minimise disturbance by focusing on one area at a time and working swiftly
- Monitor contractors to mitigate illegal hunting risks
- Treat felled trees with eco-friendly herbicide to prevent regrowth

9.2.4 Security

Security measures must address illegal activities such as poaching

Proactive measures:

- Develop a site-specific security plan identifying current threats and hotspots
- Establish regular patrols (e.g., by horseback rangers who also collect ecological data)
- Maintain fencing, refurbish collapsed sections, and install 'No hunting' boards with Oribi/Dog image as well as no trespassing warning signs
- Explore feasibility of installing a controlled-access gate at R65 intersections to monitor use with cameras
- Deploy both real and dummy cameras as deterrents
- Collaborate with neighbouring farmers on intruder detection
- Forward illegal access records from ecological monitoring to the security team
- Employ drones for surveillance
- Coordinate with Stock Theft Unit and SAPS, and understand relevant legislation and procedures for dog impoundment

Reactive measures:

- Collect evidence (photos, statements) to support prosecution
- Report incidents to Stock Theft Unit and SAPS
- Keep records to identify security weaknesses and patterns

9.2.5 Fencing

Fencing must allow gene flow while preventing injury and illegal access.

Recommendations:

- Ensure fencing allows for oribi to move safely underneath the fence. If Bonnox fencing is used ensure that bottom sections close to the ground is removed or rolled up to allow oribi movement. Single strand fencing such as 5-strand cattle fencing can be used to make snares and best avoided.
- Avoid barbed wire due to injury risk; retrofit existing barbed wire if not removed during construction
- Conduct regular patrols to inspect fences and remove snares
- Maintain all fences in good condition
- Do not create deliberate holes as these can be targeted for setting snares; instead, ensure the entire fence is permeable to small fauna.

9.2.6 Local Community Support

- Provide financial support to local veterinary services for vaccination and sterilisation campaigns to reduce transmittable disease and number of stray/unwanted dogs and cats
- Ascertain measures to reduce stray dogs and livestock in oribi habitat such as sponsoring fencing around homesteads. Importantly ensure measures do not inadvertently further increase threats to oribi (i.e. fencing used for snares). Measure efficacy of support measures.

9.2.7 Disturbance

Human disturbance can lead to habitat avoidance. The impact of construction is expected to be greatest. Where possible, disruptive construction activities should occur outside key foraging periods (early morning, late afternoon, night) and avoid lambing season. All personnel must remain within designated construction areas at all times. Unauthorized access or movement into surrounding natural

areas (i.e. wandering into the veld) is strictly prohibited to prevent disturbance to sensitive habitats and wildlife. This must be communicated during site inductions, and non-compliance may result in disciplinary action.

There is currently no literature on wind turbine operational impacts on oribi and other African terrestrial fauna. Monitoring will assess behavioural and habitat use changes. Mitigation (e.g., oribi refuge) may be adopted based on findings.

9.2.8 Predator Control

While mesopredators (such as black-backed jackal and caracal) may impact oribi populations, there is insufficient evidence to support targeted predator control. Furthermore, control efforts (especially with dogs) may introduce disturbance. Therefore, no predator control methods should be implemented to conserve oribi until evidence suggest otherwise. Presence on site will form part of the monitoring activities.

9.3 Oribi Monitoring

9.3.1 Population Monitoring

Monitoring is essential to assess subpopulation status and management outcomes, though ecological complexity and resource constraints must be acknowledged. Scientifically led monitoring methods provide data invaluable for informing conservation strategies and management plans to ensure long term survival of the species. Oribi can be extremely difficult to monitor due to their hiding out behaviour, as such the best time to conduct population estimates are when firebreaks are flushing new green growth as these attract oribi to graze in the open making them more visible, alternatively monitoring can also be done when block burns are conducted as the oribi will flush (Marchant pers. comm. 2025). Monitoring should start prior to construction to establish baseline status and population estimates. A pilot survey is required to establishing appropriate monitoring protocol by testing different monitoring methods. Dataset from pilot survey can be used for baseline population status if dataset is found to be adequate, however additional data collection may be required.

9.3.2 Baseline Population Status (i.e. Year 1-2):

- Establish baseline population estimates
- Establish current subpopulation distribution and habitat use to determine important oribi areas
- Establish current threats, including presence of predators on site
- Establish site specific monitoring protocol, including appropriate methods for monitoring species at the site (camera trapping, drone, transect and point counts).
- Identify wildlife corridors
- Monitor during lambing season for breeding population status

9.3.3 Construction Phase (Year 2/3)

- Monitor all identified subpopulations
- Record level of disturbance (noise/human activity/visual disturbance)
- Record oribi movement and displacement
- Record activity patterns
- Provide adaptive management recommendations

9.3.4 Operational Phase (Year 3-8)

- Ongoing annual monitoring of oribi subpopulation
- Review monitoring data annually to assess the effectiveness of interventions

- Management actions and mitigation based on monitoring data
- Monitoring of oribi with fire management, invasive alien plant management, anti-poaching efforts

9.3.5 Monitoring methods:

9.3.5.1 Habitat suitability

Identify and assess all areas potentially suitable to support oribi subpopulations using key indicators of habitat attributes for grassland areas large enough to support oribi. Indicators should include food abundance and quality, habitat structure, level of anthropogenic disturbance, and predator abundance to create different levels of habitat suitability. Provide habitat suitability score, ranging from 0–100%.

9.3.5.2 Camera Trap Survey:

Using high-performance camera trap models, design and conduct a systematic and targeted camera trap survey to maximize detection of oribi and other species/sites of importance providing information on demographics, activity pattern, corridors, human activity, predator activity, domestic dog activity and other species presence including relative abundances.

Ascertain oribi distribution for occupancy estimates and habitat use. Analyse using occupancy models in R to estimate detection, naïve occupancy, station use, and habitat variables.

Establish the latency to first detection and determine the minimum duration required for effective camera trap surveys in monitoring oribi populations. To ensure reliable detection probabilities and meet population closure assumptions, surveys should run for a minimum of 45 days, with extensions up to 90 days where feasible. This duration balances the need for sufficient detection events while minimizing the risk of demographic or spatial changes within the population during the sampling period.

Camera trap survey should be conducted in winter for better visibility and sensor performance.

9.3.5.3 Transect Counts

Establish transects in oribi habitat. Traverse habitat early morning by foot, vehicle, or horseback, recording oribi sightings. For each sighting record distance, group size and composition. Transect counts should be done to coincide when firebreaks have new green flush which attract oribi making them more visible (Marchant pers comm.). Estimate oribi density

9.3.5.4 Point Count Survey

Conduct point count surveys from identified vantage points. Collect group and demographic data and other habitat variables. Estimate oribi density.

9.3.5.5 Drone Survey

Establish suitability of drone surveys in identified oribi habitats/areas. Ascertain suitability of drone surveys in different weather conditions (i.e. wind/mist).

9.3.5.6 GPS collar

Capture and fit GPS collar on individuals from different oribi groups to collect high-resolution spatial data to record movement patterns, habitat utilization, identify corridors and threats. Apply and obtain all required permits for capture and collaring, adhering to all regulations regarding this activity.

9.3.5.7 Anti-poaching patrols

Conduct anti-poaching patrols in collaboration with existing Stock-theft unit. Collate data on snares, poaching incidents and feral dogs to establish baseline poaching threats and measure anti-poaching and security effort from WEF.

9.3.5.8 Roadkill monitoring

Annual roadkill transects collecting records of all wildlife mortality records and identify hotspots for mitigation measures.

9.3.5.9 Incidental sightings

All oribi sightings recorded with GPS location, group size and demographics to be collected on ad hoc bases by specialist and other consultants (e.g., from anti-poaching patrols, bird monitors, carcass searchers).

9.3.5.10 Future Monitoring Additions:

Trial indirect methods (e.g., dung counts with Conservation Scent Detection Dogs). Evaluate new emerging methods as they become available.

9.4 Monitoring Area

Monitoring will focus on onsite dynamics rather than offsite control comparisons. Monitoring should extend beyond the borders of the WEF site and include all suitable areas within the broader area where turbines are visible (>5km buffer). Monitoring during construction phase must include powerline routes which may create disturbance and displace oribi that make up subpopulation.

9.5 Research

The Emvelo WEF should contribute to broader ecological knowledge. Establish partnerships with institutions (e.g., University of Mpumalanga) to initiate at least one research project.

Research priorities:

- Impacts of WEF construction and operation on habitat use and behaviour
- Mortality causes (direct and indirect)
- Effects of land management (e.g., burning, grazing) on population performance

Techniques:

- Use of satellite or radio collars to study movement, home ranges, and mortality
- DNA analysis (e.g., from dung) to study diet, stress, or genetics

10 ADAPTIVE MANAGEMENT

- Review monitoring methods after initial (pilot) survey and establish the need for further data collection for baseline dataset.
- Review monitoring data annually to assess the effectiveness of interventions.
- Adjust management actions based on population trends, habitat quality, and emerging threats.
- Integrate findings into broader biodiversity offset or stewardship programs, if applicable

11 KEY PERFORMANCE INDICATORS (KPIS)

- Stable or increasing oribi population over a five-year period.
- Maintenance or improvement of grassland habitat quality in core areas.

- Disturbance index of different areas with improvement of land through restoration.
- Reduced or Zero poaching incidents recorded annually.
- 100% compliance with buffer and no-go zone regulations by WEF staff.
- Partnership established for oribi and habitat conservation.

11.1 Workplan, roles and responsibilities

A workplan, with roles, responsibilities and targets for each management objective is provided in the tables below.

Objective: Oribi Habitat Management to promote the persistence of oribi subpopulation									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Manage fire to promote suitable oribi habitat	Before fire season, evaluate vegetation post-fire age within oribi areas. Implement planned burns in late winter or early spring for vegetation >2 years post-fire age with the goal of maintaining 30-60% young vegetation.	EWEF (Pty) Ltd Landowners	X	X	X	X	X	Vegetation structure is assessed within oribi areas. Planned burns are conducted to ensure sufficient short grass areas for oribi.	Site assessments and maps of post-fire vegetation age. Records of planned burns.	Annual assessment of post-fire age by July each year. Planned burns implement between August and September. Maintain 30-60% young vegetation in any given year.
	Dynamic map containing all firebreaks and blocks updated annualy	EWEF (Pty) Ltd Landowners	X	X	X	X	X	Map showing burnt and unburnt areas, including unplanned fires	GIS layers and maps	Annually updated and shared with fauna specialist for oribi monitoring
	Burn or mow boundary and internal firebreaks in autumn to protect site from runaway wildfires entering the site and to provide winter grazing for oribi.	EWEF (Pty) Ltd Landowners	X	X	X	X	X	Reduced probability of unplanned fires entering the property.	Records of firebreak implementation	Firebreaks burned or mowed completed by May each year.

Objective: Oribi Habitat Management to promote the persistence of oribi subpopulation										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
								Increased winter grazing for oribi within site away from boundaries (internal firebreaks)		
	Develop a fire response strategy and respond to unplanned fires.	EWEF (Pty) Ltd Landowners	X	X	X	X	X	Prevention of extensive habitat loss from unplanned fire.	Incident reports with records of responses to fire and post fire damage.	Fire response strategy finalised by end of Year 1.
Manage livestock and game in oribi habitat to promote the persistence of oribi	In consultation with the farmers, develop a grazing strategy that takes oribi and requirements into consideration. This needs to include farmland condition assessment. Maintain conservative stocking rates and provide exclusion zones (guided by Fauna Specialist) where grasses are left to grow to provide refuge for oribi.	EWEF (Pty) Ltd Landowners	X					Grazing practices do not compromise oribi conservation objectives. Grazing supports maintenance of habitat structural heterogeneity. Grazing is non-selective and does not change grass composition and prevents habitat degradation.	Grazing strategy, farmland assessment and implementation records	Grazing strategy developed by end of Year 1. Mapped exclusion zones for oribi.

Objective: Oribi Habitat Management to promote the persistence of oribi subpopulation											
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Control invasive alien plants in oribi habitat	Implement strategic clearing with a goal of eradication prioritising oribi habitat patches and connectivity between patches. Map alien infested areas to improve habitat suitability for oribi	EWEF (Pty) Ltd Landowners Invasive Alien Plant Control Contractors	X	X	X	X	X	Habitat quality and connectivity between patches improved. Tree felled with eco-friendly herbicide to prevent regrowth.	Records of control operations and follow up monitoring. Dynamic map showing areas cleared, undergoing maintenance with percentage of habitat rehabilitated	Initial clearing of priority areas by end of Year 1. Ongoing maintenance of cleared areas. Rehabilitated grassland habitats

Objective: Prevent oribi mortality from anthropogenic sources										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Increase security presence and detect and respond to incursions.	Develop a security plan that identifies security weak points, establish hotspots for illegal activities by collaborating with existing security groups, examines required security	EWEF (Pty) Ltd Security contractor	X					Security measures are implemented in a systematic manner.	Security plan.	To be developed and implemented as soon as possible.

Objective: Prevent oribi mortality from anthropogenic sources										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	infrastructure, examines required security personnel and their deployment.									
	Install surveillance cameras and 'No hunting/trespassing' warning boards at key points.	EWEF (Pty) Ltd Security contractor	X					Ability to detect incursions is improved. Surveillance cameras and boards act as a deterrent.	Number of cameras and boards installed	Cameras and boards installed within 2 months of project reaching Financial Close.
	Monitor surveillance footage to detect incursions. Employ drone for surveillance.	Security contractor	X	X	X	X	X	Incursions are detected and responded to.	Reports	Immediate response by security company to detected incursions. Incidents reported to EWEF (Pty) Ltd, EWEF (Pty) Ltd within 24 hours Quarterly summary of incidents.

Objective: Prevent oribi mortality from anthropogenic sources									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	Conduct regular patrols of the oribi along the fence-line.	EWEF (Pty) Ltd Farmers Security contractor	X	X	X	X	X	Incursions by people and animals (dogs) are detected. Snares are detected and removed. Damaged fences are detected and refurbished Additional information is gathered (oribi sightings).	Number of patrols and distance covered (verified through log sheets, pocket books, GPS tracks)	Daily fence-line patrols conducted. Patrols of oribi areas twice per week. Incidents reported to EWEF (Pty) Ltd, EWEF (Pty) Ltd within 24 hours
Reduce road mortality.	Annual roadkill transects collecting records of all wildlife mortality records and identify hotspots for mitigation measures	EWEF (Pty) Ltd	X	X	X	X	X	Establish roadkill prevalence and hotspots for mitigation	Wildlife mortality records. GPS tracks	Reduce road mortalities
	Enforce speed limits along internal roads (30 km/h)	EWEF (Pty) Ltd Security contractor Landowners	X	X	X	X	X	Probability of road mortality along internal roads reduced.	Incident reports.	Zero oribi and other wildlife mortalities within site. Any road mortalities

Objective: Prevent oribi mortality from anthropogenic sources									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
										reported to EWEF (Pty) Ltd EWEF (Pty) Ltd with 24 hours.
	Installation of speed humps along sections of road that intersect with oribi habitat and corridors.	EWEF (Pty) Ltd	X					Probability of road mortality along internal roads reduced.	Location of speed humps.	By end of Year 1.
Reduce probability of injury or mortality due to fence collisions or entanglement.	Inspect condition of fences and conduct maintenance. Remove and/or replace barbed wire fences if deemed unsafe by specialist.	EWEF (Pty) Ltd Security contractor Landowners	X	X	X	X	X	Reduced probability of injury or mortality due to fences	Records of work undertaken.	Fences continually maintained in a good state of repair.
Reduce probability of mortality due to farm management actions.	Ensure that dogs are not free roaming or utilised (e.g., for control of damage causing animals) within site	EWEF (Pty) Ltd Landowners Security contractor	X	X	X	X	X	No incidental mortality of oribi from damage causing animal control. No detection of free roaming dogs on camera traps or incidental observations	Landowner agreement.	All landowners agree to this.

Objective: Prevent oribi mortality from anthropogenic sources									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Reduce mortality due to illegal activities	Conduct regular patrols to remove snares, apprehend illegal intrusions, remove free roaming dogs. Monitor invasive alien contractors to mitigate illegal hunting.	Security contractor	X	X	X	X	X	Reduced probability of mortality due to snares, hunting dogs and illegal hunters	Record patrols (GPS tracks, records of snares, illegal activities, and dogs)	Zero oribi and other wildlife mortalities within site. Any illegal activities and hunting dogs reported to EWEF (Pty) Ltd EWEF (Pty) Ltd with 24 hours

Objective: Minimise disturbance to oribi									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Minimise disturbance during the construction of the WEF	Where possible, limit intense disturbance-causing construction activities during peak activity periods for oribi	EWEF (Pty) Ltd		X	X			Disturbance during times of peak oribi activity and lambing season is minimised.	Construction logs.	Where possible, intense disturbance-causing construction

Objective: Minimise disturbance to oribi									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	(early morning, late afternoon) and lambing period. Use findings of baseline survey to adjust understanding of oribi areas and peak activity times for oribi at the site (this will vary seasonally) as well as lambing season for oribi at the site. Construction phase to be kept as short as possible.							Monitor oribi population, including recording oribi movement and displacement	Oribi monitoring data	activity should occur outside of the hours from 08:00 to 17:00 and outside of lambing season in oribi areas. Peak period adjusted based on monitoring data.
	Confine construction activity to identified footprints and treat oribi habitat as no-go areas.	EWEF (Pty) Ltd ECO		X	X			Disturbance during times of peak oribi activity is minimised.	No evidence of construction activity outside of footprint areas.	Construction workers confined to operational areas.
Minimise disturbance during the operation of the WEF	Ensure that any maintenance activities near oribi areas happen outside periods of peak oribi activity and oribi lambing season.	EWEF (Pty) Ltd				X	X	Disturbance during times of peak oribi activity and lambing season is minimised.	Maintenance logs	No maintenance activity outside of the hours from 08:00 to 17:00 and during lambing season in oribi areas.

Objective: Minimise disturbance to oribi									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Minimise disturbance caused by farm management activities and invasive alien control contracors	Develop a set of rules for farm staff and contractors operating in oribi areas. Invasive alien contractors focus operations in one area at the time and working swiftly.	Landowners Contractors	X	X	X	X	X	Farm activities and invasive alien plant control program cause minimal disturbance to oribi subpopulations.	Set of rules for farm staff and contractors operating in oribi areas.	All landowners agree to this. Contractors to limit invasive alien control activity outside of the hours from 08:00 to 17:00 and outside of lambing season in oribi areas. Peak period adjusted based on monitoring data.

Objective: Monitor the status of the population by estimating baseline population parameters and conducting ongoing monitoring										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Conduct pilot monitoring programme to obtain a baseline understanding of population size, demographics, and distribution. Establish current threats Establish site specific monitoring protocol Identify wildlife corridors	Identify and assess all areas potentially suitable to support oribi	EWEF (Pty) Ltd	X					Key high sensitivity habitats mapped	Habitat suitability score, ranging from 0–100%.	Before construction commences.
	Conduct camera trap survey	EWEF (Pty) Ltd	X					Improved understanding of oribi distribution, population structure, minimum population size, corridors and activity patterns. Understanding of human and domestic dog activity, predator activity, and other species presence	Camera trap data	Before construction commences. Preferably in winter for improved visibility and camera trap performance.
	Conduct transect counts	EWEF (Pty) Ltd	X					Improved understanding of oribi population size and structure	Transect count data	Before construction commences. Coincide when firebreaks have new green flush

Objective: Monitor the status of the population by estimating baseline population parameters and conducting ongoing monitoring										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
										which attract oribi making them more visible
	Point Count Survey	EWEF (Pty) Ltd	X					Improved understanding of oribi population size and structure	Point count data	Before construction commences. Coincide when firebreaks have new green flush which attract oribi making them more visible
	Drone Survey	EWEF (Pty) Ltd	X					Establish suitability of drone surveys in identified oribi habitats/areas and in different weather conditions to collect information on oribi population size and structure	GPS track and oribi data	Before construction commences.

Objective: Monitor the status of the population by estimating baseline population parameters and conducting ongoing monitoring										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	Capture and fit GPS collar on oribi from different groups	EWEF (Pty) Ltd	X					Movement patterns, habitat utilization, corridor use	high-resolution spatial data	Before construction commences.
	Present an overview of population status and demographics and refine oribi and mountain reedbuck distribution maps for the site.	EWEF (Pty) Ltd	X					Monitoring outcomes accessible and informs site management. Greater understanding of the significance of the site's oribi and mountain reedbuck subpopulations.	Monitoring report.	Before construction commences.
Refine monitoring programme and conduct ongoing monitoring.	Review outcomes of pilot monitoring programme and refine monitoring programme.	EWEF (Pty) Ltd		X				Strategy for ongoing monitoring developed. Additional monitoring aspects considered.	Refined monitoring programme.	Before construction commences.

Objective: Monitor the status of the population by estimating baseline population parameters and conducting ongoing monitoring										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	Conduct ongoing monitoring.	EWEF (Pty) Ltd		X	X	X	X	Trends in oribi and subpopulations recorded. Review monitoring data annually to assess the effectiveness of interventions. Management actions and mitigation based on monitoring data	Monitoring reports.	Annual monitoring reports for the first five years, thereafter every second year for the lifespan of the facility.

Objective: Contribute to broader oribi conservation initiatives										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
Contribute to the broader understanding of	Report on monitoring results to Oribi Working Group and MPTA.	EWEF (Pty) Ltd	X	X	X	X	X	Monitoring of subpopulations informs efforts to understand the	Submissions to MPTA and Oribi Working Group.	Annual submissions.

Objective: Contribute to broader oribi conservation initiatives										
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
oribi population status.								status of the species.		
	Develop relationship with Chief of Mpumalanga Eastern Highveld Parks Agency and landowners in the broader area to understand oribi occurrence in the broader landscape for subpopulation connectivity.	EWEF (Pty) Ltd	X					Improved communication with Mpumalanga Eastern Highveld Parks Agency and Landowners. Extension support.	Correspondence with Mpumalanga Eastern Highveld Parks Agency and Landowners.	Before construction commences.
	Register as an Oribi Custodian Site.	EWEF (Pty) Ltd		X				Recognition of contribution the site is making to oribi conservation. Opportunities to communicate and collaborate with other Oribi Custodian Sites. Extension support.	Submission	Before COD.
Contribute to oribi research	Develop relationships with tertiary research institutions (e.g. University of Mpumalanga) and make the	EWEF (Pty) Ltd		X	X	X	X	Research on the ecology and management of oribi, which leads to	Records of correspondence with researchers.	At least one research project registered by end of Year 4.

Objective: Contribute to broader oribi conservation initiatives									
Subobjective	**Actions**	**Responsibility**	**Time Frames (Years)**					**Key Outcomes**	**Key Verifiers**	**Target**
			1	2	3	4	5			
	site available for oribi research.							improved understanding of potential for coexistence and effect of WEFs on oribi behaviour.		

Table 1: An annual schedule of management actions

Biological/Natural Event	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Growing season	X	X	X							X	X	X
Nutritional stress							X	X	X			
Calving (oribi)										X	X	X
Fire season						X	X	X	X	X		
Planned activities												
Planned mosaic burning							X	X	X			
Establish fire-breaks				X	X							
Invasive Alien Plant Clearing	X	X	X	X	X	X	X	X	X	X	X	X
Patrols	X	X	X	X	X	X	X	X	X	X	X	X
Camera trap survey					X	X	X	X				
Transect counts										X	X	
Point count surveys										X	X	
Roadkill monitoring										X	X	

Drone Survey										X	X	

11.2 Management plan review

This plan should be reviewed after the first year of monitoring, at the end of the five-year planning period, and thereafter every five years. The review process should consider the outcomes of the monitoring programme and be informed by an improved understanding of oribi population dynamics and habitat utilisation on the site. The review process should include a re-evaluation of threats, an evaluation of the achievement of objectives, and any lessons-learned from implementation during the first five years

12 REFERENCES

Adamczak, V.G. & Dunbar, R.I.M. 2007. Variation in the mating system of oribi and its ecological determinants. *African Journal of Ecology*, **45:**197-206

Barbeau, L. & Gopaul, S. Proposed Emvelo Wind Energy Facility and Auxiliary Infrastructure, Mpumalanga. Draft for Public Comment. Project No. 14/12/16/3/3/2/2611. Date: March 2025. ERM Southern Africa (Pty) Ltd.

Brashares, J.S. & Arcese, P. 2002. Role of forage, habitat and predation in the behavioural plasticity of a small African antelope. *Journal of Animal Ecology,* **71:** 626–638.

Coverdale B., Daly B., Friedmann Y., Lemmer F., Marchant A., McCann K., Rushworth I., & Wakelin J. 2006, *Oribi antelope (Ourebia ourebi) population and habitat viability assessment workshop report*. Conservation Breeding Specialist Group (SSC/IUCN)/CBSG Southern Africa, Endangered Wildlife Trust, Johannesburg.

Everett, P.S., Perrin, M.R., & Rowe-Rowe, D.T. 1991. Responses by oribi to different range management practices in Natal. *South African Journal of Wildlife Research*, **21:** 114–118.

Grey, R.V. 2006. *Aspects of the conservation of oribi (Ourebia ourebi) in KwaZulu-Natal*. M.Sc thesis. University of KwaZulu-Natal, Pietermaritzburg.

Grey‐Ross, R., Downs, C.T., & Kirkman, K. 2009. Is use of translocation for the conservation of subpopulations of oribi *Ourebia ourebi* (Zimmermann) effective? A case study. *African Journal of Ecology,* **47:** 409–415.

Grey-Ross, R., Downs, C.T. & Kirkman, K. 2010. An assessment of illegal hunting on farmland in KwaZulu-Natal, South Africa: implications for oribi (*Ourebia ourebi*) conservation. *South African Journal of Wildlife Research*, **40(2):** 152-161.

IUCN SSC Antelope Specialist Group. 2016. *Ourebia ourebi*. The IUCN Red List of Threatened Species 2016: e.T15730A50192202. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T15730A50192202.en. Accessed on 17 January 2024.

Louw, A.J., Pienaar, E.F., & Shrader, A.M. 2021. The biological, social, and political complexity of conserving oribi antelope (*Ourebia ourebi*) in South Africa. *Endangered Species Research*, **45:** 71–83.

Manqele, N.S., Selier, J.A., Hill, T.R. & Downs, C.T. 2018. Drivers of the illegal hunting of serval (Leptailurus serval) and oribi (Ourebia ourebi) in the KwaZulu-Natal Midlands, South Africa. *African Journal of Wildlife Research*, **48(2):** 23–34.

Patel, T., Stears, K., Little, I.T. & Shrader, A.M. 2021. Evaluating oribi translocations for conservation: the importance of translocation guidelines. *African Journal of Wildlife Research* **51(1):** 144-148

Perrin, M.R., & Everett, P.S. 1999. Habitat use by oribis at midlands elevations in KwaZulu-Natal, South Africa. *South African Journal of Wildlife Research*, **29:** 10–14.

Phukuntsi, M. A., Dalton, D. L., Mwale, M., Selier, J., Cebekhulu, T. Sethusa, M.T. 2022. Genetic patterns in three South African specialist antelope species: Threats, conservation management and their implications. *Conservation Science and Practice,* **4(12):** 1-17.

Reilly, B.K. 1989. *Ecology of a population of oribi Ourebia ourebi ourebi (Zimmerman, 1783) in the Golden Gate Highlands National Park.* M.Sc. thesis, University of Pretoria, Pretoria.

Roberts, D.H. 1986. Determination of predators responsible for killing small livestock. *South African Journal of Wildlife Research,* **16(4):** 150-152.

Rowe-Rowe, D.T., 1975. Predation by black-backed jackals in a sheep-farming region of Natal. *Journal of the Southern African Wildlife Management Association*, 5(2), pp.79–81.

Rowe-Rowe, D.T. 1982. Influence of fire on antelope distribution and abundance in the Natal Drakensberg. *South African Journal of Wildlife Research*, **12:** 124–129.

Rowe-Rowe, D.T., Everett, P.S. & Perrin, M.R. 1992. Group sizes of oribis in different habitats. *South African Journal of Zoology*, **27:** 140–143.

Shrader, A.M., Little, I., Coverdale, B. & Patel, T. 2016. A conservation assessment *of Ourebia ourebi ourebi*. In: Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D., Davies-Mostert, H.T. (Eds.) The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Skinner, J.D. and Chimimba, C.T. (eds). 2005. *The Mammals of the Southern African Subregion*. Cambridge University Press, United Kingdom, Cambridge.

Stears K, Shrader AM (2020) Coexistence between wildlife and livestock is contingent on cattle density and season but not differences in body size. PLoS ONE 15(7): e0236895. https://doi.org/10.1371/journal.pone.0236895

Tekaling, W., & Bekele, A. 2015. Diurnal activity pattern of oribi (*Ourebia ourebi*) in Maze National Park, Ethiopia. *International Journal of Ecology & Ecosolution*, **2:** 31–35.

Trollope, W.S.W. 2007. Fire—a key factor in the ecology and management of African grasslands and savannas. Pages 2–14. In: Masters, R.E. & Galley, K.E.M (Eds.). Proceedings of the 23rd Tall Timbers Fire Ecology Conference: Fire in Grassland and Shrubland Ecosystems. Tall Timbers Research Station, Tallahassee, Florida, USA.

van Vuuren, B. J., Rushworth, I., & Montgelard, C. 2017. Phylogeography of oribi antelope in South Africa: evolutionary versus anthropogenic panmixia. *African Zoology*, **52(4):** 189–197.

APPENDIX 1: SPECIALIST CURRICULUM VITAE AND SACNASP CERTIFICATE

Mrs Aliénor (Eleanor) Brassine
Pr. Sci. Nat. (Ecological Science)
Faunal & Avifaunal Specialist
National Geographic Explorer
Photographer
Email: alienor.brassine@gmail.com
Tel: +27 (0)76 494 6881
Address: Hoedspruit, Limpopo

WORK HISTORY

- 2015 - Present: Independent **Fauna & Avifaunal Specialist,** registered **Professional Natural Scientist** in the discipline of Ecological Science with South African Council for Natural Scientific Professions **SACNASP Reg. no: 116197**

    - **Fauna Specialist Studies**: Faunal Species of Conservation Concern (SCC) assessments and management plans for Renewable Energy Facilities and other clients. **SCC:** Riverine Rabbit, Oribi, Blue Duiker, Mountain Reedbuck, Cheetah, Brown Hyena. Clients: Hive Hydrogen South Africa (Pty) Ltd & AMDA Developments (Pty) Ltd; Coastal and Environmental Services (Pty) Ltd; Khabasi North (Pty) Ltd; Bohemian Scientists; EnviroWorks; Simon Todd Consulting; Arcus Consulting (Pty) Ltd; Mulilo Renewable Project Developments (Pty) Ltd; Private Landowners

    - **Avifaunal and Raptor Nest Surveys** for Renewable Energy Facilities. Clients: Wildskies Ecological Services Pty Ltd, Chris van Royen, Hollands and Associates Environmental Consultants, Arcus Consulting (Pty) Ltd

    - **Ingwe Research Program:** Provided strategic input on survey design for leopard monitoring, guiding research priorities and methodologies, facilitated networking with relevant stakeholders and review of budget and proposals.

    - **Assessor** for the **Riverine Rabbit** and **Oribi Red List Assessment 2023-2025**

    - **Bat Studies** and **Equipment Installation.** Clients: Animalia, Arcus Consulting Pty Ltd

- **The National Geographic Okavango Wilderness Project:** collaboration for analysis and publication of camera trap data of Angolan highland mammal surveys.

- **The Endangered Wildlife Trust, Cheetah Metapopulation Project:** data management and cheetah identification for the Kruger Cheetah Census

- 2015 - Present: **Co-owner** and **Photographer** for **Lodge Shots** (www.lodgeshots.com) Marketing photography of tourism establishments in Africa

- 2015, 2016, 2017, 2019: **Coordinator and teacher** for **Leeds University** (UK) African Ecology Field Courses (South Africa)

- 2015: **Teaching assistant** for **Arizona State University** (USA) study abroad Wildlife Ecology program in South Africa in partnership with Rhodes University

- 2014: **MSc candidate** and **demonstrator** for 3rd year Zoology students at **Rhodes University**

- 2011 – 2013: **Cheetah Researcher** at *Mashatu Nature Reserve, Botswana* and ***National Geographic Explorer*** and founder of ***The Northern Tuli Cheetah Project***.

- 2011 **Horseback safari guide** at **Horizon Horseback Safari**

- 2010: **French and English foreign language teacher** for ***AYC Intercultural Programmes,*** Thailand

- 2009: **Zoology tutor** for university students studying Cell Biology and Zoology at **Rhodes University**, South Africa.

EDUCATION & QUALIFICATION

- **Master of Science** in Zoology, Rhodes University (2015)
- **BSc Honours** in Zoology (African Vertebrate Biodiversity), Rhodes University (2009)
- **Bachelor of Science** Zoology & Entomology, Rhodes University (2006-2009)
- **SASSETA-accredited K9 Dog Handler** (DH5) for scent detection (2021) with trained and certified Conservation Scent Detection Dogs
- Permit to Operate **Work at Height** and **Fall Arrest Technician** (2018-2021)
- **FGASA level 1**: South African field guide's license (2011)
- **TEFL** (Teaching English Foreign Language) (2010)
- **HIGCSE** (University of Cambridge International Examinations): Biology (1), French (1), Geography (1), Maths (2), Physical Science (2), English (3), St Paul's College - Namibia (2001-2005)

WORK EXPERIENCE & SKILLS

- **Faunal Assessments:** Specialist Faunal Assessments for renewable energy projects. Site Sensitivity Verification, Screening and Basic Assessment including species-specific management plans for Species of Conservation Concern (Riverine Rabbit, Southern Mountain Reedbuck, Blue Duiker, Oribi, Brown Hyena and Cheetah). Implementation of all aspects of surveys including survey design, data analyses and scientific reporting.

- **Avifaunal surveys:** Specialist Avifaunal Site Sensitivity Verification and Screening assessment including Raptor Nest Surveys and other important bird habitat study.
- **Scent-Dog training and handler with scent detection K9** for the detection of rare species substances (scats): Cheetah, Riverine Rabbit, Black-Footed Cat, Brown Hyena, Wild Dog, and Blue Duiker
- **Bat Monitoring:** SongMeter and equipment installation, setup, downloads & maintenance.
- **Work at Heights:** installation of bat microphones on Meteorological (Met) Masts and Wind Turbines.
- **Ecological survey techniques**: questionnaires/interviews, photographic survey, collaring and radio tracking large predators, pit fall trap, small-mammal (Sherman trap) surveys and bird mist-netting.
- **Managing research projects**: proposal writing and project fundraising, responsible for time, financial and personnel management, data collection, data analysis and reporting.
- **Co-supervisor to university students**, including coordinating and teaching student ecology field courses
- **Collaboration and Consulting work:** Provide strategic input on survey design, research project development and planning.
- Microsoft Office proficiency and familiar with a range of IT software applications including GIS and Statistical software.
- Excellent interpersonal and communication skills
- Excellent knowledge of southern African mammals and birds

AWARDS

2014 - **Rhodes University Postgraduate Scholarship**

2014 - **NRF Innovation Master Bursary**

2014 – **Rhodes University Full Colours** – Sports Council award

2012 – 2013 - **National Geographic Big Cats Initiative Grant**

2012 – 2013 – **Rufford Small Grant**

2012, 2024 – **Idea Wild** funding

2012 – **Zoofaris & Wildwonders** funding

2009 – **Rhodes University Half-colours** – Sports Council award

REFERENCES

John Power
Biodiversity Specialist: Mammals
Department of Economic Development, Environment, Conservation & Tourism
North West Provincial Government
John.safaris@gmail.com
+27 76 198 2502

Christy Bragg
Fauna Specialist
Bohemian Scientist
christy.porcupine@gmail.com
+27 82 332 5447

Jon Smallie
Avifauna Specialist
WildSkies Environmental Services
jon@wildskies.co.za

+27 824448919

PUBLICATIONS

- BRASSINE, E. & PARKER, D. 2015. Trapping elusive cats: using intensive camera trapping to estimate the density of a rare African felid. PLOS ONE 10(12): e0142508. doi:10.1371
- BRASSINE, E. 2014. The cheetahs of the Northern Tuli Game Reserve, Botswana: Population estimates, monitoring techniques and human-predator conflict. MSc thesis. Rhodes University. Grahamstown
- CRAIG, C. A., BRASSINE, E. I. AND PARKER, D. M. 2017. A record of cheetah (*Acinonyx jubatus*) diet in the Northern Tuli Game Reserve, Botswana. Afr. J. Ecol. doi:10.1111/aje.1237
- COOMBS, G., DOLD, A.P., BRASSINE, E.I. & PETER, C.I. 2012. Large pollen loads of a South African asclepiad do not interfere with the foraging behavior or efficiency of pollinating honeybees. *Naturwissenshaften:* DOI 10.1007/s00114-012-0932-2
- VAN DER WEYDE, L. K., et al. (2021). Collaboration for conservation: Assessing countrywide carnivore occupancy dynamics from sparse data. *Diversity and Distributions*:1–13. https://doi.org/10.1111/ddi.13386
- VILLET, M.H. & BRASSINE, A. 2025. Predation of paper wasp (Hymenoptera: Vespidae) brood by the fruit chafer *Oplostomus fuligineus* (Oliver, 1789) (Coleoptera: Scarabaeidae): apicultural and conservation implications. *Journal of Natural History,* 59:21-24, 1725-1724, DOI: 10.1080/00222933.2025.2501396

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Eleanor Iseult Brassine

Registration Number: 116197

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Ecological Science (Professional Natural Scientist)

Effective **21 September 2016** Expires **31 March 2026**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

*cc



Terrestrial Biodiversity Assessment

Mulilo Amsterdam WEF Complex: Emvelo

Date: 07/02/2025
Version: Draft Report
Author: J. Pote

Terrestrial Biodiversity Assessment

Mulilo Amsterdam WEF Complex: Emvelo

Compiled by: **Jamie Pote** (Pr. Sci. Nat.)
Postnet Suite 57, Private Bag X13130, Humewood, Port Elizabeth, 6013, South Africa
jamiepote@live.co.za +27 (0)76 888 9890

Compiled for: **ERM Southern Africa (Pty) Ltd**

Date of report: **07/02/2025**

Draft Report

This Report has been prepared with all reasonable skill, care, and diligence within the scope of appointment by Mr Jamie Pote, with consideration to the resources devoted to it by agreement with the client, incorporating our Standard Terms and Conditions of Business.
This Report is prepared exclusively for use by the client, and the author disclaims any liability in respect of its use by any party other than the client and for the purpose for which it was written. The Report is subject to all the copyright and intellectual property laws and practices of South Africa and contains intellectual property and proprietary information that is protected by such copyright in favour of the author. No person, other than the client, may reproduce, distribute to any third party, or rely on the content of any portion of this report, without the prior written consent of the author. The author accepts no responsibility of whatsoever nature to third parties to whom this Report, or any part thereof, is made known. Any such persons or parties rely on the report at their own risk.

Revisions

Report/Revision Version:	Date:	Approved by:
First Draft	07/02/2025	Jamie Pote
Revisions/Comments		
Final Report		

Table of Contents

Revisions ii
Table of Contents i
List of Tables iii
List of Figures iii
1 Introduction & Background 1
1.1 Background 1
1.2 Purpose of Report 1
1.2.1 Report Structure 1
1.3 Project Description 2
1.3.1 Activity Location and Description 2
1.3.2 Data sources and references 5
1.4 Methodology and Approach 5
1.4.1 Aspects of the project that could potentially have Biodiversity related Impacts 6
1.4.2 Assumptions, Uncertainties and Gaps in Knowledge 6
1.5 Site visit 7
2 Legislation Framework 7
2.1 Systematic Planning Frameworks 10
2.1.1 DFFE National Environmental Screening Tool 13
2.1.2 Vegetation of Southern Africa 15
2.1.3 Red List of Ecosystem Status and National Biodiversity Assessment 15
2.1.4 Mpumalanga Biodiversity Conservation Plan (MBCP, 2006) 18
2.1.5 Mpumalanga Biodiversity Sector Plan (MBSP, 2014): Terrestrial 18
2.1.6 Other Biodiversity Sector Plans 21
2.1.7 Freshwater Ecosystem Priority Areas 21
2.1.8 Strategic Water Source Areas 24
2.1.9 Regional Hotspots and Centres of Endemism 24
2.1.10 Key Biodiversity Areas 25
2.1.11 Protected Areas 26
2.2 Vegetation, Flora & Fauna and Ecological Processes 29
2.2.1 Critical Biodiversity Areas: Terrestrial 29
2.2.2 Ecological Support Areas: Terrestrial 29
2.2.3 Critical/Important Terrestrial Habitats 29
3 Biodiversity Risk Identification and Assessment 30
3.1 Terrestrial Biodiversity Baseline Description 30
3.1.1 Topography and Drainage 30
3.1.2 Terrestrial Landscape Features Overview 30
3.1.3 Primary Vegetation and Habitat 31
3.1.4 Mapped Vegetation (Habitat) 34
3.1.5 Flora 43
3.1.6 Fauna 48
3.1.7 Aquatic Habitat 51

3.1.8 Terrestrial Vegetation Sensitivity Assessment 52
3.1.9 No-Go Areas 55
3.1.10 Critical Habitat 55
3.1.11 Potential Development Footprints 55
3.2 Risks and Potential Impacts to Biodiversity 57
3.2.1 Potential Terrestrial Biodiversity Impacts (Direct) 57
3.2.2 Impacts and Risks to Irreplaceable Biodiversity Resources 58
3.2.3 Residual Risks and Uncertainties 58
3.3 Assessment of Potential Impacts to Biodiversity 58
3.3.1 Impact Assessment Methodology 58
3.4 Assessment of Impacts 61
3.4.1 Assessment of Direct Impacts 61
3.4.2 Assessment of Indirect Impacts 68
3.4.3 Assessment of Cumulative Impacts 68
3.4.4 Terrestrial Biodiversity Impact Reversibility 70
3.4.5 Impacts and Risks to Irreplaceable Biodiversity Resources 70
3.4.6 Residual Risks and Uncertainties 70
3.4.7 Implications of Biodiversity Offset Guidelines 70
3.5 Environmental Management Plan Recommendations 72
3.5.1 Planning & Design 72
3.5.2 Construction 73
3.5.3 Operation 77
3.6 Findings and Recommendations 78
3.6.1 Overview of Findings 78
3.7 Implementation Plans 83
3.7.1 Site Preparation and Vegetation Clearing Plan 83
3.7.2 Rehabilitation and Landscaping Plan 83
3.7.3 Alien Vegetation Management Plan 84
3.7.4 Open Space Management/Conservation Plan 84
3.7.5 Maintenance Management Plan 84
4 Organizational Capacity and Competency 84
5 Emergency Preparedness and Response 84
6 Stakeholder Engagement 84
7 Appendices 85
7.1 Appendix 1: References 85
7.2 Appendix 2: Site Photos 88
7.3 Appendix 3: Flora Species Lists 92
7.3.1 Flora 92
7.3.2 Fauna 98
7.4 Appendix 4: Systematic Conservation Planning: Further Information 105
7.4.1 Vegetation of Southern Africa 105
7.4.2 Mpumalanga Biodiversity Sector Plan (MBSP, 2014) 107

7.4.3 Mpumalanga Biodiversity Sector Plan (MBSP, 2014): Aquatic 116
7.4.4 Vegetation & Ecological Principles 121
7.5 Appendix 5: Abbreviations & Glossary 124
7.5.1 Abbreviations 124
7.5.2 Glossary 125
7.6 Appendix 6: Biodiversity Environmental Management Plan 131
7.6.1 Protection of Flora and Fauna 131
7.6.2 Alien and Invasive Plan Management Plan 131
7.6.3 Fires 132
7.6.4 Soil Aspects 132
7.6.5 Dust 132
7.6.6 Infrastructural Requirements 133
7.6.7 Rehabilitation Plan 134
7.6.8 Monitoring and Reporting 136
7.6.9 Closure objectives and extent of alignment to pre-construction environment 136
7.7 Appendix 7: Specialist Declaration, Profile & Registration 137
7.8 Appendix 8: Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity 154

List of Tables

Table 1: Technical Specifications. 2
Table 2: Summary of Regional Planning Biodiversity features. 11
Table 3: Summary of DFFE National Environmental Screening Tool designations. 13
Table 4: List of Protected Areas in vicinity 26
Table 5: Vegetation community areas (Emvelo site). 31
Table 6: Flora including Species of Special Concern (Endangered species in **bold**) flagged for the WEF site and grid. 44
Table 7: Fauna Species of Special Concern 49
Table 8: Alien (exotic) invasive and other weed species and status. 50
Table 9: Sensitivity Summary for the site. 53
Table 10: Potential Impacts to Terrestrial Biodiversity 57
Table 11: Biodiversity Offset Guidelines Status for vegetation units represented on site. 71
Table 12: Summary of map categories shown in the terrestrial CBA map for Mpumalanga, and their meanings. 108
Table 13: Map categories, definitions, and desired management objectives 110
Table 14: Land-use guidelines for terrestrial Critical Biodiversity Areas 113
Table 15: Land-use guidelines for aquatic Critical Biodiversity Areas. 119

List of Figures

Figure 1: Site location, surrounded commercial farmland, with a fragmented mozaic of cultivated lands, plantations and natural vegetation. 3
Figure 2: Aerial Photo overview of the Emvelo WEF site and grid connection route (Sheepmoor site to the south indicated in red for reference). 4

Figure 3: Terrestrial Biodiversity Sensitivity. 14
Figure 4: Plant Species Sensitivity. 14
Figure 5: Animal Species Sensitivity. 14
Figure 6: Landscape Sensitivity 14
Figure 7: Agricultural Sensitivity. 14
Figure 8: Aquatic Sensitivity 14
Figure 9: National Vegetation Map (2018) and National Biodiversity Assessment Status (2022). 16
Figure 10:Coverage and remaining extent of affected vegetation units (National Vegetation Map, 2018). 17
Figure 11: Mpumalanga Biodiversity Sector Plan (MBSP, 2014) – Terrestrial Overview. 19
Figure 12: Mpumalanga Biodiversity Sector Plan (MBSP, 2014) – Terrestrial (site). 20
Figure 13: Aquatic Resources Map indicating Rivers, Watercourses, Wetlands & NFEPA. 22
Figure 14: Aquatic Resources Map indicating Rivers and SWSA. 23
Figure 15: Protected Areas and Important Bird Areas (IBA's) in proximity to the site. 27
Figure 16: Protected Areas and designated NPAES areas in proximity to the site. 28
Figure 17: Aerial Photo of the Emvelo Wind Energy Facility site with layout indicated. 32
Figure 18: On-site mapped vegetation communities and/or habitat units. 33
Figure 19: Locality of known records of flagged Flora Species of Conservation Concern in relation to the site and OHL. 47
Figure 20: Overall Terrestrial Biodiversity Sensitivity Map. 54
Figure 21: Overall Terrestrial Biodiversity Sensitivity Map with actual turbine sensitivity indicated. 56
Table 22: Defining the significant in terms of the impact criteria. 59
Figure 23: Map indicating potential cumulative impacts resulting from nearby renewable energy projects. 69

1 Introduction & Background

1.1 Background

Respective Special Purpose Vehicles (SPV's) are proposing the development of a commercial wind farm cluster that is expected to comprise three separate (up to 360 MW) Wind Energy Facilities (WEFs). Each WEFs will apply for its own grid connection route to connect to the existing Eskom Uitkoms Substation, via approximately 20 – 30 km long 132 kV overhead transmission lines. The powerlines are proposed and should be assessed within a 300 m assessment corridor each. The proposed development sites are located near Ermelo and fall within the Msukaligwa Local Municipality and the Gert Sibande District Municipality, in the Mpumalanga Province. The two WEF facilities are **Sheepmoor WEF** and **Emvelo WEF** with the respective SPV's being Sheepmoor Wind Energy Facility (Pty) LTD and Emvelo Wind Energy Facility (Pty) LTD. A third facility, namely Rochdale WEF was initially proposed but has been absorbed into two remaining proposed facilities. This specific Scoping Report, which provides a high-level background and risk assessment of the site as well as the terms of reference for the full assessment in specific to the **Emvelo WEF and associated infrastructure (including grid connection)**.

The purpose of this report is a terrestrial biodiversity assessment of the **Emvelo WEF** site including infrastructure to assess potential terrestrial biodiversity risks to the proposed project as per the terms of reference provided in the relevant section of this report. Since the **Sheepmoor** and **Emvelo WEFs** are adjacent to each other and occupy a similar landscape and habitat the baseline description will include both sites and the *Area of Influence*, whereas the assessment portion of the report will assess the specific project (i.e. **Emvelo WEF**).

1.2 Purpose of Report

The purpose of this report is to undertake a terrestrial biodiversity assessment of the proposed WEF project. This terrestrial biodiversity assessment report has been compiled with reference to the reporting requirement for:

- **Terrestrial Biodiversity Assessment** as per the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA (GNR 320), **as gazetted on 20 March 2020.**
- **Terrestrial Plant species** themes as per the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of sections 24(5)(a) and (h) and 44 of NEMA, **gazetted** on **30 October 2020.**

The principles that guide this process include protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources which are fundamental to sustainable development. Note: The terrestrial assessment component will include some general faunal aspects as per the reporting requirements but does not constitute and animal or faunal species assessment.

1.2.1 Report Structure

This report has been structured and written to provide background information and assessment relating to the various relevant terrestrial biodiversity and plant species topics, primarily for the for the unfamiliar reader. Specific observations and analyses of the project in relation to the various topic are indicated in green text. Text boxes at the end of each section summarise the implications of the aspect under consideration in relation to the specific project. Summary information tables are provided, including a synopsis of applicable regional planning aspects (Table 2). A general description of the systematic

conservation planning components as well as further information is provided in Appendix C: Systematic Conservation Planning for reference purposes.

1.3 Project Description

1.3.1 Activity Location and Description

The WEF cluster is situated between approximately 25 and 40 km east of Ermelo within the Mpumalanga Province (Figure 1). The specific **Emvelo** facility assessed in this report is indicated purple in Figure 1 below and further technical information is contained in Table 1. The proposed activity will be to construct three separate wind energy facilities, which will feed into the national grid, being accessible in proximity as the site is near coal power generating facilities and existing transmission powerlines at Camden.

The proposed **Emvelo WEF** site is comprised of several farm portions with a total area of approximately 7 020 Ha, of which the approximate total anticipated WEF footprint of 180 Ha will constitute 3.5 % of the farm area. The site is situated within a predominantly commercial farming area, generally comprising beef farming with dryland grazing and dryland pastures and crops including maize. Several coal mines are present in the broader landscape, as well as coal fired power stations. The area falls within a moderate to high summer rainfall area.

Table 1: Technical Specifications.

Developer / Applicant	**Emvelo Wind Energy Facility (Pty) LTD**
DFFE Reference	TBC
WEF Generation Capacity	Up to 260 MW
Site Access	Via R65 & Secondary farm roads. Total width up to 15 m (12 m after rehabilitation) consisting of up to 3 m width for underground 33 kV reticulation.
Farm portion extent	2 354.4 Ha + 2 288.8 Ha (4 643.2 Ha) 7 638.5 Ha + 575.6 Ha +374.5 Ha (13 231.8 Ha)
Total WEF footprint (approximate)	160 Ha (~3.5 %)
Number of Turbines	Up to 40 WTG (~19.2 Ha)
Hub Height from ground level	Up to 150 m
Blade Length	Up to 110 m
Rotor Diameter	Up to 220 m
Length of internal roads	~40 km (~160 Ha, a portion shared with Sheepmoor WEF.)
Width of internal roads	Up to 12 m to be rehabilitated to up to 9 m.
On-site substation capacity	Up to 132 kV
Proximity to grid connection	Approximately 30 km
Grid Connection Capacity	Up to 132 kV
Temporary turbine construction laydown and storage areas.	Crane platforms & Hardstand laydown area up to 40 Ha (Up to 0.8 Ha per WTG)
Permanent footprint area dimensions, incl. WTG Hardstand areas, roads, O&M buildings & BESS.	O&M: Up to 1 Ha Hardstand areas: Up to 1 Ha Total area of final footprint (including roads): up to ~180 Ha
Operations and maintenance buildings (O&M building) with parking	Up to 0.5 Ha
BESS Area	Approximately 400 x 400 m
Height of fencing	2.8 m
Type of fencing	Where site offices are required, temporary screen fencing used to screen offices from the wider landscape.

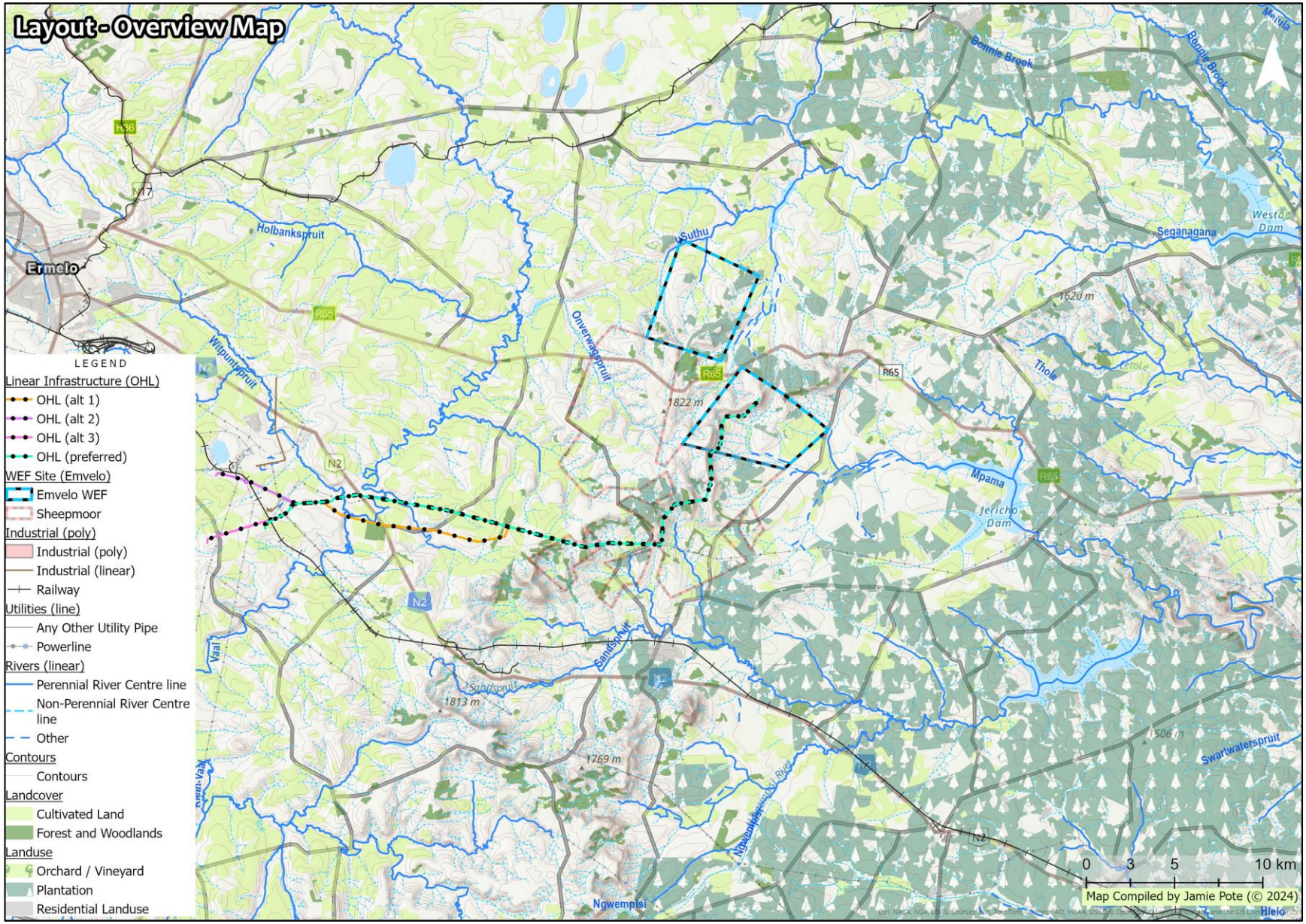


Figure 1: Site location, surrounded commercial farmland, with a fragmented mozaic of cultivated lands, plantations and natural vegetation.

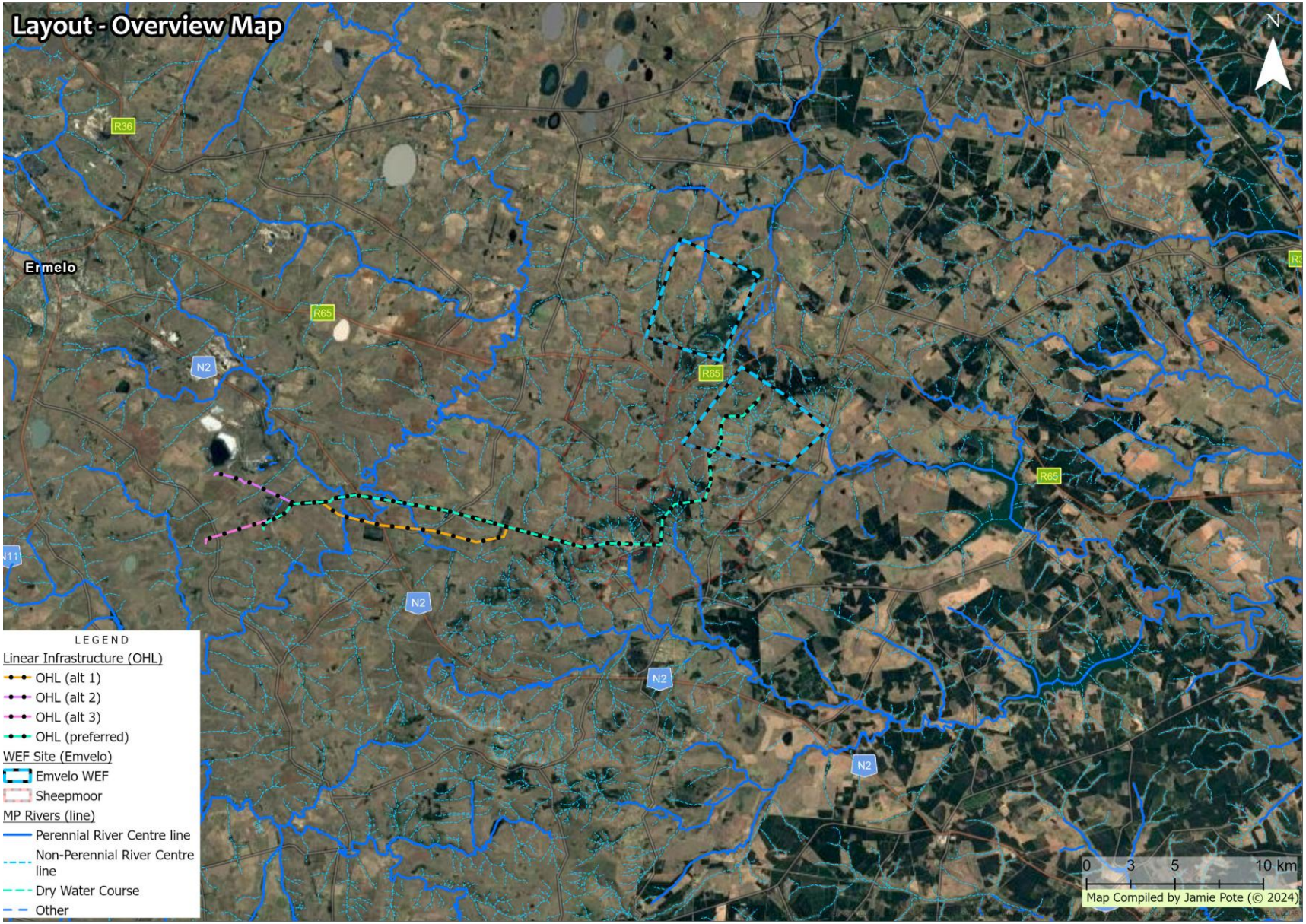


Figure 2: Aerial Photo overview of the Emvelo WEF site and grid connection route (Sheepmoor site to the south indicated in red for reference).

Emvelo WEF

Emvelo WEF is proposed to comprise 24 turbines with a maximum output capacity of up to 260 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 20 – 25 years. The final design which will be requested for approval in the EA, has been determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design.

It is proposed that an on-site substation with a capacity up 132 kV and an up to 132 kV Overhead Powerline (OHPL) of approximately 30 km (300 m corridor) in distance, traversing eighteen (18) land parcels and be constructed to connect the proposed WEF to the Eskom Uitkoms Substation located to the south-west near Camden.

1.3.2 Data sources and references

A comprehensive list of references, including data sources is provided in Section 7.1. Data sources that were utilised for this report include the following:

- National (DFFE) Web Based Screening Tool – to generate the sites potential environmental sensitivity.
- National Vegetation Map 2018 (NVM, 2018), Mucina & Rutherford (2006) and Red List of Ecosystem Status (RLE, 2022) – description of vegetation types, species (including endemic) and vegetation unit conservation status.
- Regional Systematic and Bioregional Planning frameworks, guidelines and GIS data sources.
- National and Regional Legislation including Provincial Conservation Acts and Ordinances. NEM:BA Threatened or Protected Species (ToPS).
- Botanical Database of Southern Africa (BODATSA) and New Plants of Southern Africa (POSA) – lists of plant species and potential species of concern found in the general area (SANBI).
- International Union for Conservation of Nature (IUCN) - Red List of Threatened Species.
- Global Biodiversity Information Facility (GBIF) – potential faunal species.
- National Freshwater Ecosystem Priority Areas assessment (NFEPA, 2011) - important catchments.
- National Protected Areas Expansion Strategy (NPAES, 2010 & 2018) and South Africa Protected Area database (2020) – protected area information.
- Sub-Topical Ecosystem Planning (STEP, 2002) – Bioregional Plan.
- SANBI BGIS – All other biodiversity GIS datasets.
- Aerial Imagery – Google Earth, Esri, Chief Surveyor General (http://csg.dla.gov.za).
- Cadastral and other topographical country data - Chief Surveyor General (http://csg.dla.gov.za).
- Other sources include peer-reviewed journals, regional and local assessments, and studies in the general location of the project and its area of influence, landscape prioritization schemes (Key Biodiversity Areas), systematic conservation planning assessments and plans (as above), and any pertinent masters and doctoral theses, among others.

Since separate fauna, avifauna and bat assessments have been undertaken by appropriate specialists, this terrestrial biodiversity assessment does not include any comprehensive analysis of these aspects.

1.4 Methodology and Approach

The assessment approach includes the following, as well as in accordance with the respective terrestrial biodiversity and species reporting protocols:

1. Undertake a comprehensive desktop study to identify potential risks for terrestrial biodiversity inclusive of the national screening tool, relevant regional biodiversity planning frameworks, any previous studies as well as interrogation of applicable databases.

2. Undertake seasonal site visits including a preliminary site visit to inform layout design, specifically in terms of broader landscape processes, followed by a more comprehensive site visit in order to assess undertake seasonal sampling and potentially the specific layout options, depending on project timeline.
3. Detailed reporting will be comprised of a *Terrestrial Biodiversity and Aquatic Screening Report*. The screening report will address the following (in line with the gazetted Assessment Protocol requirements):
    a. Indicate any assumptions made and gaps in available information. Assessment of all the vegetation types and habitat units within the relevant Regional Planning Frameworks.
    b. A desktop-based species list (flora and fauna) highlighting any potential species of special concern categories (endemic, threatened, Red Data species and other protected species requiring permits for destruction/relocation and invasive/exotic weeds) that could be present. Indicate the need for any permitting/licensing or detailed studies that may be required. Site visit will include limited screening for species, but being out of season, it will be limited.
    c. Aquatic screening will serve to identify and preliminarily assess aquatic features and processes including watercourses and wetlands and recommend no-go areas associated with these features.
    d. Description and assessment of the vegetation/habitat units and site sensitivities ranked into very high, high, medium, low, or very low classes based on potential sensitivity and conservation importance using a standardised methodology (desktop based).
    e. A site ecological sensitivity map will be compiled, indicting the sensitivities as described above, inclusive of any aquatic features as far as possible using most recent available aerial photography. No site verification will be conducted.
    f. A map indicating any buffers to accommodate Regional Planning requirements (if required).
    g. Recommendations based on the findings of the assessment.

This terrestrial biodiversity Scoping Report is aligned with the requirements of the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation (GN 320, 20 March 2020).

1.4.1 Aspects of the project that could potentially have Biodiversity related Impacts

The proposed project will require clearing of vegetation for construction of the WEF facility (WEF turbines, hardstands, laydown areas, and other operational and maintenance infrastructure), as well as infrastructure including access roads and grid connections (i.e. substations and powerlines).

1.4.2 Assumptions, Uncertainties and Gaps in Knowledge

The findings and recommendations of this report may be susceptible to the following uncertainties and limitation:

- No assessment has been made of aquatic aspects relating to any wetlands, pans, and rivers/seeps, nor faunal aspects outside of the scope of a terrestrial biodiversity report. Refer to separate reports.
- Any botanical surveys based upon a limited sampling time-period, may not reflect the actual species composition of the site due to seasonal variations in flowering times. Additionally, the composition of fire adapted vegetation such as grassland may vary depending on level of maturity or time since last burn. It is also not feasible to sample every square meter of such an extensive site thoroughly, although the approach used is based on the specialists' extensive experience. As far as possible, site collected data has been undertaken to represent seasonal aspects and is supplemented with desktop and database-centred distribution data. In addition, measures are included in the project mitigations to address any shortcomings as far as possible and to reduce risks to an acceptable level.

1.5 Site visit

A preliminary overview site visit was conducted on 18 April 2023 (late autumn/early winter) for the purposes of a high-level reconnaissance of the site, followed by a further site visit between 19 & 22 June 2023 (winter) in order to undertake the preliminary screening, site sensitivity mapping and survey. A final comprehensive site visit and survey was undertaken between 09 & 13 December 2024, which constituted the summer seasonal site visit and assessment and also served to inform final layout design.

The site falls within a summer rainfall area, so the range of site visits are deemed to be adequate. The site visit and assessment are undertaken by Mr Jamie Pote, SACNASP registered ecological scientist with a BSc (Hons) degree in Botany and a BSc degree in Botany and environmental Science, with over 20 years' experience undertaking ecological and terrestrial biodiversity assessments in all habitats and vegetation biomes across Southern, Western & Central Africa.

2 Legislation Framework

In terms of NEMA EIA Regulations (07 April 2014, as amended), the following specific listing notices have bearing on the proposed activity and terrestrial biodiversity[1]:

Listing Notice 1 (GNR):

1. The development of facilities or infrastructure for the generation of electricity from a renewable resource where—
(i) the electricity output is more than 10 megawatts but less than 20 megawatts; or
(ii) the output is 10 megawatts or less, but the total extent of the facility covers an area in excess of 1 hectare.

Activity 1 could apply relating to facilities or infrastructure for the generation of electricity more than 10 megawatts but less than 20 megawatts from a renewable resource but is not related to terrestrial biodiversity unless additional activities are triggered, as below.

11. 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;
~~(ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.~~

The proposed 132 kV grid connection and associated infrastructure will trigger this listed activity.

12. 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.
~~(b) in front of a development setback; or~~
(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse: —

Watercourses are present on site and the listed activity would be triggered if such an activity was to take place, which is likely in order to accommodate site access.

1 *The listed activities itemized are only those with Biodiversity relevance to this report and is not a complete list of potential triggers.*

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.

Watercourses are present on site and the listed activity would be triggered if such an activity was to take place, which is likely in order to accommodate site access.

27. The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for—
(i) the undertaking of a linear activity; or

Indigenous vegetation is present on site and the listed activity will likely be triggered as clearing of natural vegetation will exceed 1 Ha.

Listing Notice 2 (GNR):

15. The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for—
~~(i) the undertaking of a linear activity; or~~
~~(ii) maintenance purposes undertaken in accordance with a maintenance management plan.~~

The proposed WEF footprints will likely require the clearing of greater than 20 Ha of indigenous vegetation, hence Activity 15 will likely be triggered, which will require a full Scoping and EIA process. The site does not fall within ant=y designated REDZ area, the closest being the Emalahleni REDZ to the north-west, hence the reduced BA process will not be applicable.

Listing Notice 3 (GNR):

4. The development of a road wider than 4 metres with a reserve less than 13,5 metres
(f) Mpumalanga
i. Outside urban areas:
~~(aa) A protected area identified in terms of NEMPAA, excluding disturbed areas; (bb) National Protected Area Expansion Strategy Focus areas;~~
~~(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;~~
~~(dd) Sites or areas identified in terms of an international convention;~~
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
~~(ff) Core areas in biosphere reserves; or~~
~~(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, where such areas comprise indigenous vegetation; or~~
~~ii. Inside urban areas:~~
~~(aa) Areas zoned for use as public open space; or~~
~~(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.~~

The listed activity would be triggered if access roads exceed the threshold (wider than 4 m) and occur within designated critical biodiversity areas.

12. 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

~~i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;~~
ii. Within critical biodiversity areas identified in bioregional plans; or
~~iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning or proclamation in terms of NEMPAA.~~
The listed activity would be triggered if clearing of indigenous vegetation (natural areas) exceeds 300 m² and occurs within designated critical biodiversity areas.

14. 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:
~~(aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas;~~
~~(cc) World Heritage Sites;~~
~~(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;~~
~~(ee) Sites or areas identified in terms of an international convention;~~
(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
~~(gg) Core areas in biosphere reserves; or~~
~~(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or~~
~~ii. Inside urban areas:~~
~~(aa) Areas zoned for use as public open space; or~~
~~(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose.~~

Watercourses are present on site and the listed activity could be triggered if such an activity was to take place.

Implications:

- The proposed activity will require the clearing of more than 300 m² within a designated Critical Biodiversity Area and/or more than 1 Ha of indigenous vegetation and/or an activity in a watercourse in terms of EIA listing notices 1 and 3, hence as a minimum would trigger a Basic Assessment process.
- The project will also likely require clearing of more than 20 Ha of indigenous vegetation in terms of EIA listing notice 2, hence triggering a full Scoping and EIA process, as the site is not within any designated Renewable Energy Development Zone (REDZ).
- Additional listed activities that may pertain to the type of activity or other aspects that are not directly related to the terrestrial biodiversity features and risks have not been considered in depth.

Other potentially relevant legislation, which will be evaluated as required, includes the following:

- NEMA: Environmental management principles set out in NEMA, and other Specific Environmental Management Acts (SEMA's) should guide decision making throughout the project life cycle to

reflect the objective of sustainable development. One of the most important and relevant principles is that disturbance of ecosystems, loss of biodiversity, pollution and degradation of environment and sites that constitute the nation's cultural heritage should be avoided, minimised or as a last option remedied. This is supported by the Biodiversity Act as it relates to loss of biodiversity.

- Liability for any environmental damage, pollution, or ecological degradation: Arising from all -related activities occurring inside or outside the area to which the permission/right/permit relates is the responsibility of the rights holder. The National Water Act and NEMA both oblige any person to take all reasonable measures to prevent pollution or degradation from occurring, continuing, or reoccurring (polluter pays principle). Where a person/company fails to take such measures, a relevant authority may direct specific measures to be taken and, failing that, may carry out such measures and recover costs from the person responsible.
- Public participation: Public consultation and participation processes prior to granting licences or authorisations can be an effective way of ensuring that the range of ways in which the activities impact on the environment, social and economic conditions are addressed, and considered when the administrative discretion to grant or refuse the licence is made.
- Constitution of Republic of South Africa (1996): Section 24(a) of the Constitution states that everyone has the right *'to an environment that is not harmful to their health or well-being'*. Construction activities must comply with South African constitutional law by conducting their activities with due diligence and care for the rights of others.
- National Forests Act 84 of 1998 with Amendments: Lists Protected trees, requiring permits for removal Department of Agriculture, Forestry and Fisheries). Section (3)(a) of the National Forests Act stipulate that '*natural forests must not be destroyed save in exceptional circumstances where, in the opinion of the Minister, a proposed new land use is preferable in terms of its economic, social, or environmental benefits*'.
- Water Use Authorisations: The National Water Act (No. 36 of 1998): Requires that provision is made both in terms of water quantity and quality for 'the reserve', namely, to meet the ecological requirements of freshwater systems and basic human needs of downstream communities. It is essential in preparing an EMP that any impacts on water resources be they surface water or groundwater resources, and/ or impacts on water quality or flow, are carefully assessed, and evaluated against both the reserve requirement and information on biodiversity priorities. This information will be required in applications for water use licenses or permits and/or in relation to waste disposal authorisations.
- Conservation of Agricultural Resources Act 43 of 1993: Lists Alien invasive species requiring removal.
- National Environmental Management Act, 1998 (Act No. 107 of 1998): DARDLEA and DEA are the Competent Authority for the implementation of the National Environmental Impact Assessment Regulations, promulgated under the National Environmental Management Act NEMA], as amended.

2.1 Systematic Planning Frameworks

A screening of Systematic Planning Framework for the region was undertaken (summarised in Table 2), that included the following features:

- Critically Endangered and Endangered Ecosystems
- Critical Biodiversity Areas & Ecological Support Areas
- Vulnerable Ecosystems
- Rivers, Watercourses, Estuaries, Wetland Freshwater Ecosystem Priority Areas (FEPAs), Strategic Water Souce Areas (SWSA's) as well as any associated buffers
- Protected Areas (and buffers) and Protected Area Expansion Strategy Area (PAES)
- Critical Habitat for listed endemic, protected or species of conservation concern.

Table 2: Summary of Regional Planning Biodiversity features.

FEATURE[2]	DESCRIPTION	IMPLICATIONS/COMMENT
National Environmental Screening Tool (Terrestrial Biodiversity)	Very High Terrestrial Biodiversity High & Medium Animal Species Medium & Low Plant Species Very High & Low Aquatic Very High, High, Medium & Low Agriculture	Several high sensitivity biodiversity and aquatic indicators. Refer to relevant sections.
National Vegetation Map (NVM, 2018)	Eastern Highveld Grassland Wakkerstroom Montane Grassland	Endangered Least Concern
Critically Endangered and Endangered Ecosystems: Terrestrial (RLE, 2022)	Eastern Highveld Grassland	Endangered
Vulnerable Ecosystems (RLE, 2022)		N/A
Mpumalanga Biodiversity Sector Plan (2014): Terrestrial	CBA (Irreplaceable); CBA (Optimal); ESA Local & Landscape corridor; ESA species specific; Other Natural Areas (ONA); Moderately Modified (Old Lands) & Highly Modified (Cultivated)	Specific flagged areas to preferably be avoided, including CBA (Irreplaceable), ESA Local & Landscape corridor. Limited footprints within CBA (Optimal) & ESA may be possible, depending on more comprehensive site-specific assessment.
Mpumalanga Biodiversity Sector Plan (2014): Aquatic	Aquatic CBAs & ESAs, Strategic water source area, Wetlands, Freshwater ecosystem priority area quinary catchments.	Any activities that may impact on CBA rivers, even upstream or in sub-catchments, need to be avoided, or impacts mitigated if they cannot be avoided. Any damaging activities within CBA river buffers must be avoided.
Protected Areas (SAPAD)	The Jericho Dam Nature Reserve lies 2,6 km; and the Josua Moolman Private Nature Reserve 20,2 km, to east, the Langcarel Private Nature Reserve lies 3,2 km west, north of the site lies the Chrissiesmeer Protected Environment (2,1 km), the Laughing Waters Private Nature Reserve (27 km), the Maffia Private Nature Reserve (38 km), the Bewerwyk Private Nature Reserve (42 km), the St. Louis Private Nature Reserve (41 km) and the Rentia Kritzinger Private Nature Reserve (43 km). To the north-west lies the Ahlers Private Nature Reserve (22 km) and the Rietvlei Private Nature Reserve (28 km).	No protected areas nor any ecological processes associated with them are likely to be affected by the proposed project other than some transient faunal species from the Jericho Dam Nature Reserve & Langcarel Private Nature Reserve and/or linked ecological processes.
NPAES	The entire project footprint/boundary is situated within an NPAES (2018) Priority Focus Area.	
Strategic Water Source Areas (SWSA)	Portion of site is situated within a designated SWSA areas; Upper Usutu SWSA and a small portion designated to Upper Vaal SWSA.	Specific activity unlikely to have any significant impact to downstream water resources, based on elevated baseline levels of transformation. .
Freshwater Ecosystem Priority Areas (FEPA's)	Several rivers and wetlands falling within and surrounding the project footprint including Onverwagspruit, Vaal, Witpuntspruit, Mpama, and the uSuthu River. Several channelled valley-bottom wetlands, seepage wetlands, floodplains, wetland flats, wetland depressions, and unchanneled valley-bottom wetlands occur within and surrounding the site.	Specific activity unlikely to have any significant impact to nearby rivers. No land-use practices that lead to deterioration of condition of FEPA rivers and wetland FEPA's as well as associated sub-quaternary catchments should take place.
Regional Hotspots & Regions of Endemism	Outside of any endemism hotspots.	N/A.

[2] Refer to Section 2.1.

FEATURE[2]	DESCRIPTION	IMPLICATIONS/COMMENT
Important Bird Areas (IBA's)	A large portion of the Grassland IBA is located within the project boundary, the Chrissie Pans IBA is located 1,5 km north of the boundary, and the Amersfoort-Bethal-Carlina District IBA is located 12,5 km west of the project Boundary.	Birds associated with these IBA's may be present and further avifaunal assessment will be required.
Key Biodiversity Areas (KBA's)	None	N/A
Marine/Coastal areas	The site is not located within 1 km of any coastal area.	N/A
Estuaries	The site is not located within 1 km of any estuary.	N/A
RAMSAR sites	None	N/A
Within 32 m of Watercourse	Several non-perennial watercourses are present.	Watercourses will only be affected if proposed activity is undertaken in proximity.
Within 100 m of River	Site is within 100 m of several perennial rivers.	Development of the site is unlikely to significantly impact any watercourse.
Within 100 m of Wetland	Site is within 100 m of extensive natural wetlands.	Wetlands will only be affected if proposed activity is undertaken in proximity.
Forest	None	N/A
Surrounding Land Uses	Mostly commercial agriculture including dryland grazing and commercial agriculture including pastures and crops including fodder crops and maize.	Site is generally significantly disturbed overall within a patchy mosaic of remnant natural vegetation
Critical Habitat for listed endemic/ protected species	There are several red listed species in the surrounding area and vegetation units that are known to have limited distributions, however none were recorded on the footprint at the time of the preliminary site visit (refer to Section 0). Furthermore, optimal seasonal assessment will be required.	

Implications:

- One of the vegetation units (Eastern Highveld Grassland) present has an Endangered conservation status, being significantly transformed and highly fragmented regionally, as a result of historical agriculture, mining and rural/urban development, hence remnant intact vegetation patches will have an elevated sensitivity status. This unit generally occurs to the north and the east & west sides of the broader site. The other vegetation unit, comprising the central and southern parts of the site, has a Least Concern status and is not under threat now has high levels of transformation and fragmentation. In broad terms the Eastern Highveld Grassland is associated with flat plains having good soils, hence transformed for agriculture and forestry, whilst the Wakkerstroom Montane Grassland occurs on hill slopes and plateaus with poorer rocky soils.
- Irreplaceable and Optimal CBA areas are present as well as ESA local and landscape corridors that corresponds to the above remnant patches for Eastern Highveld Grassland as well as a representative portion of the Wakkerstroom Montane Grassland . Irreplaceable CBA areas should be avoided (No-Go), as per the applicable regional planning guidelines.
- Several rivers and wetlands surround the site or are present within the site boundary. Appropriate buffers to be considered, as per aquatic specialist assessment.
- The site is also in proximity to several nature reserves and portions of the site are also designated as NPAES (National Protected Areas Expansion Strategy).
- Several Species of Conservation Concern are also potentially present that would require appropriate seasonal sampling.
- The specific type of development (Wind Energy Facility with grid connection and other associated infrastructure) tends to have a dispersed and relatively low footprint area in proportion to the overall project area, in comparison to for example an intensive project such as cultivation where larger areas require clearing.

2.1.1 DFFE National Environmental Screening Tool

Since all three sites are situated within a localised and adjacent area, for the purposes of this scoping phase, it will be assumed that the flagged sensitivities across all sites may have influence or relevance. The DFFE Screening Tool indicates the following sensitivities (Table 3), which may have terrestrial biodiversity and/or ecological implications or considerations.

- Terrestrial Biodiversity is *Very High* (Figure 3).
- Plant species sensitivity is Low & Medium (Figure 4).
- Animal Species sensitivity is Medium & High (Figure 5).
- Landscape Sensitivity is *Very High, High, Medium & Low* (Figure 6).
- Agricultural Sensitivity is *High & Medium* (Figure 7).
- Aquatic Sensitivity is *Very High* (Figure 8).

Table 3: Summary of DFFE National Environmental Screening Tool designations.

SENSITIVITY	FEATURE(S) IN PROXIMITY
Terrestrial	
Very High	CBA 1 & 2, ESA: landscape corridor & local corridor, FEPA Sub-catchments, Protected Areas Expansion Strategy, Critically Endangered Ecosystem
High	None
Medium	None
Low	None
Plant	
Very High	None
High	None
Medium	Sensitive species 1252, 1201, 41, 691, 998, 1219, 321, 851; *Indigofera hybrida, Asparagus fractiflexus, Aspidoglossum xanthosphaerum, Khadia alticola, Pachycarpus suaveolens, Gerbera aurantiaca, Zaluzianskya distans.*
Low	Present
Animal	
Very High	None
High	*Geronticus calvus, Balearica regulorum, Sagittarius serpentarius, Eupodotis senegalensis* (Aves)
Medium	*Hydroprogne caspia, Neotis denhami, Balearica regulorum, Sagittarius serpentarius, Geronticus calvus, Eupodotis senegalensis, Tyto capensis* (Aves), *Ourebia ourebi ourebi* (Mammal) *Clonia lalandei* (Invertebrate)
Low	*None*
Aquatic	
Very High	Aquatic CBAs, ESAs, SWSA, Rivers, Wetlands, Freshwater Ecosystem Priority Area quinary catchments
High	None
Medium	None
Low	Present
Agricultural	
Very High	Land capability; 11. High/12. High-Very high/13. High-Very high/14. Very high/15. Very high Annual Crop Cultivation / Planted Pastures Rotation; Land capability; 11. High/12. High-Very high/13. High-Very high/14. Very high/15. Very high
High	Land capability; 09. Moderate-High/10. Moderate-High. Annual Crop Cultivation / Planted Pastures Rotation; Land capability ;09. Moderate High/10. Moderate-High. Annual Crop Cultivation / Planted Pastures Rotation; Land capability; 06. Low-Moderate/07. Low-Moderate/08. Moderate. Annual Crop Cultivation / Planted Pastures Rotation; Land capability; 01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low. Old Fields; Land capability; 06. Low-Moderate/07. Low-Moderate/08. Moderate. Old Fields; Land capability; 09. Moderate-High/10. Moderate-High. Old Fields; 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
Low	Land capability; 01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Landscape	
Very High	Mountain tops and high ridges, Slope more than 1:4, Within 3 km of a nature reserve, botanical garden or other protected area & Within 250 m of a river

SENSITIVITY	FEATURE(S) IN PROXIMITY
High	Slope between 1:4 and 1:10, Between 3 and 5 km of a nature reserve, botanical garden or other protected area & Within 500 m of a river.
Medium	Between 5 and 10 km of a nature reserve, botanical garden or other protected area & Within 1000 m of a wetland.
Low	Slope less than 1:10

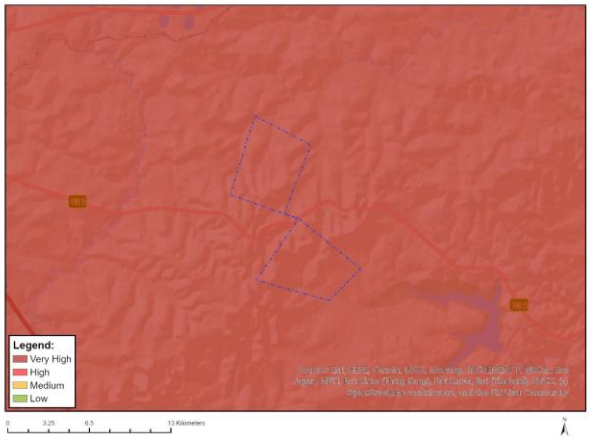


Figure 3: Terrestrial Biodiversity Sensitivity.



Figure 4: Plant Species Sensitivity.

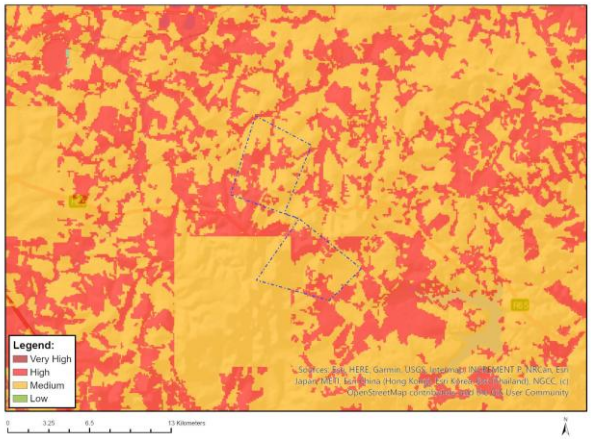


Figure 5: Animal Species Sensitivity.

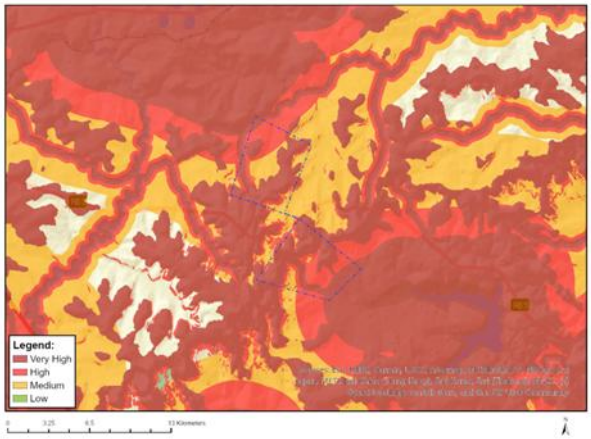


Figure 6: Landscape Sensitivity.

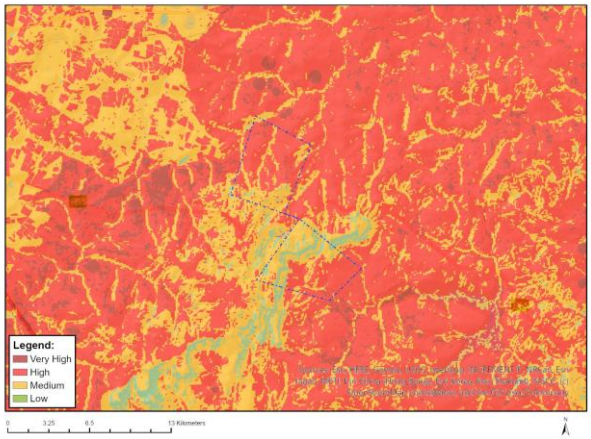


Figure 7: Agricultural Sensitivity.

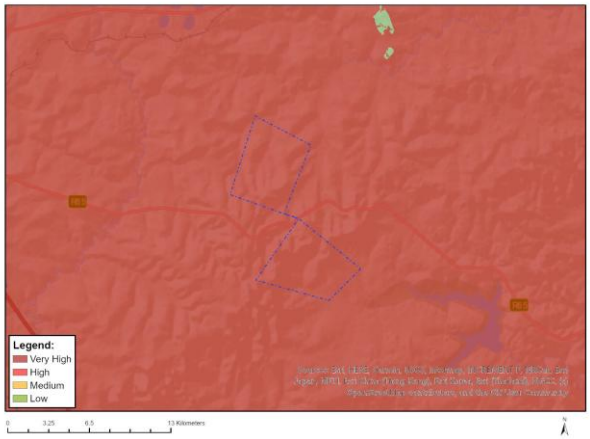


Figure 8: Aquatic Sensitivity.

In summary, the site is located within a rural commercial farming area and has a history of being used for commercial agriculture with associated infrastructure including buildings, dams and other infrastructure. Uncultivated vegetation is most near natural to natural with secondary vegetation also common where old

lands are no longer cultivated and transformed where currently cultivated. The broader area, in particular the Eastern Highveld Grassland vegetation unit tends to be significantly fragmented in areas where cultivation is extensive. Mining (opencast coal) is also present in the broader surrounding area but not in close proximity to the WEF site.

2.1.2 Vegetation of Southern Africa

Two vegetation units (Table 2, Figure 9) are primarily affected by the proposed project (Mucina & Rutherford, 2006). The site is located within Eastern Highveld Grassland (currently having an *Endangered* conservation status) and Wakkerstroom Montane Grassland (currently having a *Least Concern* conservation status). The Eastern Highveld Grassland tends to be associated with lower lying relatively flat areas, while the Wakkerstroom Montane Grassland is associated with higher elevation mountainous areas, particularly towards the central and south-east of the WEF cluster formed by a series of mountainous ridges as well as the eastern portions of the southern grid connection routes. Being situated on relatively flat areas with good soils and rainfall, the eastern highveld grassland has been subject to significant historical clearing for agricultural activities including pastures, fodder and crops. As per Figure 10, the site covers a small area of the original extent and remining extent of the vegetation units that are represented within the site (Eastern Highveld Grassland & Wakkerstroom Montane Grassland). Furthermore, the remining extent within the site is predominantly comprised of only a few fragmented pockets. The fine scale mapping undertaken in this assessment will serve to identify the remaining patches and ensure that any loss is contained to a reasonable area and within acceptable limits.

2.1.3 Red List of Ecosystem Status and National Biodiversity Assessment

The Red List of Ecosystem Status (RLE, 2022) is currently the primary tools for monitoring and reporting on the state of biodiversity in` South Africa and informs policies, strategic objectives, and activities for managing and conserving biodiversity more effectively. The RLE is preceded by the National Biodiversity Assessment (NBA, 2018) The RLE/NBA is especially important for informing the National Biodiversity Strategy and Action Plan (NBSAP), the National Biodiversity Framework (NBF) and the National Protected Area Expansion Strategy (NPAES) and informs other national strategies and frameworks across a range of sectors, such as the National Spatial Development Framework, the National Water and Sanitation Master Plan and the National Biodiversity Economy Strategy. Ecosystem protection level is an indicator that tracks how well represented an ecosystem type is in the protected area network. It has been used as a headline indicator in national reporting in South Africa since 2005. It is computed by intersecting maps of ecosystem types and ecological condition with the map of protected areas. Ecosystem types are then categorised based on the proportion of the biodiversity target for each ecosystem type that is included in one or more protected areas. For terrestrial ecosystems, biodiversity targets are set for each ecosystem type using established species–area accumulation curves (ranging between 16 and 34%).
The outcome of the most recent Red List of Ecosystem Status (2022) indicate that Eastern Highveld Grassland has an Endangered conservation status (Table 2), which is an elevated threat status elevation. This indicates that the vegetation unit has lost significant amounts (~less than 40 % remains) of their original natural habitat, so their overall ecological functioning is likely compromised to some extent through loss of habitat and fragmentation. There is a widespread high level of utilization of this unit leading to degradation and transformation. Shifting cultivation and the effects of development have caused continuous disturbance of the soil surface, which can lead to secondary succession changes in the grassland. Wakkerstroom Montane Grassland has a Least Concern conservation status which is the lowest threat status elevation. This indicates that more than 60 % of the unit remains, and ecosystem functioning is unlikely significantly compromised. `

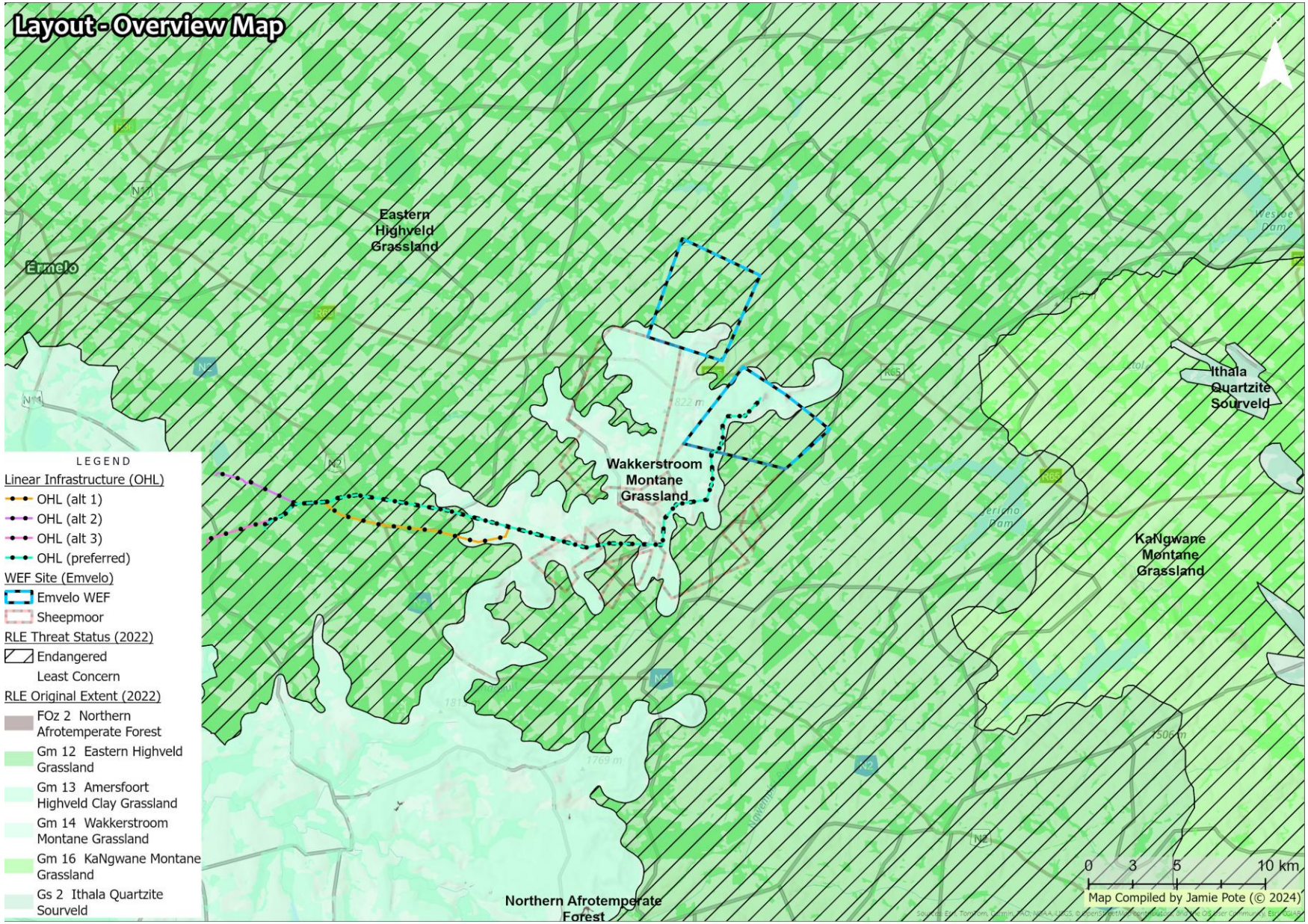


Figure 9: National Vegetation Map (2018) and National Biodiversity Assessment Status (2022).

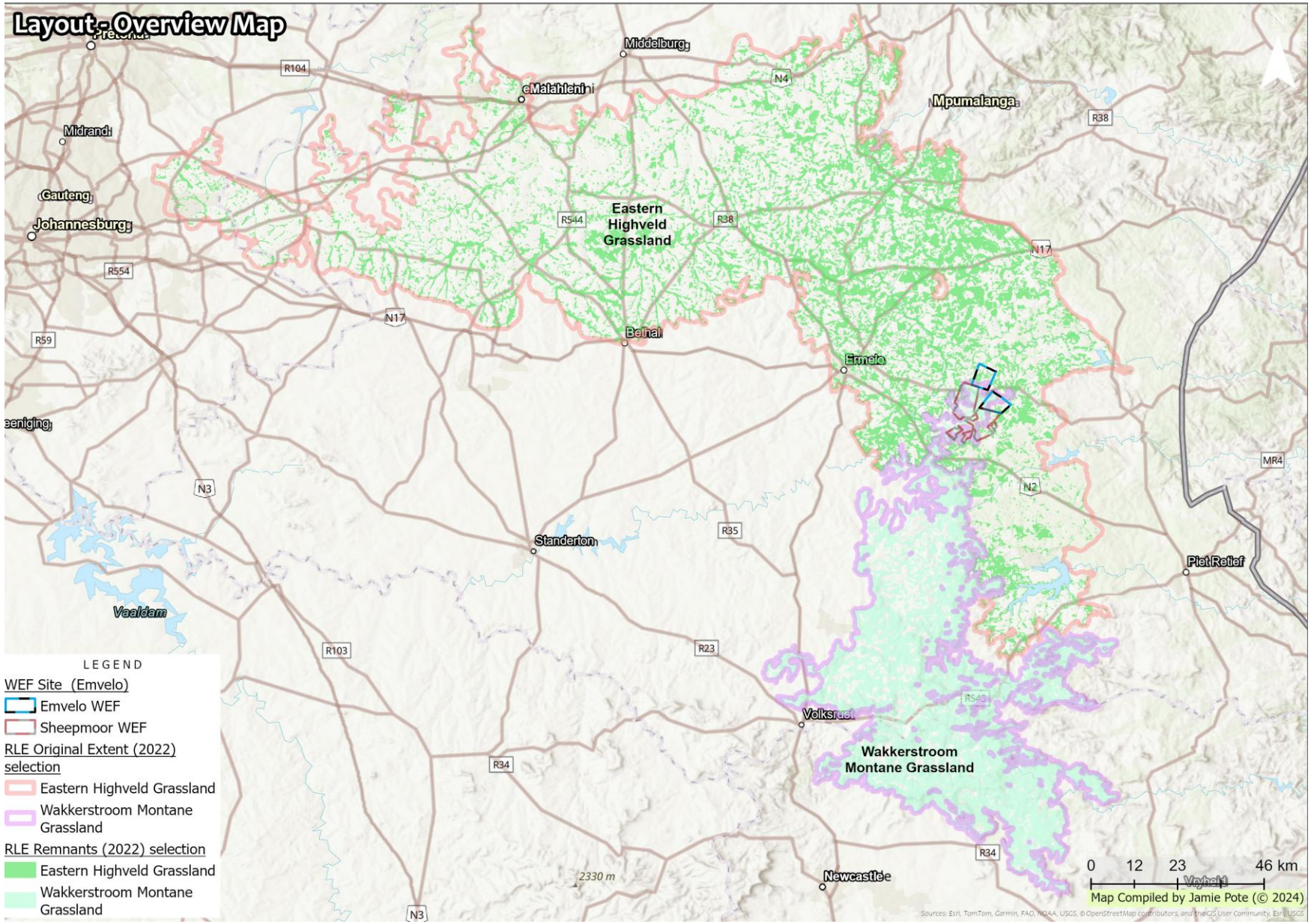


Figure 10:Coverage and remaining extent of affected vegetation units (National Vegetation Map, 2018).

Implications:

- The Eastern Highveld Grassland vegetation unit has an *Endangered* status, indicating that more than 40% has been transformed and there will likely already be some loss or disruptions to ecological functioning which will be exacerbated by further loss. Further loss in remnant areas is not advisable as per the respective guidelines. All measures are taken to minimise this impact.
- Much of the indicated Eastern Highveld Grassland, comprising a portion of the historical coverage on the site in lower lying valleys, is already transformed as a result and/or comprised of secondary grassland due to historical cultivation.
- Wakkerstroom Montane Grassland in present in the southern and central area, having a Least Concern status and not under threat.
- As is evident from land-use coverages, the wider area is highly fragmented because of land-use, including agriculture, mining and urbanisation.

2.1.4 Mpumalanga Biodiversity Conservation Plan (MBCP, 2006)

The Mpumalanga Biodiversity Conservation Plan (2006) is superseded by the Mpumalanga Biodiversity Conservation Plan (2014) and thus not considered further.

2.1.5 Mpumalanga Biodiversity Sector Plan (MBSP, 2014): Terrestrial

A Biodiversity Sector Plan can be used to guide conservation action (such as identifying priority sites for expansion of protected areas), or to feed spatial biodiversity priorities into planning and decision-making in a wide range of cross-sectoral planning processes and instruments such as provincial and municipal integrated development plans and spatial development frameworks, land-use management schemes, environmental management frameworks and environmental management plans. Figure 11 indicates the Terrestrial MBSP categorisation of the site and surrounding area.

Implications:

- As is evident from land-use coverages, the wider area is highly fragmented because of land-use, including agriculture, mining, and urbanisation.
- Intact vegetation on the site and surrounding sites is considered to be of conservation value, being generally designated either Irreplaceable or Optimal CBA with Other Natural Area (ONA) associated with transformed (cultivated) land, mostly associated with remnant Eastern Highveld Grassland, being designated Irreplaceable CBA.
- The degraded, secondary vegetation (old lands) and cultivated areas are generally not designated a CBA status but in some cases are designated ESA: local corridor or ESA: species specific. Specific reasons or sensitivities for these designations are not known at this stage but would require further investigation during the assessment phase to confirm current status and condition of designated areas.
- Land use guidelines indicates that Irreplaceable CBA sites must be avoided in terms of the mitigation hierarchy, however for Optimal CBA (referred to as Important and necessary in MBCP), the guidelines indicate that, although not desirable, if small-scale land-use change is unavoidable, it must be located and designed to be as biodiversity-sensitive as possible.
- Portions of the proposed grid connection corridors will also traverse some more extensive designated CBA: Irreplaceable areas. It is not anticipated that the actual footprint or loss within these areas will be significant due to the limited footprint of pylons as well as the corridors generally being near or within existing powerline corridors.
- ESA areas can accommodate loss, but ecological processes and connectivity must be given consideration.
- Actual remaining extent will be refined in vegetation mapping.

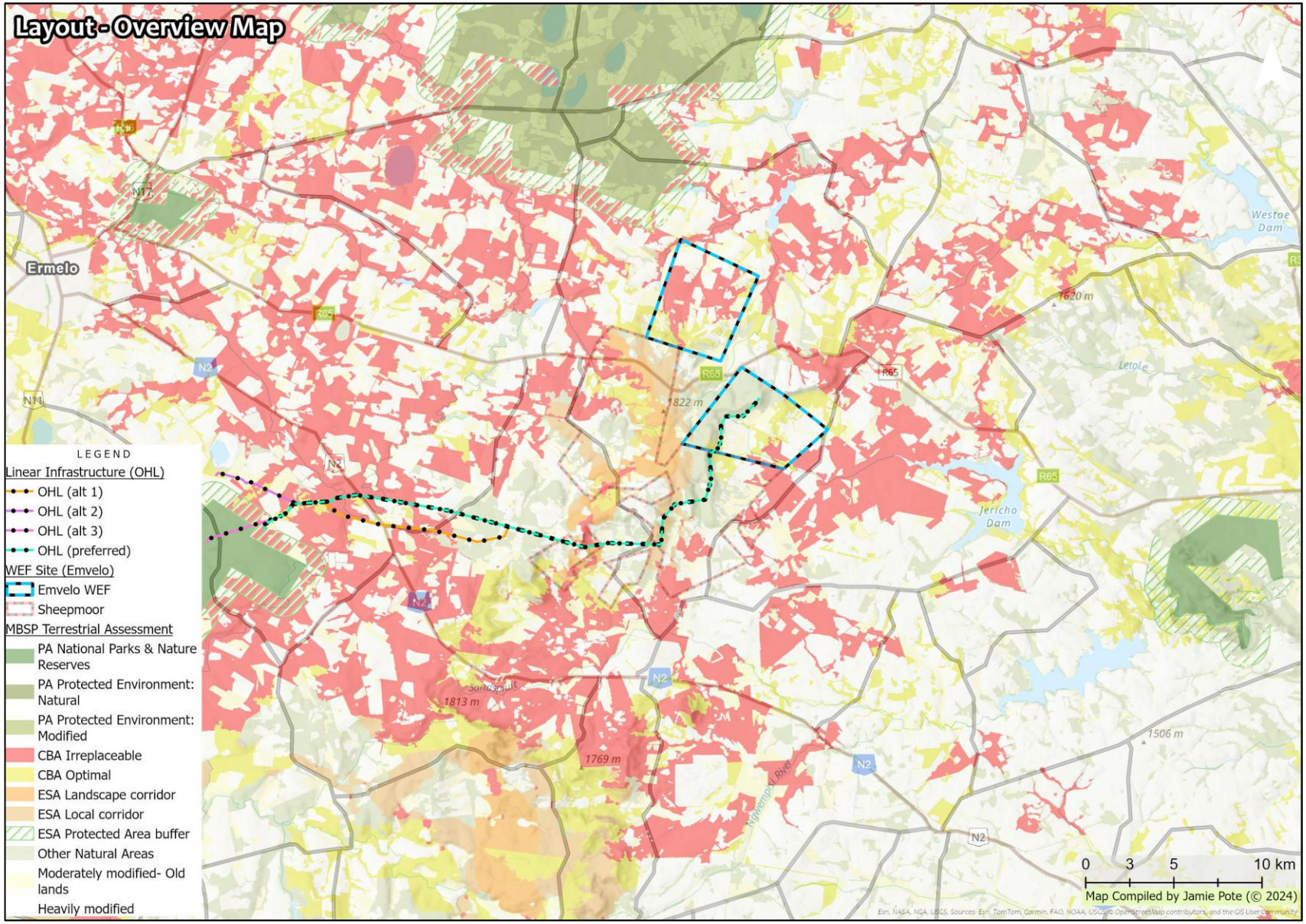


Figure 11: Mpumalanga Biodiversity Sector Plan (MBSP, 2014) – Terrestrial Overview.

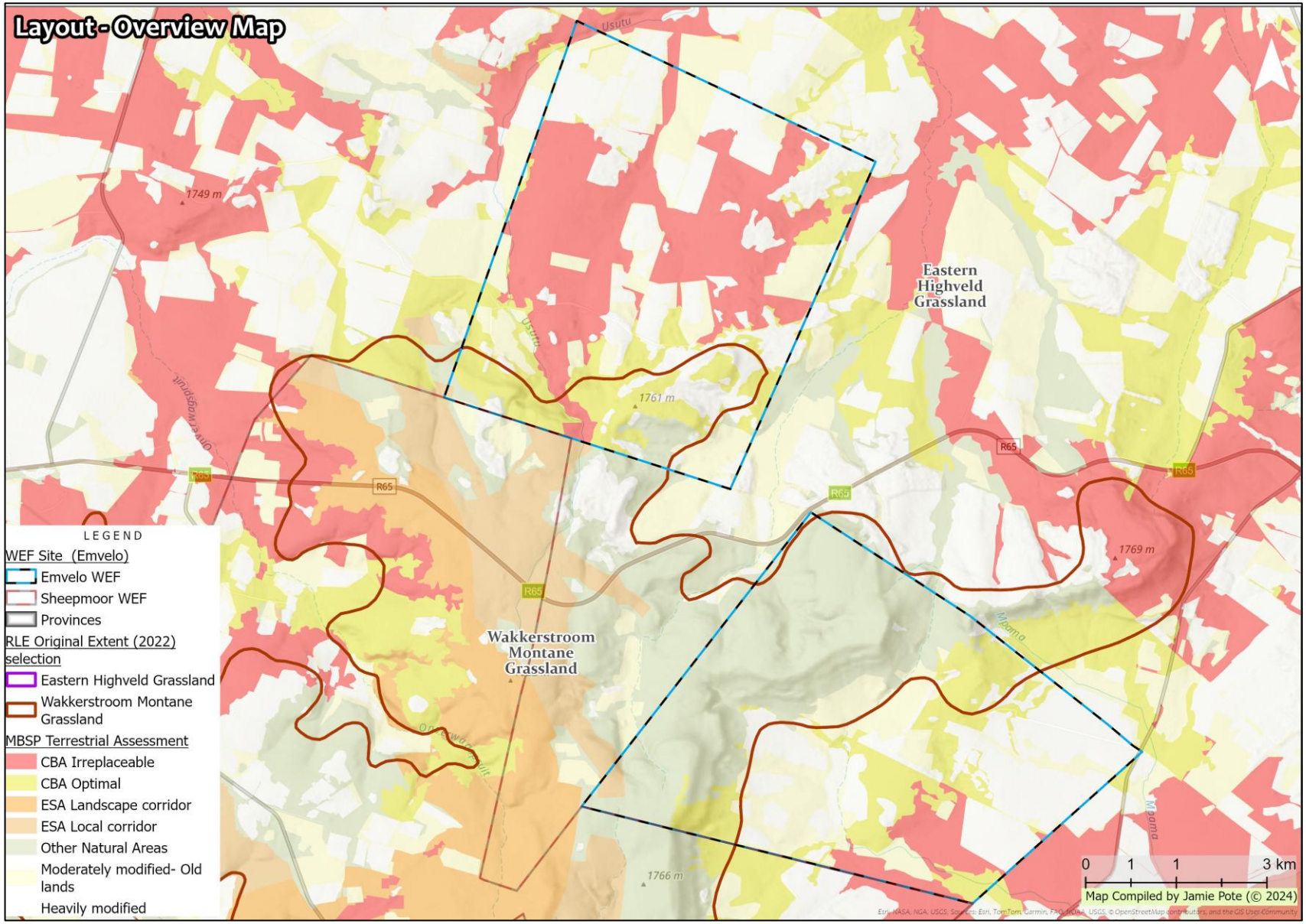


Figure 12: Mpumalanga Biodiversity Sector Plan (MBSP, 2014) – Terrestrial (site).

2.1.6 Other Biodiversity Sector Plans

The site is outside of the planning domain of any other Biodiversity Sector Plans.

2.1.7 Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project responds to the high levels of threat prevalent in river, wetland, and estuary ecosystems of South Africa (Figure 13). It provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or '*FEPAs*'.

Biodiversity targets set minimum, quantitative requirements for biodiversity conservation. They reflect scientific best judgement and will need to be refined as knowledge evolves. Quantitative biodiversity targets were set for fish species, river ecosystem types, wetland ecosystem types, priority estuaries, wetland clusters and free-flowing rivers:

1. Threatened and near-threatened freshwater fish species – all populations (100%) of considered to be critically endangered or endangered species, and at least ten populations of species that are in the International Union for Conservation of Nature (IUCN) vulnerable or near threatened categories and some populations of special concern (e.g., very restricted distributions in South Africa)
2. River ecosystem types – 20% of total length per type
3. Wetland ecosystem types – 20% of total area per type
4. Wetland clusters – 20% of total area per wetland vegetation group
5. Free-flowing rivers – 20% of total length per ecoregion group
6. Priority estuaries – 100% of all priority estuaries, which already considered biodiversity targets of 20% for estuary ecosystem types and habitat, 50% of the populations of threatened species; 40% of the populations of exploited estuarine species; 30% of the populations of all other estuarine species.

Terrestrial and aquatic resources are interdependent, with one affecting the other. For example, to ensure the healthy functioning of rivers, wetlands, and estuaries, it is essential to protect mountain catchment areas where the water originates, and to safeguard riverside vegetation because these plants prevent soil erosion, sedimentation and water pollution (Vromans et al., 2012).

The health of a river ecosystem is largely dependent on the presence of natural vegetation or "riparian habitat" along its banks, including good vegetative cover within the surrounding landscape (catchment area). Riparian bank vegetation filters pollutants, helps maintain water temperatures, supplies organic matter ('food') in support of aquatic life (fish, insects etc.) and acts as a buffer to adjacent land-uses. The roots of the riparian plants also reduce the effects of floods, by binding riverbanks and thus preventing erosion. Furthermore, bank storage is increased by slowing run off during floods. For these reasons, it is essential that new developments are separated from a river and its "riparian habitat" by a buffer area.

The NFEPA Implementation Manual for Freshwater Ecosystem Priority Areas (2011) provides recommendations, guidelines and management measures for activities within wetland FEPAs (including wetland clusters), river FEPAs, sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas.

Several perennial and non-perennial river, watercourses and wetland features occur within the site. These are addressed in more detail in the respective aquatic assessment reporting but are generally regarded as no-go areas as far as possibly in this assessment.

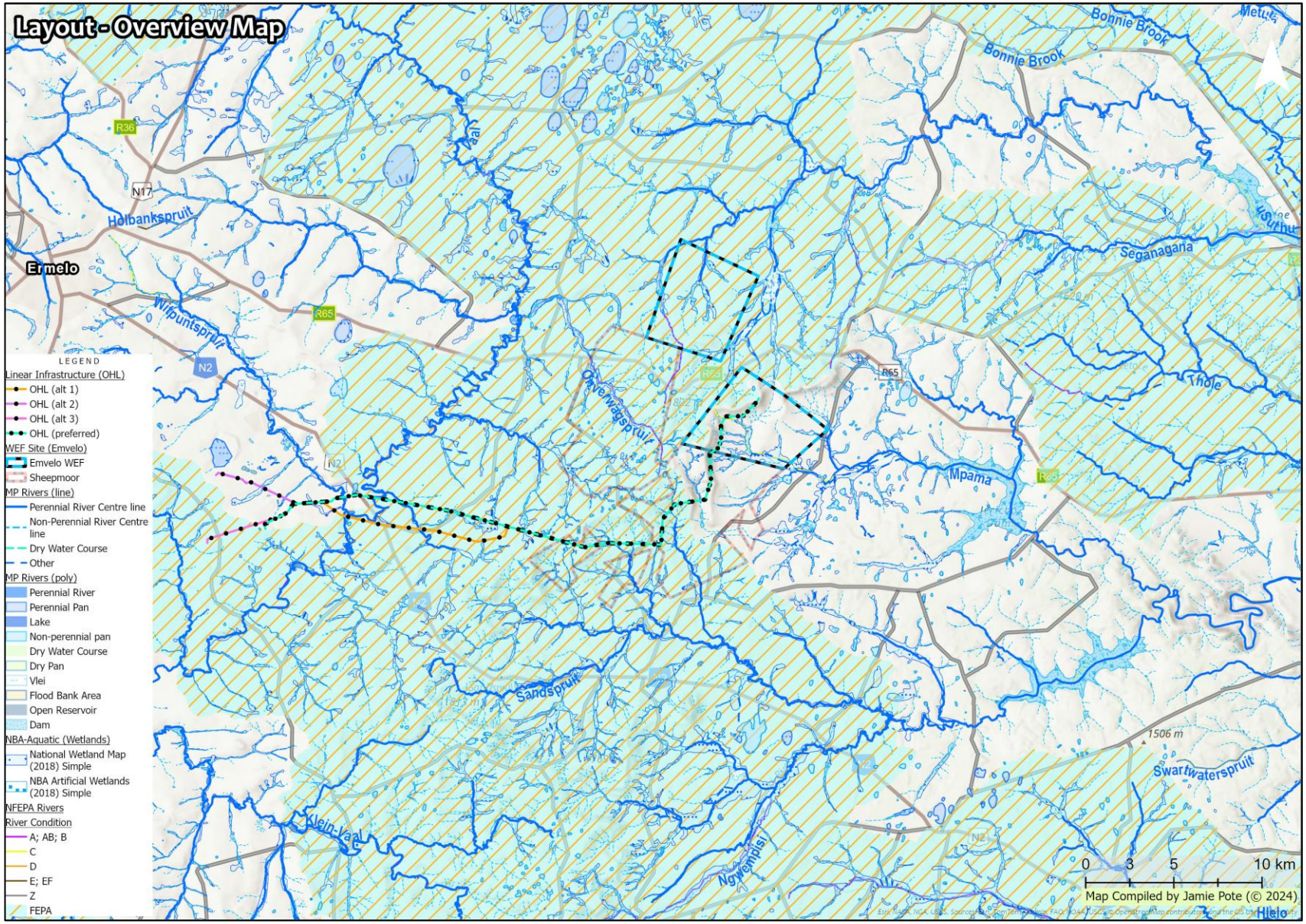


Figure 13: Aquatic Resources Map indicating Rivers, Watercourses, Wetlands & NFEPA.

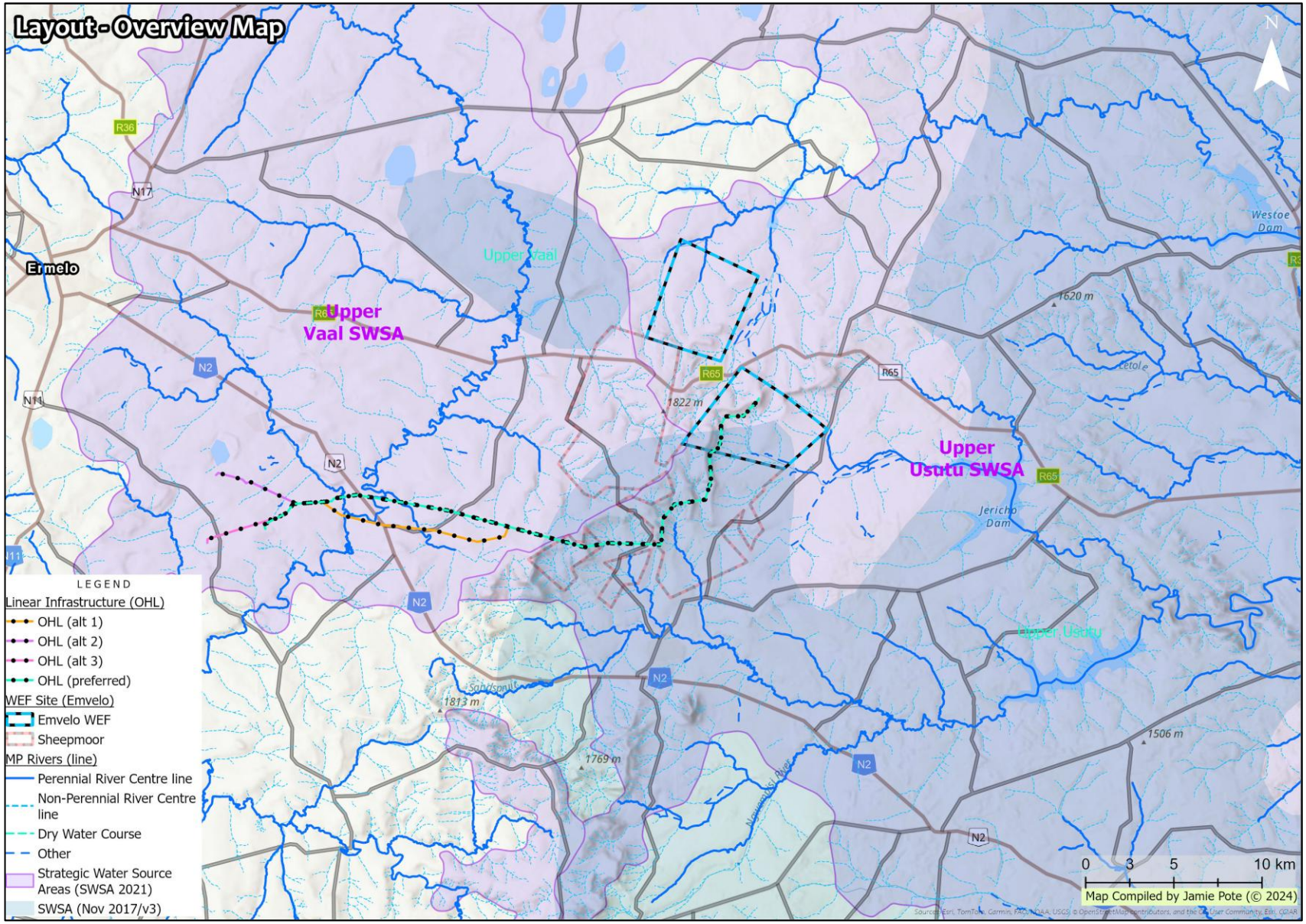


Figure 14: Aquatic Resources Map indicating Rivers and SWSA.

Wetland classification:

Several channelled valley-bottom wetlands, seepage wetlands, wetland flats and unchanneled valley-bottom wetlands occur within and surrounding the site. These were considered final wetland FEPA's.

Several wetland clusters were identified within the project site according to NFEPA.

Implications:

- No land-use practices that lead to deterioration of condition of FEPA rivers and wetland FEPA's as well as associated sub-quaternary catchments should take place.
- Wetland habitat is identified and mapped as far as possible in order to align with the aquatic assessment but is addressed in more detail in the aquatic assessment. All buffers and exclusions pertaining to wetlands or other aquatic features are to be as per the aquatic assessment.

2.1.8 Strategic Water Source Areas

Strategic Water Source Areas (SWSA, Figure 13) are those that supply substantial downstream economies and urban centres. These water source areas are vital to the national economy. Strategic water source areas are those that supply substantial downstream economies and urban centres. These water source areas are vital to the national economy. Strategic water source areas can be regarded as natural "*water factories*", supporting growth and development needs that are often far away. Deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. Appropriate management of these areas, which often occupy only a small fraction of the land surface area, can greatly support downstream sustainability of water quality and quantity.

In South Africa, such management is particularly important for enhancing downstream water quality and quantity. Not only are the country's surface water resources extremely limited – South Africa is one of the driest countries (per capita), with 98 per cent of its surface water already developed – but the country also has a growing water quality problem.

The site falls within a small section of the Upper Vaal Surface Water Strategic Water Source Area (Figure 13) and the southern portion of the site falls within the Upper uSutu SWSA.

Implications:

- The site does overlaps with designated SWSA areas.
- There is unlikely to be a significant impact to any critical water supply to downstream economies and urban centres as a result of the development of this site, due to the limited as dispersed footprint.
- Alien invasive vegetation management control programme should be prepared in alignment with the guidelines in the Strategic Water Source Areas: Management Framework and Implementation Guidelines for Planners and Managers (WRC, 2018).

2.1.9 Regional Hotspots and Centres of Endemism

The site is not situated within any designated Centre of Endemism.

2.1.10 Key Biodiversity Areas

Important Bird Areas

Important Bird and Biodiversity Areas (IBA's) are sites of international significance for the conservation of the world's birds and other biodiversity. They also provide essential benefits to people, such as food, materials, water, climate regulation and flood attenuation, as well as opportunities for recreation and spiritual fulfilment. By conserving IBA's, we look after all the ecosystem goods and services they provide, which means in effect that we support a meaningful component of the South African economy (such as water management and agriculture). Since the late 1970s, more than 12 000 IBA's have been identified in virtually all the world's countries and territories, both on land and at sea. In 1998, 122 South African IBA's were identified and listed in Barnes (1998). This inventory was revised to 112 IBA's in 2015. IBA's have also had considerable and increasing relevance when responses have been developed to several wider environmental issues, such as habitat loss, ecosystem degradation, climate change and the sustainable use of resources. The core aims of the IBA Programme are:

- To identify, monitor and conserve the sites and habitats that support South Africa's priority bird species.
- To develop a network of partners, from grassroots to national level, who collaborate to conserve IBA's.
- To gather new data regularly and monitor IBA's to track status and trends across the network and so that up-to-date information can be passed on to decision-makers, enabling them to take appropriate conservation action.
- To confirm periodically that existing IBA's continue to meet the selection criteria and to identify other critical sites that may qualify for recognition as IBA's as new information becomes available.
- To build capacity in the IBA Programme by sourcing funding, and to acquire and develop appropriate skills in staff and volunteers so that these objectives can be implemented at a regional scale.

The extension of the IBA approach to several other wildlife groups has led to the identification of Important Plant Areas, Prime Butterfly Areas, Important Mammal Areas and Key Biodiversity Areas for Freshwater Biodiversity. South Africa is also the first mega diverse country to practically test the Key Biodiversity Areas (KBA's) standards across a full range of species groups and ecosystems but is not yet published.

A large portion of the Grassland IBA is located within the project boundary (Figure 15), the Chrissie Pans IBA is located 1,5 km north of the boundary, and the Amersfoort-Bethal-Carlina District IBA is located 12,5 km west of the project Boundary. The National Screening Tool identifies several bird species that are assessed separately as part of the avifaunal assessment and are not considered further or in depth in this reporting.

Implications:

- Refer to applicable bird specialist reporting relating to avifauna.
- While avifauna are generally not considered at length in terrestrial biodiversity reporting, they do play an integral and critical role in terrestrial ecological processes.
- No significant such processes are likely to be affected since the avifaunal mitigation measures and no-go areas that are proposed will more than adequately address such risks.

2.1.11 Protected Areas

The South Africa Protected Areas Database (SAPAD) database, a comprehensive database of various protected area categories, is updated on a quarterly basis, and provides a comprehensive source of all national and private nature reserves, world heritage sites and other formal legally protected conservation areas situated within South Africa. Protected areas in the vicinity include the Chrissiesmeer Protected Environment & Jericho Dam Nature Reserve within 5 km of the site and Langcarel Private Nature Reserve just over 10 km from the site (Figure 16). All remaining protected areas are in excess of 20 km of the site and no National Parks are located within 100km of the site. No other protected areas are situated within 10 km of the site. NPAES designated Priority Focus Area does overlap with a large portion of the site.

Table 4: List of Protected Areas in vicinity

NAME	DISTANCE
Chrissiesmeer Protected Environment	~2.5 km North
Jericho Dam Nature Reserve	~2 km East
Langcarel Private Nature Reserve	~12 km West
Josua Moolman Private Nature Reserve	~20 km East
Ahlers Private Nature Reserve	~22 km North-west
Laughing Waters Private Nature Reserve	~26 km North-East
Rietvlei Private Nature Reserve	~43 km North-West
Maffia Private Nature Reserve	> 40 km North
Rentia Kritzinger Private Nature Reserve	
Bewerwyk Private Nature Reserve	
St. Louis Private Nature Reserve	
Barbeton Worl Heritage Site	60 km North-East
Kruger National Park	150 km North-East

When projects are in legally protected and internationally recognized areas, it should be ensured that project activities are consistent with any national land use, resource use, and management criteria (including Protected Area Management Plans, National Biodiversity Strategy and Action Plans (NBSAP's), or similar documents).

No protected areas nor any terrestrial ecological processes associated with them are likely to be affected significantly by the proposed WEF project other than some transient faunal species (including birds), and ecological connectivity with the Chrissiesmeer protected environment as well as other nearby protected areas. NPAES areas are indicated for all CBA and ESA designated areas in the latest draft NPAES (2018). The south-western end of the grid connection will fall near the Langcarel Private Nature Reserve, where the substation is situated within this private nature reserve. The footprint or risk is not expected to be significant.

Implications:

- The activity will unlikely have any direct impact on any protected environment, other than where the grid connection will feed into the substation at the south-western end. Indirect and cumulative impacts may require further assessment relating to species and processes associated with protected areas in proximity to the site.
- NPAES areas will be directly or indirectly affected in terms of the draft NPAES (2018).

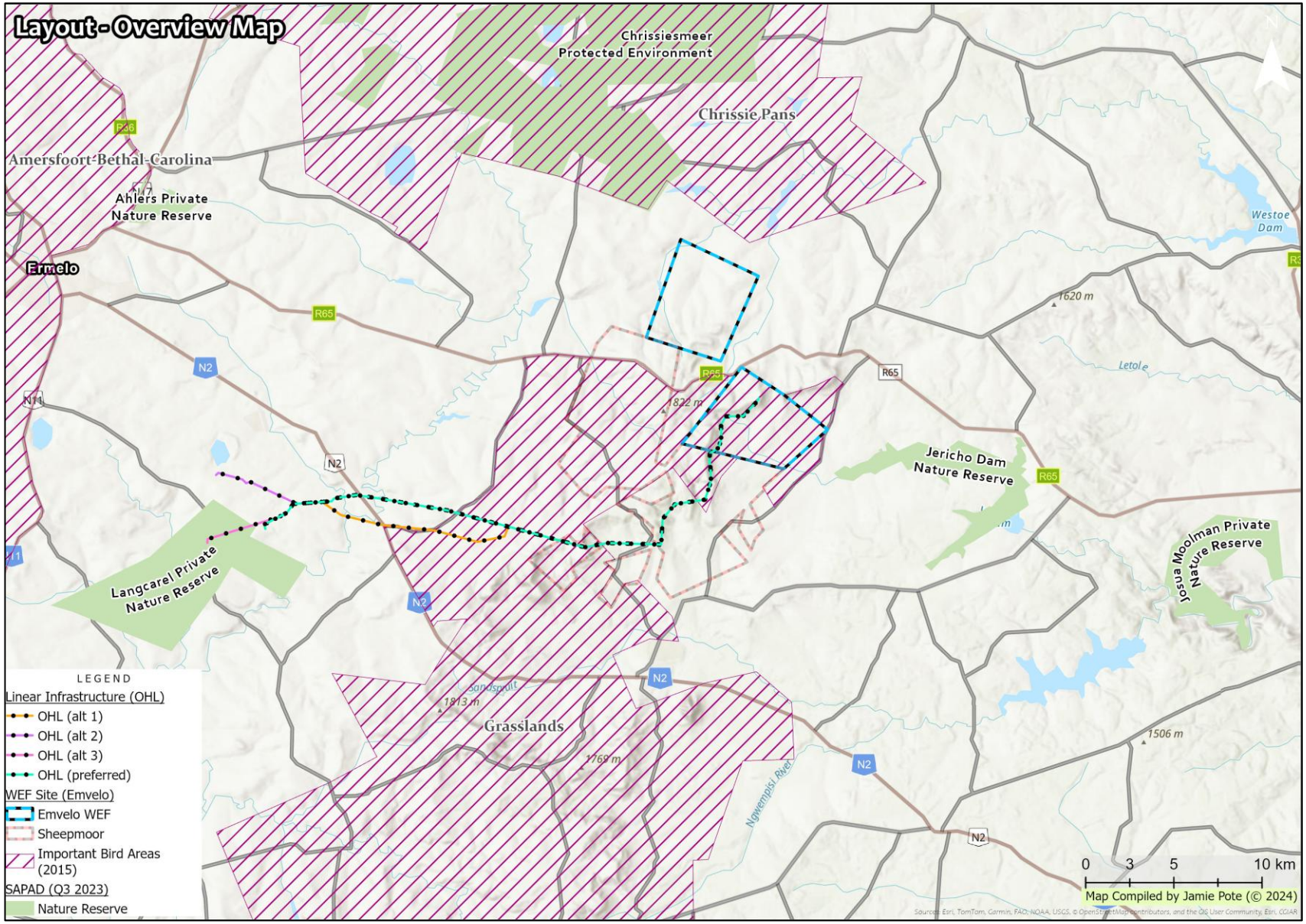


Figure 15: Protected Areas and Important Bird Areas (IBA's) in proximity to the site.

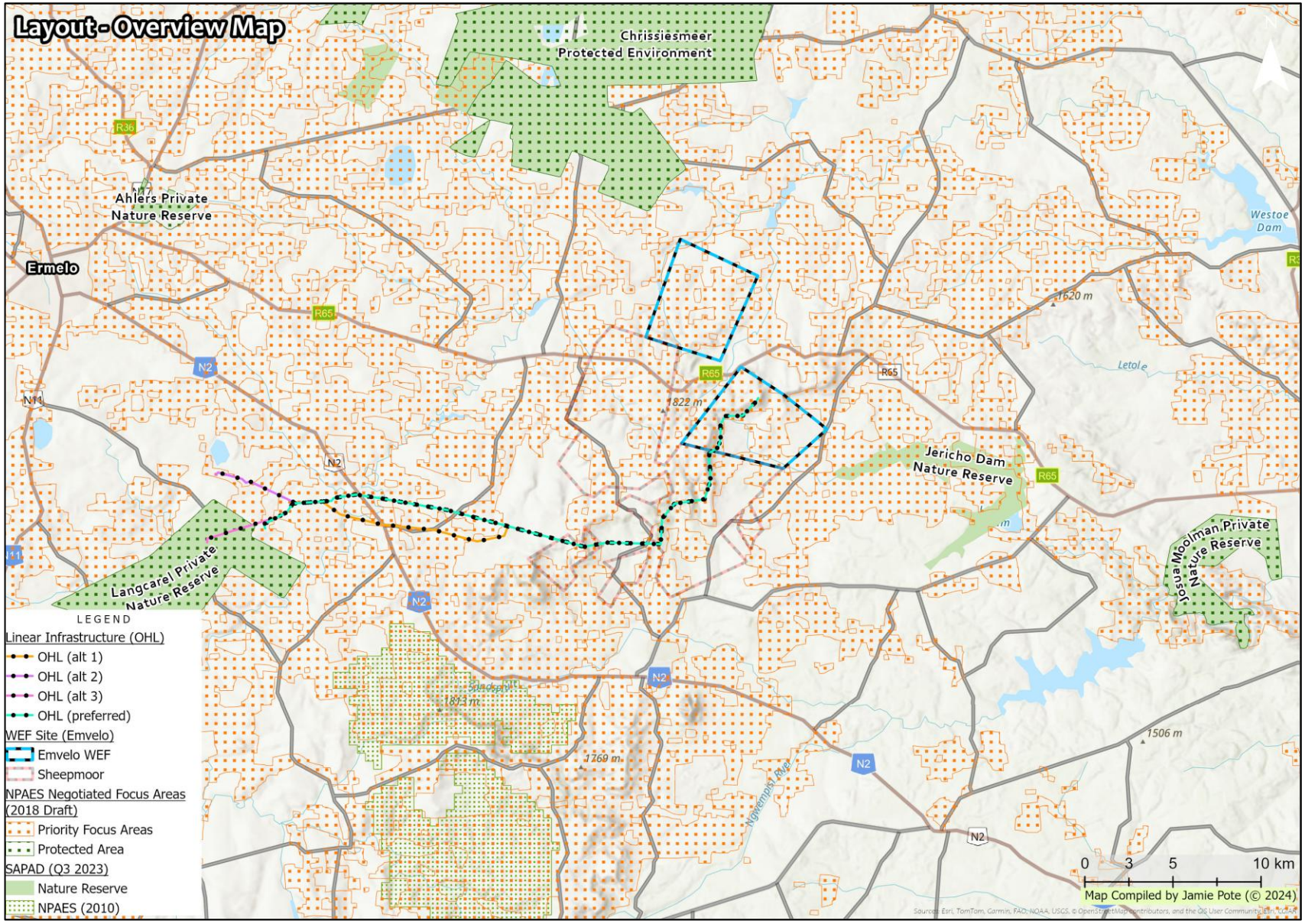


Figure 16: Protected Areas and designated NPAES areas in proximity to the site.

2.2 Vegetation, Flora & Fauna and Ecological Processes

2.2.1 Critical Biodiversity Areas: Terrestrial

Given that the objective of CBAs is to identify biodiversity priority areas which should be maintained in a natural to near natural state, development within these areas is not encouraged. Several Critical Biodiversity Areas are identified within and directly adjacent to the site.

2.2.2 Ecological Support Areas: Terrestrial

These include supporting zones required to prevent the degradation of Critical Biodiversity Areas and Protected Areas. An ESA may be an ecological process area that connects and therefore sustains Critical Biodiversity Areas or a terrestrial feature. ESAs are generally extensions to the CBA area incorporating small areas that are perhaps no longer natural, or are comprised of secondary vegetation, generally following the drainage line ecological corridors within the wider surrounding landscape that will improve connectivity.

2.2.3 Critical/Important Terrestrial Habitats

Special Habitats include areas that are rare within a region, or which support important species, ecosystems, or ecological processes. Species of Special Concern refers to red data species and important habitats include the locations where these species are known to occur. Red data species are plant, animal, or other organisms (e.g., reptiles, insects etc) that have been assessed and classified according to their potential for extinction in the near future. All known species are listed in the Red Data Book and classified as Extinct, Critically Endangered, Endangered, Vulnerable, Near Threatened or Least Concern. Red Data species are those species classified as Extinct, Critically Endangered, Endangered or Vulnerable. Some of the red data species are listed within the NEMBA Threatened or Protected Species (ToPS), and some are protected by provincial ordinances. Critical habitats include those areas that are known locations for such red data species that are under threat of extinction.

Rocky Outcrops

Rocky outcrops can provide habitat for geophytic species that often have limited distributions. Rocky areas may be present in higher lying areas within the grassland unit, most likely in areas that have not been cultivated, as they would have marginal suitability for agriculture (i.e., poor rocky soils). Such habitat is not common within the site other than a few outcrop areas, usually in steeper areas around hill slopes and edges of plateaus. Some localised ground truthing and minor layout adjustments during final ground truthing during pre-construction final layout design can usually accommodate such risks.

Riparian and Wetland habitat

Several major rivers and associated non-perennial tributaries occur within the site and are largely within wetland areas. Wetlands are special habitats as they provide a refuge for birds and other organism, such as frogs and insects. They are important hydrological process areas that are linked to ground or surface water flows. Natural wetlands are all considered to be Critical Biodiversity Areas. Wetlands are protected by the National Water Act and the Conservation of Agricultural Resources Act. Several riverine and wetland systems are present within and surrounding the site. These wetland systems include floodplain wetlands and channelled valley-bottom wetlands associated with major rivers as well as numerous seepage wetlands associated with the tributaries and headwater streams of these major systems. Several depression wetlands occur. While not directly associated with terrestrial biodiversity these wetland habitats are any integral component of terrestrial ecological processes, in particular relating to habitat for faunal species. Several water storage dams (artificial wetlands) also occur within and surrounding the site. Although artificial in nature, they largely form part of natural riverine or

wetland systems where they occur in-stream. Aquatic features to be avoided and or accommodated as per the aquatic assessment, which will adequately address any aspects that might pertain to terrestrial risks associated with these features.

Colonies or Populations of Threatened or Protected Species

This assessment only pertains to flora species, as fauna are addressed as part of separate assessments. As per the initial desktop assessment no known colonies are flagged.

- The land use of the immediate area is commercial agriculture, with cultivated lands and a mozaic of pockets of natural vegetation intersected by a network of non-perennial watercourses and channel valley bottom wetlands (vleis). In the broader area coal mining is present.
- The site is encompassing a mozaic of natural vegetation with portions designated as critical biodiversity, ecological support and other natural areas.
- Habitat fragmentation surrounding the site is relatively high, and while the specific site has notable areas designated elevated CBA or ESA status, these tend to form contiguous connectivity corridors with the broader landscape and should be preserved or any disturbance limited.
- Wetland habitat and rocky outcrops are present and will require micro-siting of WEF footprints as well as pylon micro siting to avoid such sensitive areas.

No significant risks terrestrial biodiversity & plant species associated with the above features are identified within the site, and specifically the areas where footprints are proposed. As a precautionary measure, since a final detailed layout is not yet available, a comprehensive walkdown must be undertaken in order to inform final layout design, including WEF and hardstands, internal roads, laydown, BESS, O&M and other areas as well as final substation and OHL pylon footprint positioning.

3 Biodiversity Risk Identification and Assessment

3.1 Terrestrial Biodiversity Baseline Description

3.1.1 Topography and Drainage

Gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland. Where not disturbed scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops are present.

3.1.2 Terrestrial Landscape Features Overview

The lower lying areas of the site and surrounding area fall within a gently to moderately undulating plains supporting short dense grassland (Eastern Highveld Grassland) dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya* etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* `and *Rhus magalismontanum*). Several herbs and forbs are also common to the unit. The area has high levels of transformation, primarily agriculture and mining (coal) with small wetlands, narrow stream alluvia, pans.

The above plains are interspersed with a mountainous escarpment just north of Sheepmoor to the south-east, west and east, comprised of low mountains and undulating plains with the vegetation comprising predominantly short montane grasslands (Wakkerstroom Montane Grassland) on the plateaus and the relatively flat areas, with short forest and *Leucosidea* thickets occurring along steep, mainly east-facing slopes and drainage areas. *Leucosidea sericea* is the dominant woody-pioneer species that invades areas because of grazing mismanagement. *Acacia* (wattle) and *Eucalyptus* thickets are also prevalent as well as commercial forestry across the units.

3.1.3 Primary Vegetation and Habitat

Vegetation has been mapped (Figure 17) and is comprised of the following:

- Highveld Grassland
- Degraded Highveld
- Montane Grassland
- Degraded Montane Grassland
- Riparian/Riverine/Wetlands
- Secondary/Degraded/Old Lands
- Invaded/Cleared Invaded
- Cultivated/Transformed
- Dams

This overall landscape offers suitable habitat for a limited suite of animal species, although many animals have likely been displaced significantly by people and activities in the grassland areas. Other more cosmopolitan species are likely less affected. Specific Faunal or animal assessment is reported separately by faunal specialists. A breakdown of the *approximate* areas of the above vegetation communities (habitat) is provided below (Table 5).

Table 5: Vegetation community areas (Emvelo site).

VEGETATION	AREA (HA)	PERCENT AREA
Transformed	1 283.7	27.6%
Montane Grassland	1 166.2	25.1%
Highveld Grassland	782.1	16.8%
Plantation/Invaded	672.2	14.5%
Highveld Grassland (Degraded)	437.3	9.4%
Riverine/Wetland	181.8	3.9%
Cleared Invaded	94.2	2.0%
Montane Grassland (Degraded)	24.9	0.5%
Dam	1.8	0.0%
	4 644.1	**100.00%**

Notably, transformed areas, primarily cultivated lands constitute 27.6 % and Montane Grassland 25.1 percent. Remnant intact Highveld Grassland only constitutes 16.8 % and 14.5 % comprises dense invaded thickets. The entire remining Highveld Grassland (782.1 Ha) on the site constitutes 0.002 % or the entire remaining extent of the vegetation unit (~380 000 Ha or 3 800 km^2). Watercourses and wetlands have been delineated based on vegetation characteristics where they form distinct habitat. Being a terrestrial assessment, these might not include the smallest of aquatic features, which will be subject to the aquatic assessment protocols and outside the scope of this terrestrial biodiversity assessment. In terms of ecological processes, all watercourses, including these minor drainage lines, should still be avoided as far as possible, inclusive of buffers as per aquatic assessment. This landscape offers suitable habitat for a limited suite of animal species due to homogenous nature of the vegetation, although animals may have been displaced by to some extent in the grassland areas.

Vegetation is typical and representative of the vegetation unit. Exact composition and levels of disturbance are somewhat variable, dependant on various ecological factors, slope, aspect as well as historical and current land use and fire management practices. Due to having a low conservation status, the Montane Grassland would in principle provide a suitable footprint for the proposed activity, while intact Highveld grassland would provide less opportunity. The optimum approach is thus to limit loss of more sensitive habitat, and/or where unavoidable representative areas should be retained as ecological corridors.

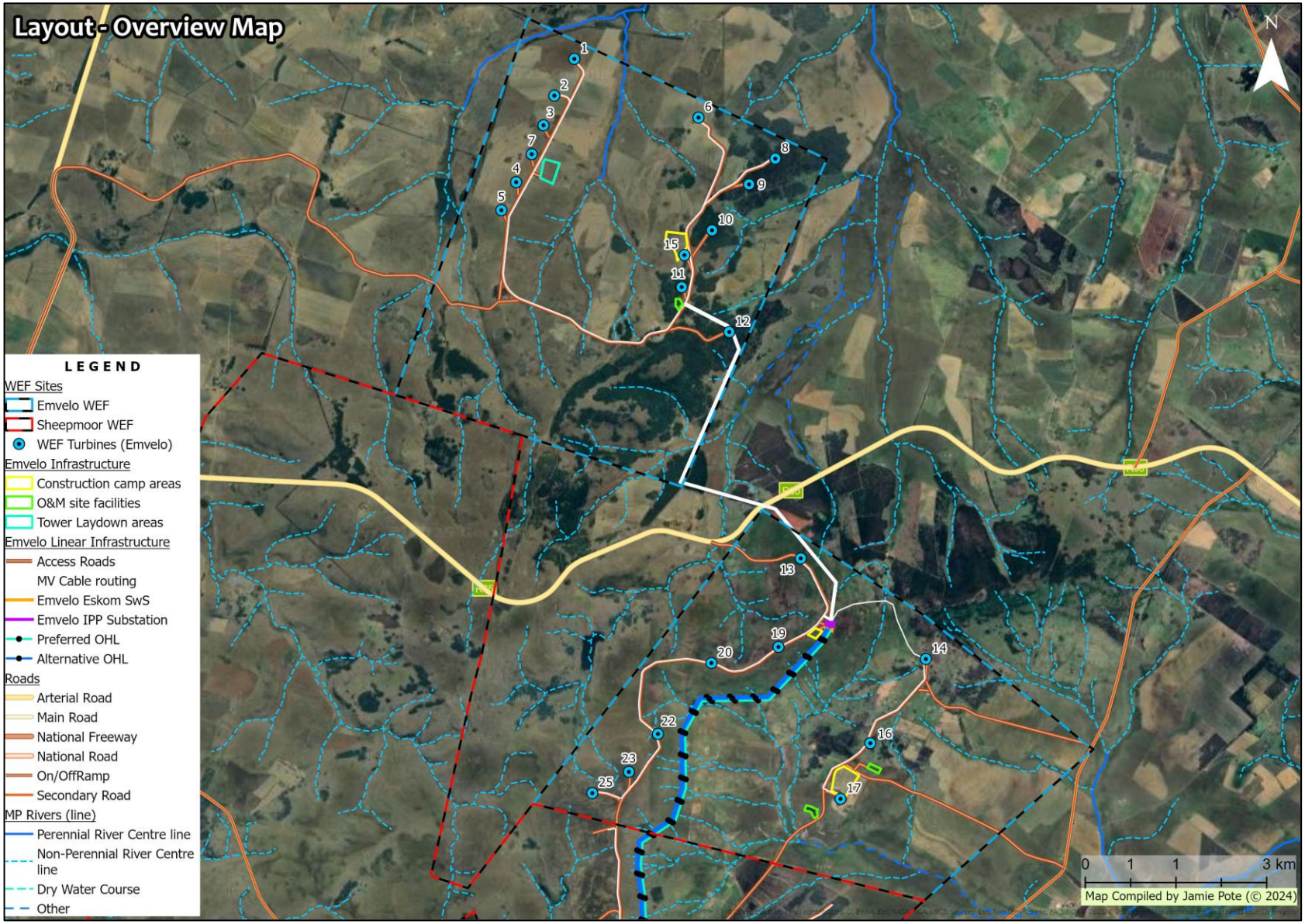


Figure 17: Aerial Photo of the Emvelo Wind Energy Facility site with layout indicated.

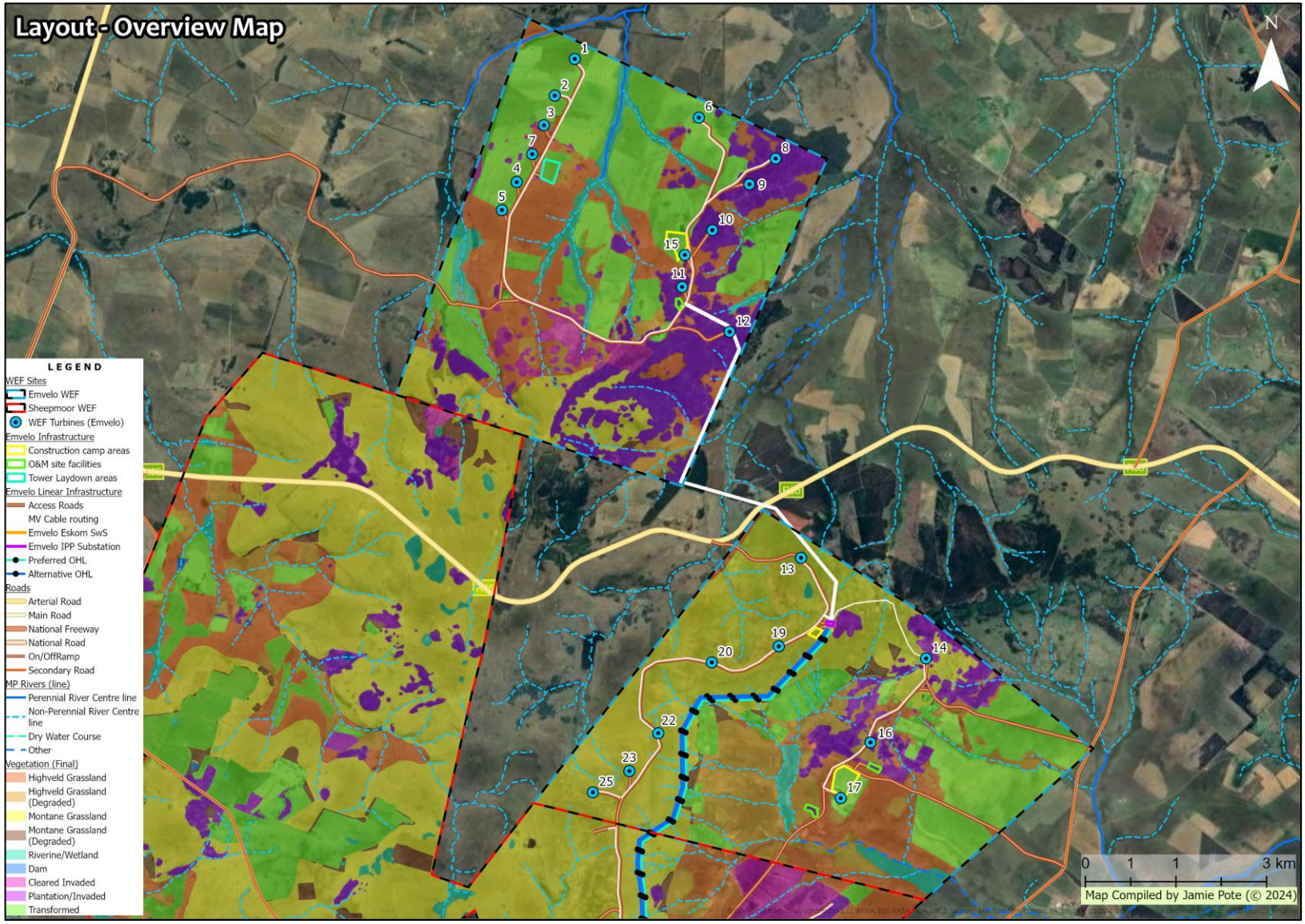


Figure 18: On-site mapped vegetation communities and/or habitat units.

3.1.4 Mapped Vegetation (Habitat)

The Emvelo Wind Energy Facility site is situated to the east of Ermelo in Mpumalanga Province (Figure 17). Fine scale on site mapping has been undertaken of the discrete vegetation units, communities and habitat utilising various tools including aerial photos (including historical imagery), Landsat land cover maps as well as on site verification, as depicted in Figure 18. The represented habitats, as outlined above are described in more detail below.

Highveld Grassland

Natural/Near Natural Eastern Highveld Grassland at higher altitudes, mostly used for grazing and crops. Well-represented on the site, with some near natural to pristine remnant patches present, but most of the area has either been transformed or disturbed at some point historically, including areas that are mowed periodically for hay and other fodder resources. More natural habitat tends to be confirmed to slopes where utilisation is less. Rocky outcrops and rocky habitat tends to be uncommon but is present on some slopes and also occasionally present in flat areas where shallower soils are present. Rocky areas tend to not have the elevated diversity that is normally associated with fire refuge outcropping, most likely due to historical utilisation for grazing and possible fire management to promote grasses. Deemed no go where designated Irreplaceable as per regional planning.





Degraded Highveld Grassland

Areas of the above unit that are distinctly degraded through historical use or has been transformed in the distant past where secondary vegetation is established and cannot be conclusively confirmed to be natural or secondary. Compaction tends to be elevated to some extent and areas with shallower soils





Montane Grassland

Natural/Near Natural Wakkerstroom Montane Grassland at higher altitudes and more prevalent in rocky mountainous areas, so transformation levels are significantly lower. Well-represented on the site, with near natural to pristine being present and common, although most areas show some level of historical utilisation for grazing and also high levels of localised alien tree infestation is prevalent. Rocky habitat including outcrops are present, often on slopes, plateaus and on edges of plateaus, with poor or shallow soils generally having an elevated presence of shrub and herbaceous species. The rocky shrub community is not well represented on the site, but generally has a higher overall non-graminoid diversity and is in a more pristine state in less accessible areas and where not having had dense alien infestations.





Degraded Montane Grassland

Areas of the above unit that are distinctly degraded through historical use or have been transformed in the distant past where secondary vegetation is established and cannot be conclusively confirmed to be natural or secondary.





Riparian/Riverine

Natural vegetation surrounding watercourses and seeps, most likely having riparian elements with some seep functionality. Grassland vegetation typical of the surrounding units, but having riparian elements, but usually lusher with taller growth. These areas would not be suitable due to ecological importance and are considered no-go areas. This category overlaps with the aquatic assessment designated delineated rivers and floodplain and channelled valley-bottom wetland systems.





Natural vegetation surrounding watercourses, generally comprising a fringe of grasses and small trees that tend to be lusher than the surrounding habitat as well as the typical riparian elements (sedges and reeds), usually where standing water or a perched water table is present for extended periods. Grassland elements tend to be lusher along lower order watercourses or where wet conditions persist longer than surrounding areas. Vary in size from incised watercourses with a thicket fringe, to shallow undifferentiated channels with grasses and/or a fringe of low shrubs.

Riverine areas should generally not be developed other than for crossings of linear features (access roads), including a 32 m watercourse buffer (or as per aquatic reporting). Where turbines may be in proximity to watercourses or wetlands or buffers, the laydown areas should be orientated away from rather than toward the watercourse (or buffer).

Secondary/Degraded/Old Lands

Old lands or other disturbed areas, where grasses regenerate from the surrounding landscape. These areas typically have lower species diversity and often lack characteristic species found in natural and near natural habitat. Such areas would most likely be the most suitable for the proposed activity having lower conservation priority and most likely also having marginal or lower agricultural suitability (which would likely be why it is no longer used).





Invaded

Areas having dense alien infestation where natural ecological processes are significantly altered, soil properties are often also altered and natural vegetation might be restricted to the occasional grass, herb or shrub scattered throughout the dense thicket clump. In areas where less dense, typical grass fires tend to burn at a significantly higher temperature, which can slowly alter soil properties and promotes proliferation and ultimately densification of the invasives.





Cultivated

Extensive areas that have been transformed for agricultural use either as pastures or crops and are either currently in use or have been in use during the assessment period. No irrigated pivots are present and lack of a large water supply in the area suggests that these are mostly dryland crops (i.e., not irrigated). Extensive currently cultivated areas are present, predominantly maize but also with some areas that are pastures. Areas that are currently old lands, may be used in the future, as crop rotation does appear to occur in the area, based on analysis of historical aerial photographs.





Transformed

Generally, where all indigenous vegetation has been removed and replaced with hardened surfaces such as houses, access roads, other infrastructure. Includes areas that are not currently used for agriculture. Transformed areas are present, including several dwellings.

Dams

Water storage dams and artificial wetland areas usually present as small impoundments along watercourses. No large dams are present within the site. These are usually comprised of small waterbodies surrounded by a fringe of typical riparian sedges, bulrushes and reeds. These dams while artificial do provide important habitat for a range of faunal species within a modified landscape. *This category overlaps with the aquatic assessment designated artificial wetlands.*





3.1.5 Flora

Several threatened or protected, endemic and range restricted species are known from the surrounding area. Due to the localised nature of the impact, as well as the level of degradation of the site, the risk of a species suffering any significant loss is low to medium. The preliminary site screening to not specifically assess species composition, being undertaken during the winter months.

Potential Red Listed, Endemic and Protected Flora

The site falls within the general distribution range of several endemic species and other species of conservation concern, some with a highly localised distribution and/or some of which may be Critically Endangered, Endangered, Vulnerable or Rare. Some of these species are also only from a single or a few populations. As per Table 6, Critically Endangered flora species are likely not present, but Endangered

species are known to occur in the vicinity and suitable habitat is present. It is likely that some sporadic clusters of species are present but will require specific footprint surveys during the final walkdown due the extent of the site. It is unlikely that the proposed WEF will pose any risk to Species of Conservation Concern as no substantial populations were found. *Sensitive species names have not been included as per reporting protocols.*

*Table 6: Flora including Species of Special Concern (Endangered species in **bold**) flagged for the WEF site and grid.*

SCIENTIFIC NAME	FAMILY	STATUS[3]	COMMENT/PRESENCE[4]
Gerbera aurantiaca	Asteraceae	EN A2ac, NEST (M)	A mistbelt grassland endemic, this species habitat has been over 90% transformed for commercial forestry plantations and crop and pasture cultivation over the past 120 years. There has also been extensive recent loss of habitat in the KwaZulu-Natal Midlands to urban development. Gerbera aurantiaca is a long-lived clonal species whose generation time is suspected to exceed 100 years. Subpopulations are scattered and there isn't a linear relationship between mistbelt grasslands and the presence of subpopulations, we therefore extrapolate a 50% loss of subpopulations from the 90% loss of habitat. Recent studies by I. Johnson and S. Johnson show that this species is a poor recruiter and has low seed viability as a result it is unlikely to be able to recover from the past loss of individuals. NOT RECORDED.
Sensitive species 998	-	EN A2bd, NEST (M)	The population is estimated to have declined at least 50% over the last three generations (60 years) due to persistent and consistent harvesting pressures for the medicinal plant trade and some loss of suitable habitat for afforestation and crop cultivation. It is a highly sought-after medicinal plant that has been exploited over its entire range both within and outside of South Africa. Widespread across the eastern highveld of Mpumalanga, the eastern Free State, and north-western KwaZulu-Natal. It occurs along the north and north-eastern borders of Lesotho and is also found in Swaziland, on the Eastern Highlands of Zimbabwe and the Chimanimani Mountains of Mozambique. Forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands. Preferred habitat (montane vleis) is excluded from footprints. NOT RECORDED.
Asparagus fractiflexus	Asparagaceae	EN A2c; B1ab(iii), NEST (M)	Gm 14. An extremely rare species from southern Mpumalanga, recorded only four times. Around 80% of its habitat in some parts of its range was transformed around the 1940-50s, which is within the last three generations of this long-lived, resprouter (generation length 50 years). An overall 50% decline across the range is suspected. The open areas between plantations, which served as fire breaks and were important refugia, are now being planted up, causing ongoing loss of habitat. NOT RECORDED.
Geranium ornithopodioides	Geraniaceae	EN B1ab(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v)	Gm 14, Not recorded
Aloe ecklonis	Asphodelaceae	LC, TNCO	Gm 12, Present
Corycium dracomontanum	Orchidaceae	LC, TNCO	Gm 14, Not recorded
Corycium nigrescens	Orchidaceae	LC, TNCO	Gm 14, Not recorded
Cyrtanthus tuckii var. transvaalensis	Amaryllidaceae	LC, TNCO	Gm 14, Present
Disa versicolor	Orchidaceae	LC, TNCO	Gm 14, Not recorded

[3] IUCN – NE – Not Evaluated, Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Least Concern (LC); End – Endemic; TNCO – Transvaal Provincial Nature Conservation Ordinance; Ex, Exotic/Invasive/Weed; NFA – National Forest Act; ToPS – Threatened or Protected Species, Not Threatened – Not an IUCN category.

[4] Common in : Gm 12 - Eastern Highveld Grassland; Gm 14 - Wakkerstroom Montane Grassland

SCIENTIFIC NAME	FAMILY	STATUS[3]	COMMENT/PRESENCE[4]
Haemanthus humilis subsp. hirsutus	**Amaryllidaceae**	**LC, TNCO**	**Gm 12, Present**
Protea subvestita	Proteaceae	LC, TNCO	Gm 14, Not recorded
Hypoxis rigidula var. pilosissima	Hypoxidaceae	NE, TNCO	Gm 14, Gm 12, Present
Protea parvula	Proteaceae	NT A2c, TNCO	Gm 14, Not recorded
Eucomis bicolor	**Hyacinthaceae**	**NT A2d, TNCO**	Gm 14, Not recorded
Eucomis sp	**Hyacinthaceae**	**TNCO**	**Present on slopes, within designated no-go areas**
Bowkeria citrina	Scrophulariaceae	Rare	Gm 14, Not recorded
Khadia alticola	Aizoaceae	Rare, NEST (M)	Montane grassland in shallow, sandy, humus-rich soil pockets and crevices between rock plates above 2000 m. Steenkampsberg, Utrecht and Wakkerstroom. NOT RECORDED.
Lotononis amajubica	Fabaceae	Rare, NEST (M)	High mountain peaks of southern Mpumalanga, north-western KwaZulu-Natal and eastern Free State. Well-drained, high altitude grassland, 1600-1800 m. NOT RECORDED.
Zaluzianskya distans	Scrophulariaceae	Rare, NEST (M)	Zaluzianskya distans is a widespread, but very rare species. It is not suspected to be in danger of extinction. This species occurs from the Mpumalanga Drakensberg Escarpment near Lydenburg southwards to the KwaZulu-Natal Drakensberg foothills near Himeville. Not under imminent threat and reasonable widespread. NOT RECORDED.
Sensitive species 321	-	Rare, TNCO, NEST (M)	Drakensberg Mountain Range from Mpumalanga through Lesotho and KwaZulu-Natal to the Eastern Cape. Montane and subalpine grassland 1 600-3 000 m, on grassy and sometimes stony or moist slopes. Not under imminent threat and reasonable widespread. NOT RECORDED.
Kniphofia linearifolia	Asphodelaceae	TNCO	Gm 14, Present
Sensitive species 1252	-	VU A2cd, TNCO, NEST (M)	There was a large population decline from 1955-1960 as a result of indiscriminate commercial harvesting for diosgenin, a substance that was used to manufacture cortisone and other steroid hormones. Exploitation of tubers for the local medicinal plant trade is ongoing and is preventing recovery. The overall decline is estimated to be >30% over the past 90 years (generation length estimated to be 30 years). NOT RECORDED.
Khadia carolinensis	Aizoaceae	VU A3c, NEST (M)	Coal reserves are found underneath the sandstones on which this species is found. Coal mining has had a small impact to date, but within the last five years many new applications for coal mining has been received. Should these applications be granted (and many more are likely to come in within the next few years), the habitat will be severely impacted by open cast mining. We estimate that up to 45% of the range (EOO) of this species could be destroyed within the next 10-20 years should the current applications go ahead. Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m. The OHL route does traverse and area having a known population of this species but can be easily avoided as pylons can be carefully micro sited and have a very limited footprint. NOT RECORDED.
Sensitive species 41	-	VU B1ab(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v), NEST (M)	A widespread (EOO <19 940 km²), but relatively rare (AOO <2000 km²) habitat specialist, estimated to remain at between six and ten locations and declining due to severe ongoing habitat loss and degradation. This species' habitat is becoming increasingly rare due to ongoing loss and degradation. The main threat is damming of streams feeding into wetlands as well as wetland drainage for agriculture. This species requires year-round moist conditions to flourish but damming and drainage reduce water flow to wetlands causing prolonged dry conditions. Specific habitat is included in no go designation, not at risk. NOT RECORDED.
Sensitive species 1201	-	VU B1ab(i,ii,iii,i	Restricted to a small area on the hilly, upper Mpumalanga escarpment (EOO 400 km²), known from six locations. It has lost

SCIENTIFIC NAME	FAMILY	STATUS[3]	COMMENT/PRESENCE[4]
		v,v), NEST (M)	habitat to commercial forestry plantations and most locations are threatened by encroachment from invasive alien species, especially wattles, which prefer rocky areas where they are protected from fire. It is also under development pressure from golf resorts. Site is outside of known range & no records in vicinity suggest local occurrence. NOT RECORDED.
Nerine platypetala	Amaryllidaceae	VU B1ab(i,ii,iii,iv,v), TNCO	Gm 14, Not recorded
Sensitive species 691	-	VU B1ab(ii,iii,v), NEST (M)	EOO between 445 and 11 158 km² and suspected to occur at fewer than 10 locations. It has lost habitat to crop cultivation in the past. It is currently threatened by ongoing degradation and habitat loss due to overgrazing and urban development. Crop cultivation is a past threat that lead to extensive loss of habitat. At present urban development on the banks of the Vaal Dam are causing ongoing loss of habitat. Invasive alien plants threaten a number of subpopulations. Habitat degradation by livestock has meant that several habitats in western Mpumalanga are currently under threat. This threat is however reversible as one subpopulation in Mpumalanga has had livestock removed and has recovered well. Preferred habitat - undulating grasslands in damp areas (seeps) is generally avoided. NOT RECORDED.
Pachycarpus suaveolens	Apocynaceae	VU B1ab(iii), NEST (M)	A showy plant known from eight historical locations and probably extremely rare. One location, last collected in Gauteng in 1929 has subsequently been lost to urban expansion and this species is likely to be locally extinct in Gauteng. The grasslands habitat across its range (EOO 19 900 km²) is extensively transformed by urban development, crop cultivation, mining and invasive alien plants. Mining is causing a continuing decline in habitat between Witbank and Carolina. Gauteng and Mpumalanga to Swaziland. Threatened by agriculture, mining and aliens. Seventy-five percent of the known localities occur in heavily transformed areas, with about 45% of the habitat within its known range already transformed (M. Lötter, pers. comm.). Around the Witbank-Carolina-Ermelo area there is substantial coal mining already, as well as renewed interest in coal mining. NOT RECORDED.
Sensitive species 851	-	VU B1ab(iii), NEST (M)	Suspected to have a very narrow distribution range, but due to taxonomic uncertainty, its range cannot be accurately defined. Its extent of occurrence (EOO) is possibly as small as 6244 km² but could be up to 22 664 km² if records from the eastern Free State and Lesotho are included. It is known from fewer than 10 locations and is declining across its range due to ongoing habitat loss and degradation. Occurs in shallow vleis and marshes in high altitude montane grassland. NOT RECORDED.
Sensitive species 1219	-	VU B1ab(iii)+2ab(iii), TNCO, NEST (M)	Gm 14. A rare species known from only a few, isolated subpopulations. It has a restricted range, with an extent of occurrence of 12 230 km², and an estimated area of occupancy of 104-112 km². It is known from five to ten locations and continue to decline due to ongoing habitat loss and degradation. Occurs in scattered, isolated subpopulations across the Mpumalanga Highveld, from Dullstroom to Graskop, and southwards to Barberton and Wakkerstroom Relatively common in the Wakkerstroom area. Site is outside of known range & no records in vicinity suggest local occurrence. NOT RECORDED.
Aspidoglossum xanthosphaerum	Apocynaceae	VU D2, NEST (M)	Recorded from four locations from a restricted range (EOO<500 km²). Potentially threatened by wetland drainage for crop cultivation and by livestock trampling and grazing. Montane grassland, marshy sites, 1800 m. Preferred habitat (montane wetlands) are excluded from footprints. NOT RECORDED.
Indigofera hybrida	Fabaceae	VU D2, NEST (M)	Known from three locations. Some habitat has been transformed to forestry plantations and agriculture and further habitat loss remains a potential threat. This is a very poorly known species. When Brown described the species in 1925, he speculated that it might be a hybrid because of its similarity to the widespread

SCIENTIFIC NAME	FAMILY	STATUS[3]	COMMENT/PRESENCE[4]
			Indigofera hilaris. The taxon is however still recognised as a distinct species NOT RECORDED.

Locality of known records of Flora of Conservation concern are indicated in Figure 19

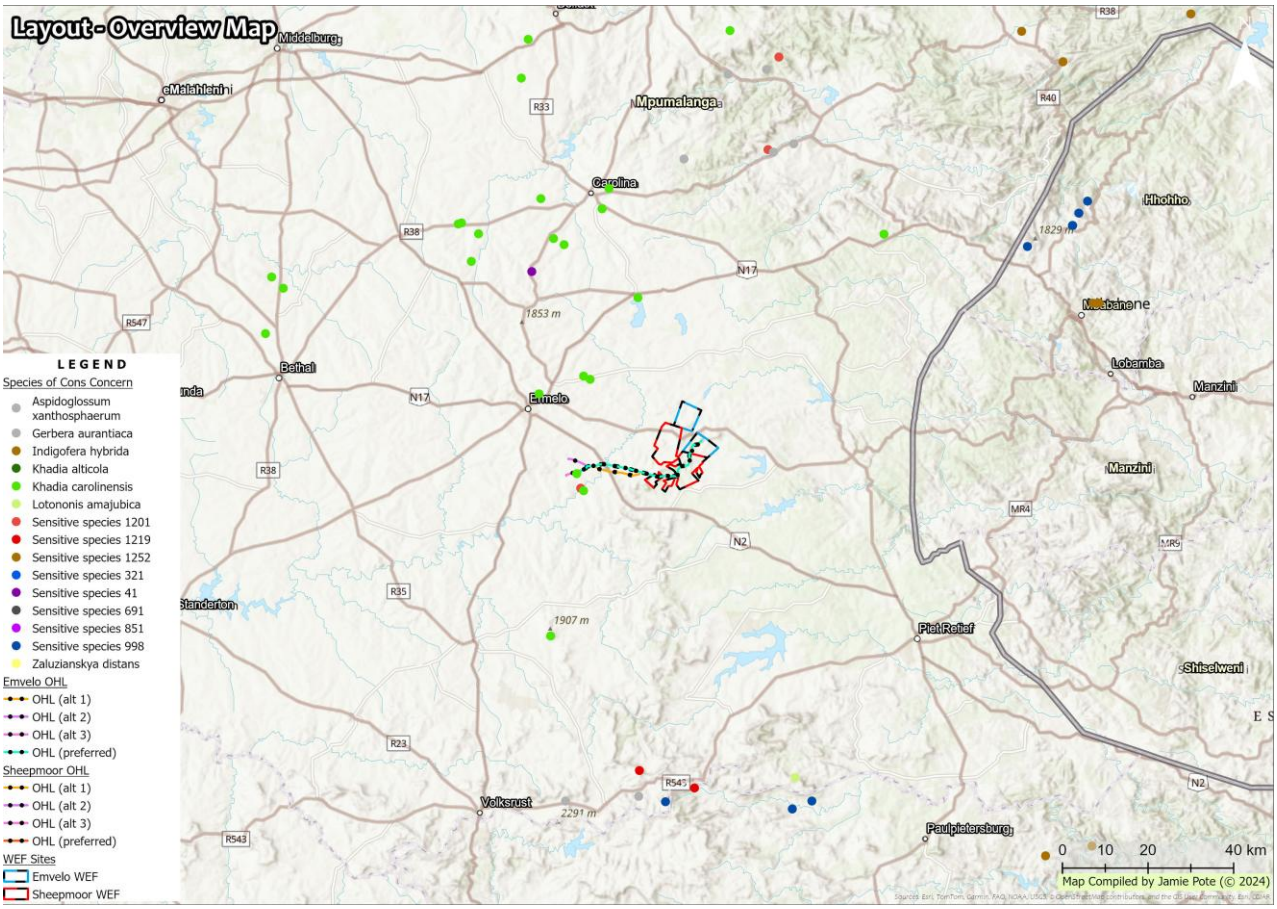


Figure 19: Locality of known records of flagged Flora Species of Conservation Concern in relation to the site and OHL.

The final site visit was undertaken in mid-summer and proved to be a suitable season; however, the final site layout was not available at the time. All reasonable measures were taken to survey the range of habitat represented within the site; however, it is not feasible to sample 70 million square meter site with certainty. It is recommended that a final site walkdown be undertaken in order to inform the final layout design and inform micro0-siting of the footprints. Avoidance and Search and Rescue mitigation measures are deemed adequate to accommodate any small populations of Species of Conservation Concern that might not have been sampled and species that are Endangered or Critically Endangered are not deemed to be of significant concern. Most likely high-risk habitat, which includes remnant pockets of Highveld Grassland in good condition, wetlands and vleis, slopes and rocky outcrops on edges of plateaus have been identified and layout excludes these areas. Where suitable habitat is present (such as Montane Grassland in good condition) that is not excluded, is it deemed to be extensive to the extent that risks to any significant population will be low to negligible. The proposed development of the site for renewable energy provides a conservation opportunity, as it allows the farms to generate income without wide sale clearing of vegetation for agriculture with associated indirect impacts. This reduces the reliance of these farms on agriculture and high levels of utilisation. Furthermore, the development of a renewable facility will allow for the enhancement of any conservation opportunities that are identified during the ongoing construction and operational phases, for example protection of species of conservation concern and improvement of habitat, as outlines in

the proposed trade off clearing of wattle thickets. These opportunities far outweigh any risks associated with loss of species of conservation concern, where measures will be in place to accommodate any specific issues during final layout design (walkdown) and construction (flora search and rescue). Wind Energy Facility projects pose a significantly different risk to terrestrial flora compared to other far more destructive development options including Mining, Agriculture (cultivation & high-density livestock), Forestry and Urban development, where extensive areas of habitat are cleared, and habitat is significantly fragmented. Wind Energy Facilities allow for very well-planned layout design and have specific measures at all stages of the development process to address ecological risks. Conservation objectives are highly compatible with Wind Energy development projects.

3.1.6 Fauna

The habitats and microhabitats present on the project site are not unique and although highly fragmented, are widespread in the broader area, hence the local impact associated with the footprint would be of low significance if mitigation measures are adhered to. The site falls within the general distribution range of several flagged faunal species. Refer to specific faunal assessment reports for detailed faunal reporting. This report will only address general faunal aspects within general ecological and terrestrial biodiversity characteristics.

Mammals

National Environmental Screening Tool identifies several mammal species as possibly occurring in the area. Refer to separate survey and assessment by respective specialists.

Avifauna and Bats

No assessment undertaken. National Environmental Screening Tool identifies several species as possibly being in the area. Refer to separate faunal survey and assessment by respective specialists.

Reptiles

Reptiles such as lizards, snakes and tortoises may be present. Site survey and assessment would be required to confirm, however no specific species flagged. Refer to separate faunal survey and assessment by respective specialists.

Amphibians

Amphibians are likely to be present due to the prevalence of watercourses and wetlands. Site assessment would be required to confirm, however no specific species flagged, and likelihood of impacts is low since most aquatic habitat is designated no-go, other than nominal necessary crossings for roads. Refer to separate faunal survey and assessment by respective specialists.

Invertebrates

National Environmental Screening Tool identifies a single invertebrate species as possibly occurring in the area. Refer to separate faunal survey and assessment by respective specialists.

Potential Red Listed and Protected Fauna

As per Table 7, Endangered or Critically terrestrial fauna species are flagged for the site. The site falls within the potential distribution range of a few faunal species of concern. No further avifaunal investigations have been undertaken but the single mammal and insect species that is flagged both have significantly more widespread distribution than the site. Since the project footprint is likely to be relatively contained, any disturbance or displacement associated with habitat destruction as a direct result of the activity is unlikely to pose a significant negative impact to terrestrial faunal species above

background disturbance levels that are already present. Seasonal assessments of the fauna recommended for clarification of risk.

Table 7: Fauna Species of Special Concern

SCIENTIFIC NAME	COMMON NAME	STATUS[5]	COMMENT/PRESENCE
Mammals			
Crocidura maquassiensis	Makwassie musk shrew	VU, NEST (M)	Possibly present, within range but no confirmed records nearby. Refer to separate faunal assessment.
Ourebia ourebi ourebi	Oribi	EN, NEST (M)	Present. Impacts are likely to be within acceptable limits due to limited WEF footprint and likely within the range of current baseline disturbance levels. Refer to separate faunal assessment and Oribi Management Plan.
Birds			
Balearica regulorum	Grey Crowned Crane	EN, NEST (H)	Refer to Avifaunal Assessment
Eupodotis senegalensis	White-bellied Bustard / Korhaan	VU, NEST (H, M)	Refer to Avifaunal Assessment
Hydroprogne caspia	Caspian Tern	VU, NEST (M)	Refer to Avifaunal Assessment
Sagittarius serpentarius	Secretary Bird	VU, NEST (H, M)	Refer to Avifaunal Assessment
Tyto capensis	African Grass Owl	VU, NEST (M)	Refer to Avifaunal Assessment
Geronticus calvus	Southern Bald Ibis	VU C1+2a(ii), NEST (H,M)	Refer to Avifaunal Assessment
Neotis denhami	Denhams Bustard	NEST (M)	Refer to Avifaunal Assessment
Reptiles			
None of concern	-	-	None flagged. Refer to separate faunal assessment.
Amphibians			
None of concern	-	-	- None flagged. Refer to separate faunal assessment
Invertebrates			
Clonia lalandei	Lalande's *Black-winged Clonia*	*VU* B1ab*(i,iii)*	Impacts are likely to be low as a result of WEF due to limited footprint and likely within the range of current baseline disturbance levels. Refer to separate faunal assessment.

Refer to Faunal taxa specialist reporting for further analysis of fauna species of conservation concern.

Specific faunal risks and mitigations are outlined in the respective faunal and avifaunal assessment reports. With including of the recommended buffers and mitigation measures overall risks to terrestrial biodiversity aspects are thus deemed to be low and within acceptable limits. Additional faunal species and risks as per separate faunal assessments, but buffers and measures are recommended to minimise these risks to acceptable levels within the terrestrial biodiversity context.

Alien Invasive Species

On 18 September 2020, the Minister of Environmental Affairs published the Alien and Invasive Species Regulations ("the Regulations") which came into effect on the 18 October 2020 in a bid to curb the negative effects of IAPs. The Regulations call on landowners and sellers of land alike to assist the Department of Environmental Affairs to conserve our indigenous fauna and flora and to foster sustainable use of our land. Non-adherence to the Regulations by a landowner or a seller of land can result in a criminal offence punishable by a fine of up to R 5 million (R 10 million in case of a second offence) and/or a period of imprisonment of up to 10 years.

- Category 1a and 1b listed invasive species must be controlled and eradicated.

5 IUCN: LC – Least Concern; VU – Vulnerable; EN – Endangered; CR – Critically Endangered; NT – Near Threatened.

- Category 2 plants may only be grown if a permit is obtained, and the property owner ensures that the invasive species do not spread beyond his or her property.
- The growing of Category 3 species is subject to various exemptions and prohibitions.

Some invasive plants are categorised differently in different provinces. *For example*: the Spanish Broom plant is categorised as a category 1b (harmful) invasive plant in Eastern Cape and Western Cape, but it is a category 3 (less harmful) invasive plant in the other seven provinces.

Invasive alien plants have a significant negative impact on the environment by causing direct habitat destruction, increasing the risk and intensity of wildfires, and reducing surface and sub-surface water. Landowners are under legal obligation to control alien plants occurring on their properties. Alien Invasive Plants require removal according to the Conservation of Agricultural Resources Act 43 of 1983 (CARA) and the National Environmental Management: Biodiversity Act (10 of 2004; NEMBA): Alien and Invasive Species Lists (GN R598 and GN R599 of 2014). Alien control programs are long-term management projects and a clearing plan, which includes follow up actions for rehabilitation of the cleared area, is essential. This will save time, money, and significant effort. Collective management and planning with neighbours allow for more cost-effective clearing and maintenance considering aliens seeds as easily dispersed across boundaries by wind or water courses. All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing. A general rule of thumb is to first target lightly infested areas before tackling densely invaded areas and prioritize sensitive areas such as riverbanks and wetlands. Alien grasses are among the worst invaders in lowland ecosystems adjacent to farms but are often the most difficult to detect and control.

Extensive areas of impenetrable invasive tree thickets are present across the site, more extensive in the north. These are comprised of a range of primarily wattle species but also include some eucalyptus and pine. These infestations have a significant effect on natural vegetation and ecological processes. Site observations indicate that there are ongoing efforts to eradicate these infestations but is a slow process. Post removal burning of brushwood also has a negative impact on soil properties, which is not an idea approach for achieving a rehabilitation goal.

Several less prominent exotic invasive and other weed species were noted within the site and surrounding area. Proliferation of weedy and exotic species often indicate disturbance especially during or after construction. A list of species is included in Table 8. During construction it is highly likely that species currently not on site could be introduced through the construction process.

Table 8: Alien (exotic) invasive and other weed species and status.

SCIENTIFIC NAME	COMMON NAME	FAMILY	STATUS[6]	PRESENCE
Acacia mearnsii	Black Wattle	Fabaceae	CARA 1b	Present, extensive
Acacia dealbata	Silver Wattle	Fabaceae	CARA 1b	Present, extensive
Acacia decurrens	Green Wattle	Fabaceae	CARA 1b	Present, common
Acacia melanoxylon	Blackwood	Fabaceae	CARA 2	Present, extensive
Acacia longifolia	Longleaf Wattle	Fabaceae	CARA 1b	Present, common
Acacia saligna	Golden Wattle	Fabaceae	CARA 1b	Present, occasional
Canna indica	Indian shot	Cannaceae	CARA 1b[7]	Present, occasional
Cenchrus clandestinus	Kikuyu grass	Poaceae	CARA 1b	Present, common
Cestrum (Pennisetum) laevigatum	*Inkberry*	Solanaceae	CARA 1b	Present, occasional
Cirsium vulgare	Scotch thistle	Asteraceae	CARA 1b	Present, occasional
Cortaderia selloana	Pampas grass	Poaceae	CARA 1b	Present, occasional
Eucalyptus camaldulensis	Gum Tree	Myrtaceae	CARA 2	Present, extensive

[6] CARA - Conservation of Agricultural Resources Act (1993); National List of Invasive Species in Terms Sections 70(1), 71(3) and 71A (2016); Weed – an exotic ruderal weed species, not indigenous but not a declared invasive species.
[7] 1b in protected areas and wetlands, not listed elsewhere.

SCIENTIFIC NAME	COMMON NAME	FAMILY	STATUS[6]	PRESENCE
Eucalyptus cinerea	Gum Tree	Myrtaceae	CARA 2	Present, extensive
Eucalyptus grandis	Gum Tree	Myrtaceae	CARA 2	Present, occasional
Eucalyptus sideroxylon	Gum Tree	Myrtaceae	CARA 2	Present, occasional
Iris pseudacorus	Yellow flag	Iridaceae	CARA 1a	Present, occasional
Lantana camara	Lantana	Verbenaceae	CARA 1b	Present, occasional
Leptospermum scoparium	Australian myrtle (Tea tree)	Asteraceae	CARA 1b	Present, common
Phragmites australis	*Spanish Reed*	Poaceae	CARA 1b	Present, occasional
Ricinus communis	Castor Oil Plant	Euphorbiaceae	CARA 2	Present, common
Rubus cuneifolius	Bramble	Rosaceae	CARA 1b	Present, common
Sambucus nigra	European elder	Adoxaceae	CARA 1b	Present, common
Senna didymobotrya	Peanut butter Cassia	Fabaceae	CARA 1b	Present, occasional
Sesbania punicea	Sesbania	Fabaceae	CARA 1b	Present, occasional
Solanum mauritianum	Bugweed	Solanaceae	CARA 1b	Present, occasional
Solanum sisymbriifolium	Wild tomato	Solanaceae	CARA 1b	Present, occasional
Urtica urens	Nettle	Urticaceae	Weed	Present, occasional
Verbena bonariensis	Wild verbena	Verbenaceae	CARA 1b	Present, occasional

Eradication protocol

The act required the removal of these species, being the responsibility of the landowner. Several other common weed species are also present which should also be managed as part of all phases commencing immediately with construction, as weed proliferation can run away quickly if not kept in check from the start. Eradication costs also increase with the construction post construction management. A weed management programme is thus highly recommended during and after construction to counter the weed proliferation that would be expected to occur resulting from disturbance to soil during construction. The most cost-effective approach is to implement immediately on commencement and to address any local weed infestations immediately in order to reduce risks of seed generation and proliferation and also being more cost effective than eradication of more mature established infestations. Early eradication also allows use of hand pulling and other hand control methods which would be preferred to using poison. It is also likely that heavy machinery used on site from outside the region, might introduce species that might not already be present or abundant, which can leave the landowners with a problem on completion if not kept in check form the start through weed management.

Specific eradication and management procedures must be stipulated in the EMP as to the methods to be implemented to remove and control the various alien invasive species as they tend to require species specific techniques. A management plan should be incorporated into the EMPr, and a detailed action plan compiled and implemented by the ECO.

3.1.7 Aquatic Habitat

Aquatic systems do not function in isolation and in terms of ecological processes, the aquatic systems are very closely linked to the terrestrial system. Perennial, non-perennial watercourses, and wetlands are present in the wider area and aquatic features, or habitat is present within the site. Any aquatic habitat should be excluded from development.

Aquatic systems are outside the scope of this assessment, however in terms of terrestrial linked processes, all watercourses and wetlands as delineated in this report and the aquatic assessment should be deemed no go areas, other than for limited linear infrastructure such as road crossings. No laydown or construction areas should be constructed near watercourses (not within 100m) and where turbines might be in proximity to watercourses or wetlands, the hard stand should be aligned away from such features.

3.1.8 Terrestrial Vegetation Sensitivity Assessment

An overall desktop Terrestrial Biodiversity Sensitivity assessment, incorporating key vegetation and ecological indicators was undertaken and includes the following key criteria:

- relative levels of *intactness* in terms of overall loss of indigenous vegetation cover.
- presence, diversity, and abundance of *species of special concern* (weighted in favour of local endemic species).
- extent of *invasion* (severity and overall ecological impact), as well as the degree to which successful rehabilitation could take place.
- overall degradation incorporating above factors.
- relative importance of the vegetation communities relative to regional conservation status - indicated as vulnerability of the area because of loss.

Intactness

Three basic classes are differentiated as follows:

- **Low**: > 75 % of original vegetation has been removed or lost; and/or no species of special concern present that are critically endangered, endangered, or endemic with highly localised distribution.
- **Moderate**: 25 - 75 % of original vegetation has been removed/lost; and or presence of species of special concern but not having high conservation status or high levels of endemicity or highly localised distributions.
- **High**: < 25 % of original vegetation has been removed or lost; and or presence of species with a highly endemicity and or high conservation status (endangered or critically endangered).

Intactness for the site is Low to High, with evidence of historical degradation evident, most likely as a result of historical and ongoing livestock grazing.

Alien Invasion

Three classes are differentiated as follows:

- **Low**: no or few scattered individuals.
- **Moderate**: individual clumps of invasives present but cover less than 50% or original area.
- **High**: dense, impenetrable stands of invasives present, or cover > 50 % of area with substantial loss functioning. Rehabilitation will most likely require specialised techniques over an extended period (> 5 years).

Alien invasion for the site is generally low in near-natural area, disturbed areas often have elevated invasive and weed populations. Extensive high density wattle infestations are also present, particularly in the northern areas.

Degradation

Overall Degradation is determined from the above alien invasion and intactness scores, according to the following matrix:

INTACTNESS	INVASION		
	LOW	MODERATE	HIGH
High	Pristine	Near Pristine	Moderately Degraded
Moderate	Near Pristine	Moderately Degraded	Severely Degraded
Low	Moderately Degraded	Severely Degraded	Transformed

Degradation is variable, but generally elevated due to historical utilisation for grazing. Extensive cultivation and other transformation are also present, with natural or near natural areas being patchy rather widespread.

Overall Sensitivity score

Overall Biodiversity Sensitivity of the vegetation within the site is calculated according to the following matrix which combines degradation and overall conservation status of the vegetation units of the site.

DEGRADATION	CONSERVATION STATUS			
	LEAST THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED
Severely degraded/ Transformed	Very Low	Low	Moderate	Moderate - High
Moderately degraded	Low	Moderate	High	High
Ecologically Pristine or near Pristine	Moderate	Moderate - High	High	Very High (No-Go area)

Refer to Figure 20 for overall sensitivity map and Table 9 for summary of the sensitivity of the respective vegetation units and habitats.

Table 9: Sensitivity Summary for the site.

SPECIES	INTACTNESS	SITE ECOLOGICAL IMPORTANCE ALIEN INVASION	DEGRADATION	STATUS	OVERALL SENSITIVITY
Riverine Vegetation	High/Moderate	Low	Pristine	LC	High or Very High[8]
Intact/ Near Intact Highveld Grassland	High/Moderate	Low	Pristine	EN	High or Very High
Intact/Near Intact Montane Grassland	Moderate/ High	Low	Near Pristine	LC	Moderate
Cultivated/Transformed	Very Low	Low	Transformed	LC	Low or Very Low

Overall vegetation sensitivity is ranked as follows, based on the above criteria:

- Very High Sensitivity – includes all intact watercourses, wetlands and riparian vegetation as well as a few patches of remnant Eastern Highveld Grassland and riparian vegetation.
- High sensitivity areas include confirmed areas of Eastern Highveld Grassland that is degraded or secondary (i.e. was historically cleared.
- Moderate sensitivity areas include the general natural or near natural Wakkerstroom Montane Grassland, where national conservation status is not elevated.
- Low sensitivity includes all transformed areas including lands or cultivated areas, and/or dwellings and other areas where no natural vegetation remains.

Due to the elevated conservation status of Eastern Highveld Grassland, intact remnant pockets of vegetation would be deemed to have a high to very high sensitivity. Where intact patches overlap with designated CBA, they are generally designated very high and high for remining intact areas. Riparian vegetation is also categorised as very high sensitivity due to ecological value and irreplaceable habitat and should be considered No-Go. Natural and near natural Wakkerstroom Montane Grassland would be categorised as moderate sensitivity as it is not deemed irreplaceable. It should be avoided as much as possible and attention must be given to bioregional planning designations, but some loss will not pose a significant risk to the vegetation unit. Transformed habitat would be deemed to have a low sensitivity where no natural vegetation remains.

[8] Riverine and Riparian vegetation has a sensitivity elevated above the surrounding vegetation unit, due to its importance in terms of ecological processes and faunal habitat as well as aquatic processes outside the scope of this assessment.

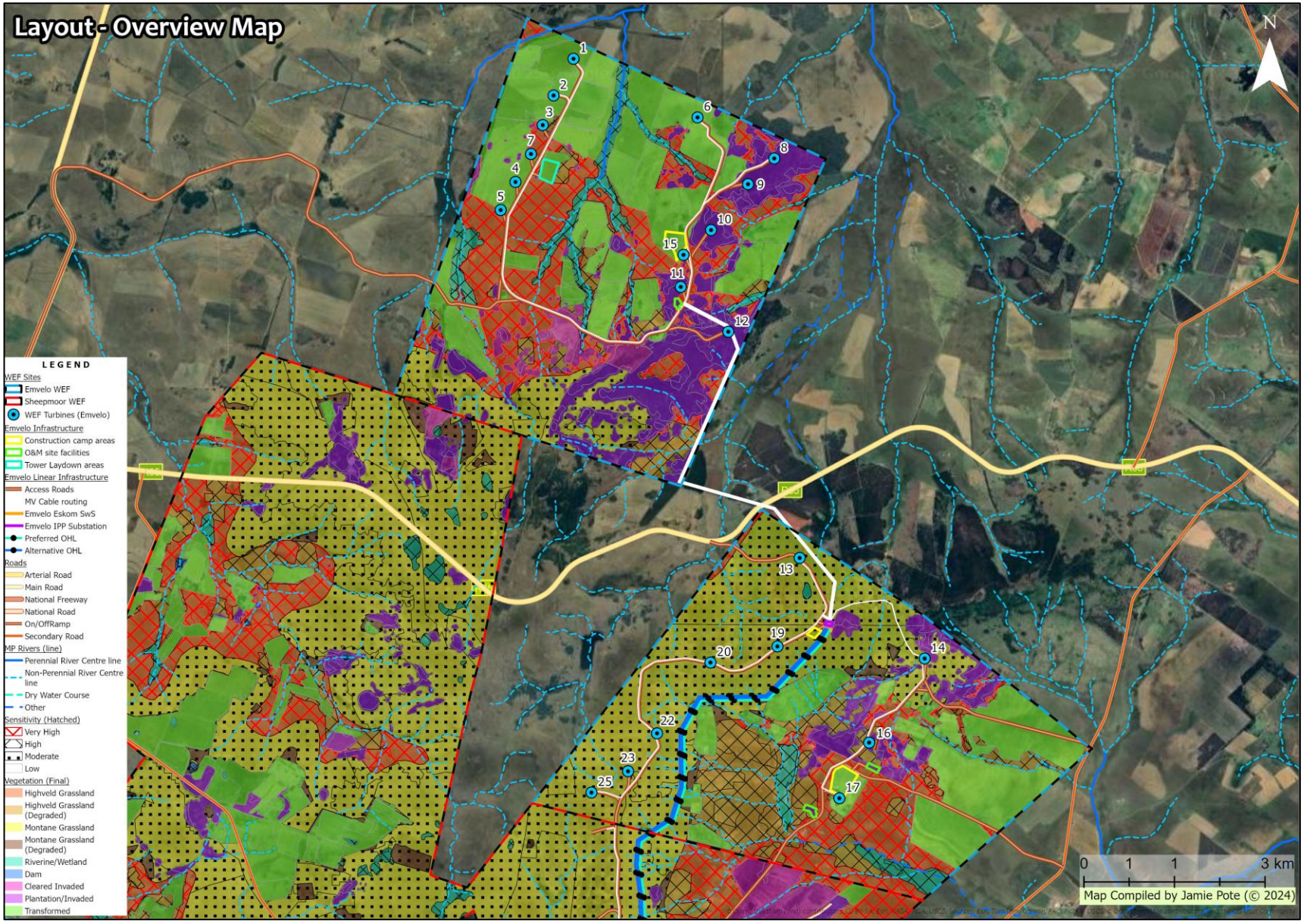


Figure 20: Overall Terrestrial Biodiversity Sensitivity Map.

The vegetation sensitivities indicated are based on a hierarchical approach, with high being the most sensitive and low being the least sensitive. The recommended approach will be to avoid higher sensitivity areas as far as is technically possible and prioritise moderate and lower sensitivity areas. The very high sensitivity riverine areas (and buffers) and irreplaceable Highveld Grassland should be avoided in terms of any footprints other than for minimal access road (including watercourse) crossings, which should also prioritise crossing watercourses where there is already disturbance (such as existing road crossings).

3.1.9 No-Go Areas

Potential No-Go areas would include all designated CBA (Irreplaceable) areas that are confirmed to be near natural or natural, as well as watercourses and wetlands, including any adjacent intact riparian vegetation and associated buffers (as per aquatic assessment). Any populations of Endangered or Critically Endangered species and/or important populations of r Vulnerable species, where relocation is not feasible, would also potentially be considered No-Go areas. No such areas were identified for flora (plant) species. In general, WEF footprints are limited in extend and are not likely to incur significant risks or losses.

3.1.10 Critical Habitat

Possible Critical Habitat features including the following would require site verification to confirm:

7. Criterion 1: Habitat for Critically Endangered (CR) and/or Endangered (EN) species
8. Criterion 2: Habitat for Endemic or restricted-range species
9. Criterion 3: Habitat for Migratory or congregatory species
10. Criterion 4: Habitat for Highly threatened and/or unique ecosystems
11. Criterion 5: Habitat for Key evolutionary processes

Based on site investigations, no flora Species of Conservation Concern, being endemic or range restricted species or having an elevated conservation status were found to occur. The Karoo padloper is considered to be a habitat specialist, preferring rocky outcrop areas with adequate rocky crevices, but also occasionally occur outside of such habitat. Suitable habitat within the site, specifically the footprint areas are not preferred habitat.

3.1.11 Potential Development Footprints

A viable development footprint has been identified within the site. Most suitable areas to minimise biodiversity impacts would be transformed areas, including old lands and currently cultivated areas and degraded areas as well as Montane Grassland areas. As evident in the combined WTG sensitivity map (Figure 21), the optimised layout has largely accommodated the sensitivities and avoided as far as technically possible. Some residual crossings and turbines are within elevated sensitivity areas, but these are deemed to be acceptable and offset measures are prosed to accommodate this nominal loss. These nominal losses are unlikely to significantly compromise any ecological functioning nor conservation targets, as they constitute a very small proportion of both the site as well as the regional coverage or remaining extent of the vegetation. No turbines are situated within the watercourse buffers and the design mitigation strategy has eliminated several crossings from watercourses and buffers. Only necessary access road crossings, mostly along existing farm tracks remain, which are deemed acceptable.

The vegetation mapping should be considered to be a refining or fine scale mapping of the designated CBA and ESA categorisation and remining intact Highveld Grassland would be considered to have a high to very high sensitivity, where additional fragmentation should be kept to a minimum, such as required access roads, and should not be prioritised for placement of turbines, although some can be accommodated as long as they are isolated from other turbines within the same corridor. Any turbines sited along the edges should be designed in a way that the hard stand is orientated towards the outside of the recommended corridor.

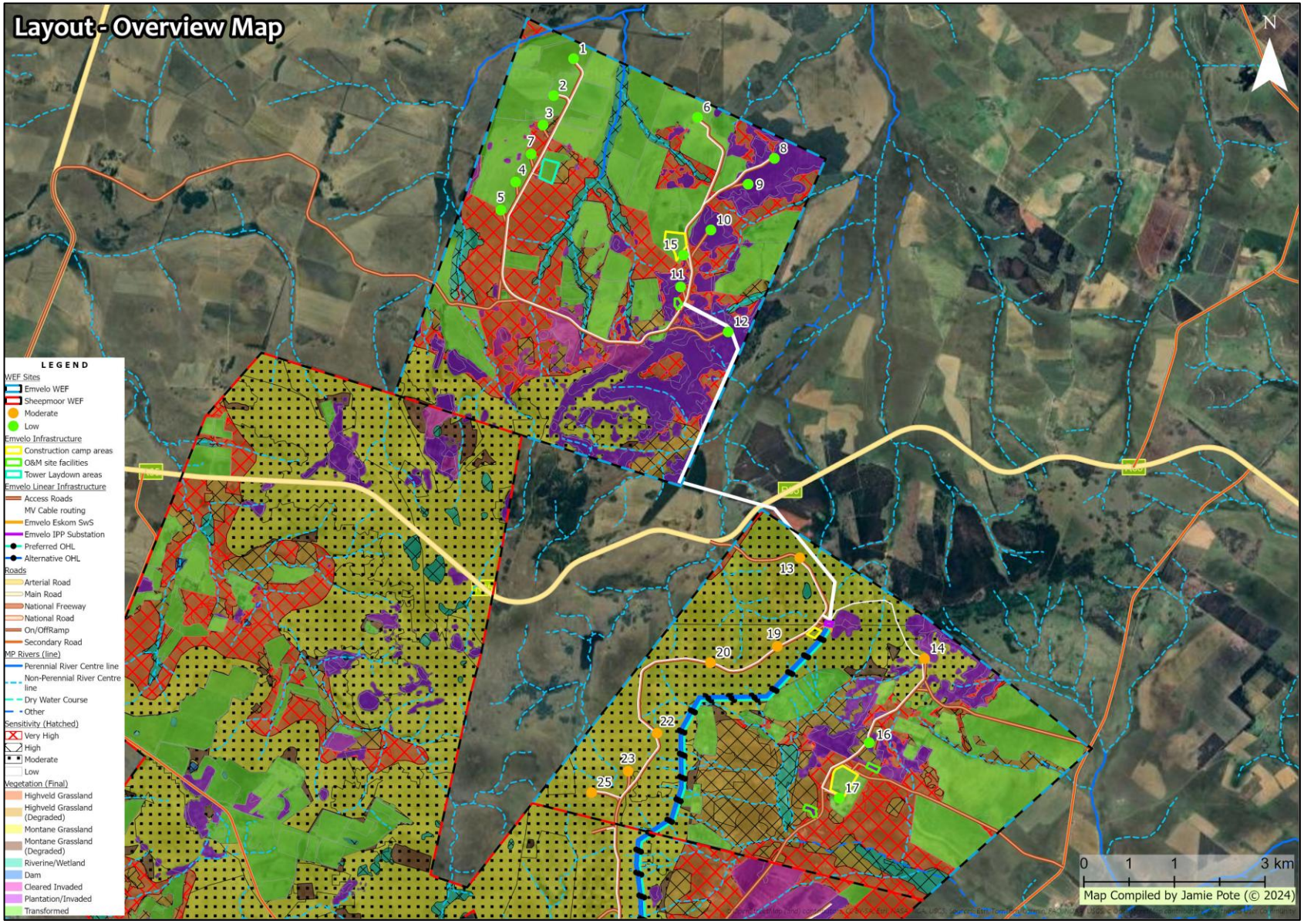


Figure 21: Overall Terrestrial Biodiversity Sensitivity Map with actual turbine sensitivity indicated.

As per Figure 21, a total of 15 or 22 WTGs are located within low sensitivity transformed habitat (cultivated and invaded). Of the remaining 10, 7 are located within natural Montane Grassland (moderate sensitivity) and none within any high sensitivity areas. Of those located in low sensitivity transformed or invaded habitat, 5 WTGs (WTGs 3, 5, 7, 11 & 15) are situated on edges or marginal to natural Highveld Grassland, where some loss of Highveld Grassland may occur, depending on final footprint configuration, but is avoidable. The access road network generally follows existing roads and tracks and invaded/cultivated areas as far as technically possible and will not significantly increase fragmentation above baseline levels. Portions of roads are aligned near remnant Highveld Grassland but are also mostly following existing roads where it intersects any such pockets. Assuming conservatively that each of the WTGs require clearing of 50 % of its footprint within natural Highveld Grassland and the total loss due to roads might be 10 Ha, a total loss of 12.5 Ha might be expected, although likely to be less with careful micro-siting. Since the entire remaining Highveld Grassland within the site is calculated at ~782.1 Ha, this loss represents only 1.6 % of the remaining Highveld Grassland on the site and only 0.003 % of the entire remaining extent. The loss associated with this nominal footprint is thus negligible and not deemed to be significant and will not pose any risk to the conservation of the vegetation unit. Furthermore, the proposed recommended clearing of densely invaded areas of a 1:3 ratio (i.e. at least ~37.5 Ha) will more than adequately compensate for this loss. Furthermore, the management of the sites under an EMPr rather than just the status quo agriculture will provide management resources that will potentially benefit overall conservation significantly more than what the loss represents on the ground.

3.2 Risks and Potential Impacts to Biodiversity

3.2.1 Potential Terrestrial Biodiversity Impacts (Direct)

The main impacts likely to result from the proposed activity are summarised in Table 10 below.

Table 10: Potential Impacts to Terrestrial Biodiversity

IMPACT	NATURE OF IMPACT
Vegetation	Permanent or temporary loss of indigenous vegetation cover because of site clearing. Site clearing before construction will result in the blanket clearing of vegetation within the affected footprint.
Flora Species	Loss of flora species of special concern during pre-construction site clearing activities.
Faunal Species, Habitat & Processes	Loss of Faunal Species, Habitat & Processes: Activity will result in the loss of faunal species and faunal habitat as well as disruptions to faunal processes.
Alien Invasive Species	Susceptibility of post construction disturbed areas to invasion by exotic and alien invasive species and removal of exotic and alien invasive species during construction. Post construction disturbed areas having no vegetation cover are often susceptible to invasion by weedy and alien species, which can not only become invasive but also prevent natural flora from becoming established.
Erosion	Susceptibility of some areas to erosion because of construction related disturbances. Removal of vegetation cover and soil disturbance may result in some areas being susceptible to soil erosion after completion of the activity.
Ecological Processes	Disturbances to ecological processes: Activity may result in disturbances to ecological processes.
Aquatic and Riparian processes	Aquatic and Riparian processes: Aquatic habitat is present and could be affected.

3.2.2 Impacts and Risks to Irreplaceable Biodiversity Resources

Further site investigations would be required to confirm the state of the habitat, as well as species composition to confirm various aspects that cannot be determined in the preliminary assessments. Due to the extensive coverage of the site, it is not feasible to survey the entire are for populations of Threatened or Protected Species. Once the preliminary layout is compiled, which will be guided largely by landscape level sensitivities, a smaller footprint can then be assessed for critical habitat and/or populations of Species of Conservation Concern (SCC). Should any such populations be located, minor layout adjustments can be made accordingly. Furthermore, the standard practice with all Wind Energy facilities including grid connection infrastructure is to undertake a final walkdown of the approved footprint, at which point further layout changes or additional mitigation measures can be made, should any sensitive features be identified which were not identified during the preliminary assessment stages.

3.2.3 Residual Risks and Uncertainties

Any terrestrial biodiversity surveys based upon a limited sampling time-period, may not reflect the actual species composition of the site due to seasonal variations in flowering times and erratic rainfall. As far as possible, site collected data has been supplemented with desktop and database-centred distribution data and the site surveys were undertaken during periods of favourable seasonal rainfall.

3.3 Assessment of Potential Impacts to Biodiversity

3.3.1 Impact Assessment Methodology

The purpose of the assessment of impacts in an EIA is to evaluate the likely extent and overall significance that a potential impact may have on an identified receptor or resource. Another important aspect of the assessment of impacts is to quantify those impacts that are not scientific-based or evidence-based and include the opinions of others (i.e., the involvement and comment from I&APs).

A successful assessment of the potential significance of impacts will include the description and development of 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.

A 7-step approach for the determination of significance of potential impacts was developed by ERM to align with the requirements of Appendix 3 of the EIA Regulations, 2014 (as amended). The approach is both objective and scientific based to allow appointed specialists and EAPs to retain independence throughout the assessment process.

ERM has adapted this 7-step approach from standard ranking metrics such as the Hacking Method, Crawford Method etc. The ERM 7-step approach complies with the method provided in the EIA guideline document (GN 654 of 2010) and considers international EIA Regulatory reporting standards such as the newly amended European Environmental Impact Assessment (EIA) Directive (2014/52/EU).

The 7-Step approach for determining the significance of impacts pre, and post mitigation, is described below:

- **Step 1:** Predict potential impacts by means of an appraisal of:
  - Site Surveys,
  - Project-related components and infrastructure,
  - Activities related with the project life cycle,
  - The nature and profile of the receiving environment and potential sensitive environmental features and attributes,
  - Input received during public participation from all stakeholders, and

- The relevant legal framework applicable to the proposed development

- **Step 2**: Determination of whether the potential impacts identified in **Step 1** will be *direct* (caused by construction, operation, decommissioning or maintenance activities on the proposed development site or immediate surroundings of the site), *indirect* (not immediately observable or do not occur on the proposed development site or immediate surroundings of the site), *residual* (those impacts which remain after post mitigation) and *cumulative* (the combined impact of the project when considered in conjunction with similar projects in proximity).

- **Step 3:** Description and determination of the significance of the predicted impacts in terms of the criteria below to ensure a consistent and systematic basis for the decision-making process. Significance is numerically quantified on the basis score of the following impact parameters:

1. ***Extent* (E)** of the impact: The geographical extent of the impact on a given environmental receptor.
2. ***Duration* (D)** of the impact: The length of permanence of the impact on the environmental receptor.
3. ***Reversibility* (R) of the impact**: The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change
4. ***Magnitude* (M)** of the impact: The degree of alteration of the affected environmental receptor.
5. ***Probability* (P)** of the impact: The likelihood of the impact actually occurring.

A widely accepted numerical quantification of significance is the formula:

S=(E+D+R+M) * P

Where: *Significance= (Extent + Duration + Reversibility + Magnitude) * Probability*

The following has also been considered when determining the significance of a potential impact.

6. **Nature (N)** of the impact: A description of what causes the effect, what will be affected, and how it will be affected.
7. **Status (S)** of the impact: described as either positive, negative or neutral
8. Cumulative impacts.
9. Inclusion of Public comment.

The significance of environmental impacts is determined and ranked by considering the criteria presented in **Table 1** below. All criteria are rank according to 'Very Low', 'Low', 'Moderate', 'High' and 'Very High' and are assigned scores of 1 to 5 respectively.

Table 22: Defining the significant in terms of the impact criteria.

Impact Criteria	Definition	Score	Criteria Description
Extent (E)	Site	1	Impact is on the site only
	Local	2	Impact is localized inside the activity area
	Regional	3	Impact is localized outside the activity area
	National	4	Widespread impact beyond site boundary. May be defined in various ways, e.g. cadastral, catchment, topographic
	International	5	Impact widespread far beyond site boundary. Nationally or beyond
Duration (D)	Immediate	1	On impact only
	Short term	2	Quickly reversible, less than project life. Usually up to 5 years.

Impact Criteria	Definition	Score	Criteria Description
	Medium term	3	Reversible over time. Usually between 5 and 15 years.
	Long term	4	Longer than 10 years. Usually for the project life.
	Permanent	5	Indefinite
Magnitude (M)	Very Low	1	No impact on processes
	Low	2	Qualitative: Minor deterioration, nuisance or irritation, minor change in species/habitat/diversity or resource, no or very little quality deterioration. Quantitative: No measurable change; Recommended level will never be exceeded.
	Moderate	3	Qualitative: Moderate deterioration, discomfort, Partial loss of habitat /biodiversity /resource or slight or alteration. Quantitative: Measurable deterioration; Recommended level will occasionally be exceeded.
	High	4	Qualitative: Substantial deterioration death, illness or injury, loss of habitat /diversity or resource, severe alteration or disturbance of important processes. Quantitative: Measurable deterioration; Recommended level will often be exceeded (e.g. pollution)
	Very High	5	Permanent cessation of processes
Reversibility (R)	Reversible	1	Recovery which does not require rehabilitation and/or mitigation.
	Recoverable	3	Recovery which does require rehabilitation and/or mitigation.
	Irreversible	5	Not possible, despite action. The impact will still persist, and no mitigation will remedy or reverse the impact.
Probability (P)	Improbable	1	Not likely at all. No known risk or vulnerability to natural or induced hazards
	Low Probability	2	Unlikely; low likelihood; Seldom; low risk or vulnerability to natural or induced hazards
	Probable	3	Possible, distinct possibility, frequent; medium risk or vulnerability to natural or induced hazards.
	Highly Probable	4	Highly likely that there will be a continuous impact. High risk or vulnerability to natural or induced hazards
	Definite	5	Definite, regardless of prevention measures.

The *significance* (s) of potential impacts identified according to the criteria above has been colour coded for the purpose of comparison. This colour coding will be used in impact tables.

Significance is deemed Negative (-)			Significance is deemed Positive (+)		
0 - 30	31 - 60	61 - 100	0 - 30	31 - 60	61 - 100
Low	**Moderate**	**High**	**Low**	**Moderate**	**High**

- **Step 4:** Determination of practical and reasonable mitigation measures based on specialists' inputs and field observations following the mitigation hierarchy (avoid, minimise, manage, mitigate, or rehabilitate).

- **Step 5:** Evaluation of predicted residual impacts after implementation of mitigation measures.
- **Step 6:** Determination of the significance of the impact taking into consideration the predicted residual impacts after implementation of mitigation measures.
- **Step 7:** Based on an acceptable significance of the impact, determination of the need and desirability of the proposed development and an opinion as to whether the development should proceed or not.

The Assessment of the significance of potential impacts is then populated in the Impact Summary Table (Section 3.4.1: Assessment of Direct Impacts).

3.4 Assessment of Impacts

In terms of the impact assessment hierarchy (Avoid, Minimize, Rectify Reduce, Offset), the proposed project underwent an initial sensitivity and screening process in order to inform the preliminary layout. After completion of this initial sensitivity screening, a sensitivity map was provided to the proponent, and the layout was refined in order to avoid and minimise sensitivities as far as technically possible. The optimised layout being assessed includes measures to rectify and/or reduce the remining or residual impacts as far as possible. Further refining of the optimised layout may occur during finalisation of the draft reporting as well as during the pre-commencement walkdown once final footprints are determined. **Since the project is not within any critical or sensitive habitat that is under imminent threat, offsets are not anticipated nor included as any recommendations.** The significance before mitigation is this assessed based on a revised layout that has already undergone a refining process to avoid most sensitive habitat pertaining to terrestrial biodiversity.

3.4.1 Assessment of Direct Impacts

Assessment of impacts is summarised in the tables below. The rating values as per the criteria described above, as identified during the assessment.

Construction Phase

Impact Phase: Construction					
Nature of the impact: Permanent or temporary loss of indigenous vegetation cover as a result of the activity					
Description of Impact: Site clearing before construction will result in the blanket clearing of vegetation within the affected footprint. The proposed footprint comprises an insignificant portion of the vegetation unit regionally and extensive areas of natural vegetation are present surrounding the site. Core habitat areas have been identified for avoidance during the preliminary sensitivity mapping and accommodated in the design.					
Impact Status: Negative to Positive					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Site	Long-term	Recoverable	High	Definite
Score	1	4	3	3	5
With Mitigation	Site	Long-term	Recoverable	Low	Probable
Score	1	4	3	2	3
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Moderate Negative Impact (55)		Moderate Positive Impact (30)		
Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~				

Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~

Mitigation measures to reduce residual risk or enhance opportunities:

- **Recommended clearing of alien invaded areas in a ratio of 1:3 for direct loss of natural grassland habitat (as a trade-off or offset), in conjunction with the mitigation measures below as well as post construction rehabilitation of the initial temporary disturbance footprint and implementation of a sound environmental management programme for the duration of the project lifespan can potentially and effectively result in a net positive impact. The loss of vegetation as a result of the loss of the expected project footprint (~180 Ha) is far outweighed by the potential improvement that can be achieved on the remaining habitat of the site (~7 000 Ha) through the positive management measures that can be implemented through the EMPr on farmland where there are currently no EMPr in place.**
- Site layout to avoid more sensitive vegetation as far as technically viable. Most of the risks associated with this impact have been reduced through identification of risk areas during the initial assessment phases and careful layout design in response to the respective sensitivity.
- Site layout design has effectively reduced this impact to negligible levels with only a very small proportion of the footprint occurring in or near higher sensitivity areas. Very High Sensitivity or No-Go habitat has largely been avoided and reduced to an acceptable level.
- Mitigation measures and management actions are proposed to enhance areas of habitat as a trade-off in order to offset this nominal loss of elevated sensitivity areas.
- Blanket clearing of vegetation must be limited to the site and footprint. No blanket vegetation clearing outside of footprint to take place.
- Topsoil must be striped and stockpiled separately during site preparation and replaced on completion in areas where revegetation or rehabilitation will take place.
- Any site camps and laydown areas requiring clearing must be located within already disturbed areas and away from watercourses.

Residual impact	*Residual risks include possible clearing of natural or near natural vegetation outside of the proposed footprint.*

Impact Phase: Construction

Nature of the impact: Loss of flora species of conservation concern during pre-construction site clearing activities.

Description of Impact: *Species of conservation concern are present within the affected area, which could be destroyed during site clearing. The proposed footprint comprises a negligible portion of the vegetation unit regionally and locally and extensive areas of natural vegetation are present surrounding the site. All species are widespread species, and removal will not result in any significant impact to any flora species or population. While present in the area, species of conservation concern are not prevalent within the WEF project site and generally in inaccessible areas or remnant vegetation that are excluded.*

Impact Status: Negative

	E	D	R	M	P
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2

Significance Calculation	**Without Mitigation**	**With Mitigation**
S=(E+D+R+M)*P	Low Negative Impact (28)	Low Negative Impact (12)

Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~

Mitigation measures to reduce residual risk or enhance opportunities:

- A site walkdown to be conducted to inform final layout design (before commencement) in order to inform final design and avoid any species populations.
- A search and rescue must be undertaken before construction commences. Any flora search and rescue will likely include a few individuals of widespread, cosmopolitan or common but protected species.
- Respective permits to be obtained prior to construction commencing.

Residual impact	*Residual risks include possible loss of species of conservation concern outside of the proposed footprint.*

Impact Phase: Construction

Nature of the impact: Loss of fauna species of conservation concern and potential loss of faunal habitat.

Description of Impact: Faunal species of conservation concern are present within the affected area, which could be destroyed during site clearing. All species are widespread species, and removal will not result in any significant impact on any flora species or population. Species may include transient fauna species. Activities associated with site preparation and killing of perceived dangerous fauna, may lead to increased mortalities among faunal species.

Impact Status: Negative

	E	D	R	M	P
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2

Significance Calculation	Without Mitigation	With Mitigation
S=(E+D+R+M)*P	Low Negative Impact (28)	Low Negative Impact (12)

Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~

Mitigation measures to reduce residual risk or enhance opportunities:

- High sensitivity areas as identified by the respective faunal specialists to be avoided and specific mitigation measures as per specialists to be implemented.
- Blanket clearing of vegetation must be limited to the footprint.
- The habitats and microhabitats present on the project site are not unique and are widespread in the general area, hence the local impact associated with the footprint would be of low significance if mitigation measures are adhered to.
- Small mammals within the habitat on and around the affected area are generally mobile and likely to be transient to the area. They will most likely vacate the area once construction commences. As with all construction sites there is a latent risk that there will be some accidental mortalities. Specific measures are made to reduce this risk. The risk of species of Conservation Concern is low, and it is unlikely that there will be any impact to populations of such species because of the activity.
- Reptiles such as lizards are less mobile compared to mammals, and some mortalities could arise. It is recommended that a faunal search and rescue be conducted before construction commences, although experience has shown that there could still be some mortalities as these species are mobile and may thus move onto site once construction is underway. A retile handler should be on call for such circumstances.
- Should any amphibian migrations occur between wetland areas during construction, appropriate measures (including temporarily suspending works in the affected area) should be implemented.
- A pre-commencement faunal search and rescue is recommended, but not necessarily required. Respective permits to be obtained beforehand.
- No animals are to be harmed or killed during the course of operations including use of snares.

Residual impact	*Residual risks include possible clearing of areas outside of the proposed footprint, killing of perceived harmful fauna during construction or not relocating any species, but are likely to be negligible.*

Impact Phase: Construction					
Nature of the impact: Invasion by exotic and alien invasive species could occur as a result of construction					
Description of Impact: Exotic (weed) and alien invasive species may proliferate during and after construction in disturbed areas. Areas disturbed during construction, having no vegetation cover, including temporary stockpile areas, are often susceptible to invasion by weedy and alien invasive species, which can not only become invasive but also prevent natural flora from becoming established.					
Impact Status: Negative to Positive					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Low Negative Impact (28)		Low Positive Impact (12)		
Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~				
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~				
Mitigation measures to reduce residual risk or enhance opportunities: • Alien species (including alien invasive trees) and weeds must be removed from the site as per CARA/NEMBA requirements. • A suitable weed management strategy to be implemented during construction and operation phases as outlined in the EMPr section of this report. It is imperative that any actions are implemented timeously as once alien and weed species generate seeds, the problem is exacerbated. • After clearing and construction is completed, an appropriate cover may be required, should natural re-establishment of grasses not take place in a timely manner along road verges. This will also minimise dust. • **Recommended clearing of alien invaded areas in a ratio of 1:3 for loss of natural grassland habitat, in conjunction with ongoing alien vegetation management of the project footprint will likely result in a net positive impact.**					
Residual impact	Residual risks are primarily related to inadequate initial and ongoing implementation of the weed management plan.				

Impact Phase: Construction					
Nature of the impact: *Disturbances to ecological processes may occur as a result of the activity.*					
Description of Impact: *Activity may result in disturbances to ecological processes. The proposed footprint comprises a negligible portion of the vegetation unit regionally and locally and extensive areas of natural vegetation are present surrounding the site. The site is already significantly fragmented as a result of commercial agriculture, alien invasion and other land uses and the additional fragmentation as a result of the activity will be negligible compared to baseline levels.* Core corridors and connectivity areas have been identified for avoidance during the preliminary sensitivity mapping and accommodated in the design.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability

Score	1	1	3	1	2
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Low Negative Impact (28)		Low Negative Impact (12)		
Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~				
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~				

Mitigation measures to reduce residual risk or enhance opportunities:

- Blanket clearing of vegetation must be limited to the development footprint, and the area to be cleared must be demarcated before any clearing commences.
- Rehabilitation or revegetation should be implemented on completion of construction.

Residual impact	*Residual risks include possible clearing of natural or near natural vegetation outside of the proposed footprint.*

Impact Phase: Construction

Nature of the impact: *Ecological processes associated with Aquatic and Riparian habitat may be affected by the activity and erosion risk may be elevated.*

Description of Impact: *Diversion and increased velocity of surface water flows during construction and operation could alter the hydrological regime and result in changes to water quality as well as loss of riparian vegetation / aquatic habitat. Removal of vegetation cover and soil disturbance during construction may result in some areas being susceptible to soil erosion, in particular during unexpected heavy rainfall. Aquatic Features are present but have largely been avoided via careful layout planning in response to initial sensitivity mapping and recommendations.*

Impact Status: Negative

	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Low Negative Impact (28)		Low Negative Impact (12)		
Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~				
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~				

Mitigation measures to reduce residual risk or enhance opportunities:

- All riverine habitats including watercourses and wetlands to be avoided as per aquatic specialist recommendations, other than minimal strategic crossings for access and linear infrastructure.
- Stormwater discharge from hard stands and roads into watercourses to be protected against erosion.
- Suitable measures must be implemented in areas that may be susceptible to erosion (such as slopes) and all. Any excavations or excavated areas must be protected from erosion.
- Topsoil must be stripped and stockpiled separately and protected from erosion and replaced on completion.
- If natural vegetation re-establishment does not occur natural (bushveld typically regenerates well with minimal intervention), a suitable local grass seed mix must be applied.

Residual impact	*Alien invasion management is an ongoing issue and will require ongoing implementation. Failure to do so may result in a regression.*

Operational Phase

Impact Phase: Operation					
Nature of the impact: Loss of fauna species of conservation concern and potential loss of faunal habitat.					
Description of Impact: Faunal species of conservation concern are present within the affected area and are likely to be mobile during operational phase (excluding avifauna), which could result in mortalities.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Low Negative Impact (28)		Low Negative Impact (12)		
Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~				
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~				
Mitigation measures to reduce residual risk or enhance opportunities: • Ongoing monitoring to be undertaken of the entire project footprint during operations and any hotspots identified. Suitable mitigation measures or responses to be devised and implemented accordingly. • Roads to have suitable speed control measures, in particular in the vicinity or watercourse crossings and where any rocky outcrops might be traversed. • Ongoing monitoring to be conducted along fences for snares. • No killing of fauna to be permitted w.r.t the WEF operations.					
Residual impact	*Residual risks include possible clearing of areas outside of the proposed footprint, killing of perceived harmful fauna during construction or not relocating any species, but are likely to be negligible.*				

Impact Phase: Operation					
Nature of the impact: Invasion by exotic and alien invasive species could occur as a result of construction					
Description of Impact: Exotic (weed) and alien invasive species may proliferate after construction in disturbed areas. Areas disturbed during construction, having no vegetation cover, including temporary stockpile areas, are often susceptible to invasion by weedy and alien invasive species, which can not only become invasive but also prevent natural flora from becoming established.					
Impact Status: Negative					
	E	**D**	**R**	**M**	**P**
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2
Significance Calculation	**Without Mitigation**		**With Mitigation**		
S=(E+D+R+M)*P	Low Negative Impact (28)		Low Negative Impact (12)		

Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~
Mitigation measures to reduce residual risk or enhance opportunities: • Alien species (including alien invasive trees) and weeds must be removed from the site as per CARA/NEMBA requirements on an ongoing basis. • Ongoing monitoring to be undertaken of the entire project footprint during operations and any hotspots identified. Suitable mitigation measures or responses to be devised and implemented accordingly. • A suitable weed management strategy to be implemented during the operational phases as outlined in the EMPr. It is imperative that any actions are implemented timeously as once alien and weed species generate seeds, the problem is exacerbated.	
Residual impact	Residual risks are primarily related to inadequate initial and ongoing implementation of the weed management plan.

Impact Phase: Operation

Nature of the impact: *Disturbances to ecological processes may occur as a result of the activity.*

Description of Impact: *Activity may result in disturbances to ecological processes. The proposed footprint comprises a negligible portion of the vegetation unit regionally and locally and extensive areas of natural vegetation are present surrounding the site. The site is already significantly fragmented as a result of commercial agriculture, alien invasion and other land uses and the additional fragmentation as a result of the activity will be negligible compared to baseline levels.* Core corridors and connectivity areas have been identified for avoidance during the preliminary sensitivity mapping and accommodated in the design.

Impact Status: Negative

	E	D	R	M	P
Without Mitigation	Local	Immediate	Recoverable	Low	Probable
Score	1	1	3	2	4
With Mitigation	Local	Immediate	Recoverable	Very Low	Low Probability
Score	1	1	3	1	2

Significance Calculation	**Without Mitigation**	**With Mitigation**
S=(E+D+R+M)*P	Low Negative Impact (28)	Low Negative Impact (12)

Was public comment received?	~~YES~~/NO. ~~If yes, provide a bullet summary of the main concerns.~~
Has public comment been included in mitigation measures?	~~YES~~/NO, ~~if NO then WHY? If YES then HOW/WHERE~~
Mitigation measures to reduce residual risk or enhance opportunities: • Blanket clearing of vegetation must be limited to the development footprint, and the area to be cleared must be demarcated before any clearing commences. • Rehabilitation or revegetation should be implemented on completion of construction.	
Residual impact	*Residual risks include possible clearing of natural or near natural vegetation outside of the proposed footprint.*

Decommissioning Phase

No terrestrial biodiversity risks or impacts of significance are identified for the decommissioning phase.

3.4.2 Assessment of Indirect Impacts

No indirect terrestrial biodiversity risks or impacts of significance are anticipated.

3.4.3 Assessment of Cumulative Impacts

In relation to an activity, cumulative impact means "*the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities*" (NEMA EIA Reg GN R982 of 2014).

Specialists are required to assess cumulative impacts associated with similar developments within a 35 km radius of the proposed developments. The purpose of the cumulative assessment is to test if such impacts are relevant to the proposed developments in the proposed locations (i.e. whether the addition of the proposed project in the area will increase the impact). In this regard, specialist studies considered whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment or sense of place
- Unacceptable increase in impact

Cumulative Impacts are assessed in the cumulative impact summary table below.

Cumulative Impact: Cumulative loss of indigenous vegetation cover, in particular Endangered Eastern Highveld Grassland as a result of the activity					
Description of Cumulative Impact: Site clearing before construction will result in the blanket clearing of vegetation within the affected footprint. The proposed footprint comprises an insignificant portion of the vegetation unit regionally and extensive areas of natural vegetation are present surrounding the site. Core habitat areas have been identified for avoidance during the preliminary sensitivity mapping and accommodated in the design. A single WTG (WTG 16) is situated within a small, degraded patch of the Endangered Highveld Grassland, with a further 5 WTGs (WTGs 15, 11, 10, 5 & 3) being marginal or on the edge where some loss of Grassland may occur. In addition, portions of road are aligned within remnant Highveld Grassland, but are mostly following existing roads. Assuming conservatively that each of the WTGs require clearing of 50 % of its footprint within natural Highveld Grassland and the total loss due to roads might be 10 Ha, a total loss of 12.5 Ha might be expected, although likely to be less. Since the entire remaining Highveld Grassland within the site is calculated at ~782.1 Ha, this loss represents only 1.6 % of the Highveld Grassland on the site and only 0.003 % of the entire remaining extent. The loss associated with this nominal footprint is thus negligible and not deemed to be significant and will not pose any risk to the conservation of the vegetation unit. Furthermore, the proposed recommended clearing of densely invaded areas of a 1:3 ratio (i.e. at least ~37.5 Ha) will more than adequately compensate for this loss. Furthermore, the management of the sites under an EMPr rather than just the status quo agriculture will provide management resources that will potentially benefit overall conservation significantly more than what the loss represents on the ground.					
Impact Status: Negative to Positive					
	E	**D**	**R**	**M**	**P**
Without Enhancement	Site	Long-term	Recoverable	High	Definite
Score	1	4	3	3	5
With Enhancement	Site	Long-term	Recoverable	Low	Probable
Score	1	4	3	2	3
Significance Calculation	**Without Enhancement**		**With Enhancement**		
S=(E+D+R+M)*P	Moderate Negative Impact (55)		Moderate Positive Impact (30)		
Can Impacts be Enhanced?	YES/~~NO~~ and HOW/WHY				
Enhancement: • **Recommended clearing of alien invaded areas in a ratio of 1:3 for direct loss of natural grassland habitat (as a trade-off or offset), in conjunction with the mitigation measures below as well as post construction rehabilitation of the initial temporary disturbance footprint and implementation of a sound environmental management programme for**					

	the duration of the project lifespan can potentially and effectively result in a net positive impact. The loss of vegetation as a result of the loss of the expected project footprint (~180 Ha) is far outweighed by the potential improvement that can be achieved on the remaining habitat of the site (~7 000 Ha) through the positive management measures that can be implemented through the EMPr on farmland where there are currently no EMPr in place. • Site layout to avoid more sensitive vegetation as far as technically viable. Most of the risks associated with this impact have been reduced through identification of risk areas during the initial assessment phases and careful layout design in response to the respective sensitivity. • Site layout design has effectively reduced this impact to negligible levels with only a very small proportion of the footprint occurring in or near higher sensitivity areas. Very High Sensitivity or No-Go habitat has largely been avoided and reduced to an acceptable level. • Mitigation measures and management actions are proposed to enhance areas of habitat as a trade-off in order to offset this nominal loss of elevated sensitivity areas. • Blanket clearing of vegetation must be limited to the site and footprint. No blanket vegetation clearing outside of footprint to take place. • Topsoil must be striped and stockpiled separately during site preparation and replaced on completion in areas where revegetation or rehabilitation will take place. • Any site camps and laydown areas requiring clearing must be located within already disturbed areas and away from watercourses.
Residual impact	*Residual risks include possible clearing of natural or near natural vegetation outside of the proposed footprint.*

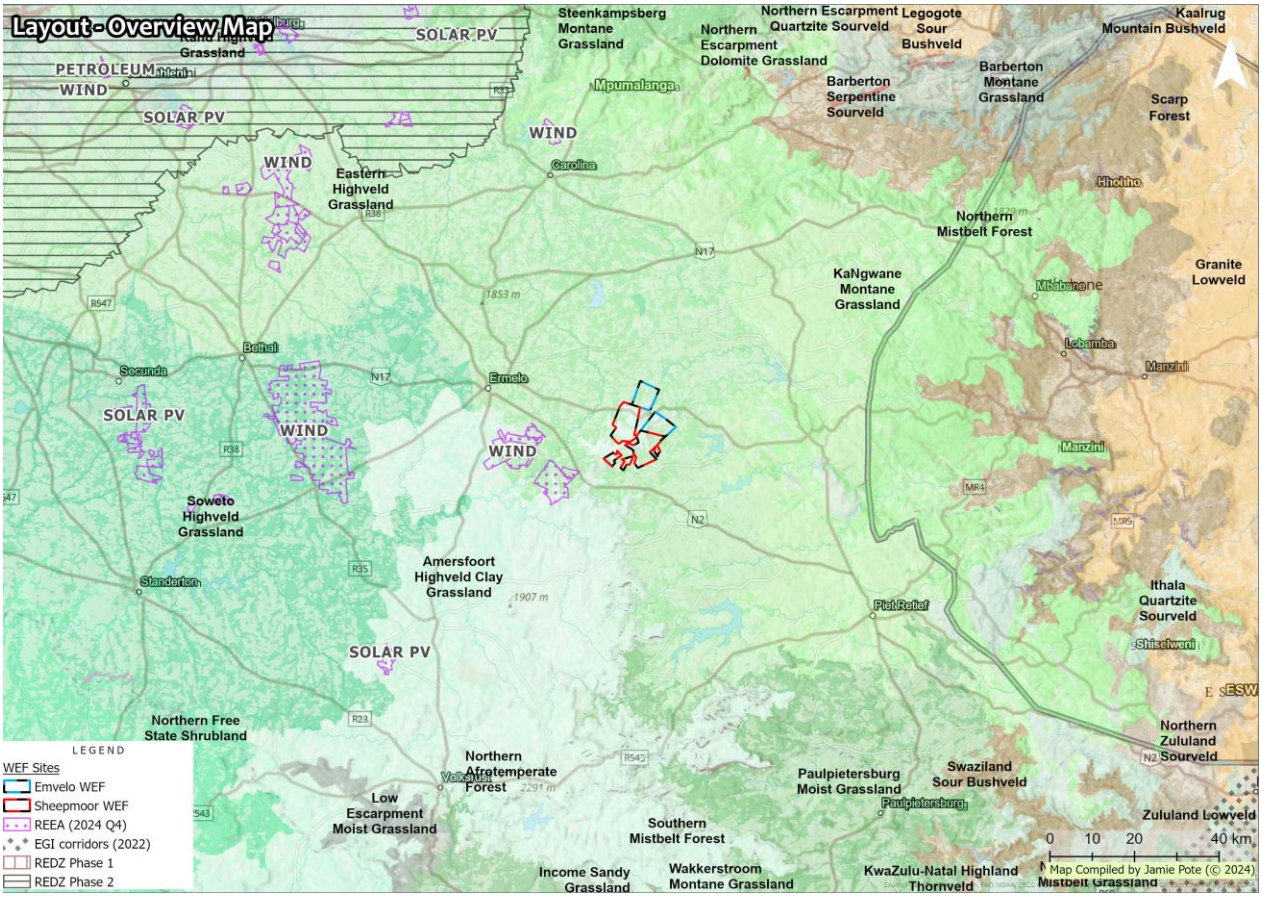


Figure 23: Map indicating potential cumulative impacts resulting from nearby renewable energy projects.

The only other renewable energy facility within 30 km of the site currently is Camden Wind, situated between 5 and 25 km to the west of the site. As indicated in Figure 23. No other significant WEF projects are proposed in the adjacent area nor in the broader vicinity within the affected vegetation units (in particular pertaining to Eastern Highveld Grassland), other than a few towards the north-eastern

extent of the unit within a significantly modified landscape. The overall cumulative impact of this project as it pertains to renewable energy projects will thus be low with respect to both Eastern Highveld Grassland and also Wakkerstroom Montane Grassland, within the Area of Influence.

The proposed WEF is unlikely to have significant cumulative impacts, nor result in any unacceptable loss or risk to terrestrial biodiversity on the site or regionally, regardless of the other WEF projects proposed in the area, as the layout has been aligned with minimising impacts and avoiding key ecological processes. WEF facilities generally have a low-density footprint that can accommodate sensitivities, and the overall footprint area is small in comparison to the total coverage area. The current and future threats to the represented grassland vegetation units would be posed by large scale clearing of habitat, which is usually associated with Agriculture, Mining and Forestry as well as urban development and expansion.

3.4.4 Terrestrial Biodiversity Impact Reversibility

Grassland vegetation is generally reasonably resilient and impacts, excluding hardening of surfaces or removal of topsoil, will to some extent be irreversible without high rehabilitation costs, although expected rehabilitation to a near natural composition and functioning is likely to be a slow process. The vegetation represented on site, however, does have a reasonably extensive regional coverage, despite elevated conservation status, and the local negligible loss as a result of the proposed activity will be low.

3.4.5 Impacts and Risks to Irreplaceable Biodiversity Resources

The site is situated within vegetation types not having an elevated status (*Least Concern*) and has a limited footprint, hence risks to irreplaceable biodiversity resources will likely be low, in particular as the represented vegetation units and habitats represented are widespread. Several bird species and other faunal species may occasionally traverse the site, but with extensive, unfragmented, similar habitat in the surrounding area, this is not deemed to be irreplaceable, bearing in mind the anticipated limited footprint size. It is thus unlikely that the proposed activity and associated infrastructure would not provide any direct or indirect risk to any species or population.

3.4.6 Residual Risks and Uncertainties

No significant residual risks are anticipated, other than a low risk of a plant species not being located during the assessment phase. The final project walkdown that will be undertaken before commencement during finalising of the layout plan, will likely further limit this risk.

3.4.7 Implications of Biodiversity Offset Guidelines

Findings of the terrestrial biodiversity assessment report of relevance can be summarised as follows:

- Affected Vegetation Units: Eastern Highveld Grassland & Wakkerstroom Montane Grassland.
- Ecosystem Threat Status (RLE, 2022): Endangered & Least Concern with high levels of transformation in Eastern Highveld Grassland. No biodiversity offset triggered for Wakkerstroom Montane Grassland. Residual impact for Eastern Highveld Grassland is not deemed to be adequately significant to warrant a Biodiversity Offset due to the negligible area of this unit that will be affected.
- Remaining Ecosystem Extents: 33 & 81 % - no Biodiversity Offset triggered.
- Critical Biodiversity Area 1 & 2: The site overlaps with a small area of CBA 2 along the southern boundary. Approximately 380 meters of access road to WEF turbine S18 will pass through

designated CBA but will have a negligible terrestrial biodiversity risk or impacts and in light of the low levels of transformation and fragmentation regionally within the represented vegetation units, biodiversity offsets are not deemed to be applicable. Furthermore, no residual impacts oh high or medium after mitigation are anticipated.

- Ecological Support Area 1 & 2: The site overlaps with an extensive area of designated ESA 1 along the main drainage areas, but the optimised layout has sought to avoid these areas as far as technically possible and thus the residual impact is deemed to be low and within acceptable limits.
- Other legislation: None applicable.

All impacts assessed are deemed to have a low significance after mitigation, hence no Biodiversity Offsets are deemed to be applicable. Refer to Table 11 for respective Biodiversity Offset information summary.

Table 11: Biodiversity Offset Guidelines Status for vegetation units represented on site.

Ecosystem Type		Eastern Highveld Grassland	Wakkerstroom Montane Grassland
ETS[9]		ENDANGERED	LEAST CONCERN
REE[10] (%)		33 %	81 %
Transformation Band		2A	4
A. TPC[11] Ratio	**NP[12]**		
	PP		
	MP		
	WP		
B. RE[13] & EPL[14] Ratios	**NP**		
	PP	13	0
	MP		
	WP		
C. ETS Ratios	**NP**		
	PP	10	0
	MP		
	WP		
D. Starting Ratios	**NP**		
	PP	13	0
	MP		
	WP		

As a gesture of sound environment management, a trade-off measure is recommended whereby alien vegetation clearing is undertaken at a 1:3 ratio for loss of natural Eastern Highveld Grassland and Wakkerstroom Montane Grassland that will result in a net improvement of total habitat across the site. Target areas should be identified during the final walkdown and calculated one the final design footprint is known. Suitable areas should be chosen in consultation with the landowner(s) in order to identify suitable areas that are not priority for future agriculture and where maximum ecological benefits can be attained. Recommended areas include the dense infestation on Emvelo in the vicinity of WTG2 8 – 12 as well as infested areas around WTG 14 around watercourses and on slopes and in the vicinity of WTGs 15 & 16. Preliminary calculations indicate an approximate area of 37.5 Ha for Eastern Highveld Grassland WTG and road loss and a further ~40 – 50 Ha for loss of Wakkerstroom Montane Grassland (road and WTG loss of natural grassland). Alternatively, the entire area (~80 - 90 Ha) can be allocated to clearing of dense alien infestation in Eastern Highveld Grassland. These areas must be

[9] Ecosystem Threat Status
[10] Remaining Ecosystem Extent
[11] Threshold of Potential Concern
[12] Not Protected, Poorly Protected, Moderately Protected & Well Protected.
[13] Remaining Extent
[14] Ecosystem Protection Levels

selected in areas where future agriculture or cultivation is not proposed. In this instance the improved Highveld Grassland area will represent an area equivalent to ~11 % of the remaining Highveld Grassland on site, which is a significant conservation contribution that can be actively managed for the lifespan of the project.

3.5 Environmental Management Plan Recommendations

Refer also to Section 7.6: Appendix 6: Biodiversity Environmental Management Plan for more comprehensive general recommendations for management of terrestrial biodiversity impacts.

Measures for inclusion in the draft Environmental Management Programme, which should be considered to be conditions of authorisation, are as detailed below, which are listed according to project phases for ease of implementation as follows:

- Pre-Construction Activities
- Bush Clearing and Site Preparation
- Construction Activities
- Site Rehabilitation and Closure
- Operations

3.5.1 Planning & Design

OBJECTIVE: Ensure that impacts to terrestrial biodiversity are minimise including fragmentation of corridors		
Project component/s	WEF	
Potential Impact	Potential impacts include unnecessary fragmentation of corridors and siting of infrastructure in elevated sensitivity areas that can be avoided.	
Activity/risk source	Pre-construction preparation activities	
Mitigation: Target/Objective	To ensure that mitigations are implemented during design to avoid sensitive areas and thus minimise impacts by avoidance during the planning and application phases.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Align WEF and other infrastructure in a manner that will minimise fragmentation and/or impacts to recommended buffers and/or sensitive features.	Applicant	During application and final walkdown before commencement.
Performance Indicator	Infrastructure within sensitive areas is minimised.	
Monitoring	• Final plan is acceptable to respective specialists.	
OBJECTIVE: Ensure that relevant permits and site-specific plans are in place to manage impacts on the environment		
Project component/s	WEF	
Potential Impact	Potential impacts include loss of flora and fauna species of conservation concern illegally.	
Activity/risk source	Pre-construction preparation activities	
Mitigation: Target/Objective	To ensure that mitigations are implemented before construction in particular before site clearing and grubbing commences in order to be compliant with applicable legislation.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Respective flora & fauna permits to be obtained timeously before construction is to commence.	ECO	At least 2 – 3 months before commencement of

		construction as delays can be expected.
Performance Indicator	Permits obtained timeously	
Monitoring	• Ensure flora permits are in place timeously (PNCO only) – allow at least 2 to 3 months before commencement.	

3.5.2 Construction

OBJECTIVE: Management of dust and emissions and damage to roads		
Project component/s	WEF	
Potential Impact	Potential impacts include excessive dust during site clearing which may cause damage to vegetation.	
Activity/risk source	Site operations for duration of life cycle of the project including movement of vehicles on roads and areas cleared of vegetation during site preparation and construction.	
Mitigation: Target/Objective	To ensure that mitigations are implemented during construction to minimise dust	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Blanket clearing of vegetation must be limited to the site footprint. No clearing outside of footprint to take place, without express approval of ECO and or indicated in approved layout plans. • Site must be clearly demarcated and pegged out before any bush clearing or construction commences. The cleared area should not exceed the required footprint including a reasonable working area. • If required, water spray vehicles should be used to control dust caused by strong winds during activities on the works. • No over-watering of the site or road surfaces. • Wind screens can be used to reduce wind and dust in open areas if required.	ECO	Duration of construction phase
Performance Indicator	Construction monitoring of dust	
Monitoring	• Monitor for excessive dust (daily).	

OBJECTIVE: Conservation of the existing soil resources within the site and in the adjacent areas		
Project component/s	WEF	
Potential Impact	Potential impacts include loss of topsoil due to incorrect storage during construction which will negatively affect rehabilitation, as well as erosion due to clearing and construction activities.	
Activity/risk source	Excessive dust due to poor dust management	
Mitigation: Target/Objective	To ensure that mitigations are implemented during construction to minimise loss of soil resources.	
Mitigation: Action/control	**Responsibility**	**Timeframe**

• Topsoil shall be removed from all areas where physical disturbance of the surface will occur. • All available topsoil shall be removed after consultation with the botanist and/or ECO prior to commencement of any operations and sufficient topsoil must be stored for later use during decommissioning. • The removed topsoil shall be stored on high ground within the site footprint outside the 1:100 flood level within demarcated areas. • Topsoil shall be kept separate from overburden and shall not be used for building or maintenance of roads. • The stockpiled topsoil shall be protected from being blown away or being eroded. The application of a suitable grass seed/runner mix will facilitate this and reduce the minimise weeds if necessary. • A suitable weed management strategy to be implemented on topsoil stockpiles.	ECO	Duration of construction

Performance Indicator	Excessive dust is not problematic
Monitoring	• Monitoring of topsoils stockpiles for erosion and weeds (monthly and after significant rainfall events)

OBJECTIVE: Minimise impact on Sensitive areas and plant species		
Project component/s	WEF	
Potential Impact	Potential impacts include excessive loss of vegetation and species of conservation concern and habitat outside of footprint.	
Activity/risk source	Site clearing activities (clearing and grubbing)	
Mitigation: Target/Objective	To ensure that mitigations are implemented on commencement of construction in particular site clearing and grubbing.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Blanket clearing of vegetation must be limited to the site footprint. No clearing outside of footprint to take place, without express approval of ECO and or indicated in approved layout plans. • Site must be clearly demarcated and pegged out before any bush clearing or construction commences. The cleared area should not exceed the required footprint including a reasonable working area. • Any site camps and laydown areas requiring clearing must be located within already disturbed areas away from watercourses. • Search and rescue operations for Species of Conservation Concern *must* be undertaken before the commencement of site clearing activities. • It is important that clearing activities are kept to the minimum and take place in a phased manner.	ECO	Duration of site clearing and grubbing activities.

This minimises wind and water erosion of the cleared areas. • Workers are NOT allowed to collect any flora. All flora remain the property of the landowner and *must* not be disturbed, upset or used without their expressed consent. • It is the responsibility of the Contractor to provide sufficient fuel for cooking and heated as needed by the staff. • No domestic animals are permitted on the sites. • Trees and shrubs that are directly affected by the operations may be felled or cleared but only by the expressed written permission of the ECO.		
Performance Indicator	Excessive clearing outside of site footprint does not occur	
Monitoring	• Check delineated footprints area not exceeded (daily).	

OBJECTIVE: Protection of terrestrial fauna		
Project component/s	WEF	
Potential Impact	Potential impacts include faunal species mortalities, erosion and stormwater management.	
Activity/risk source	Construction activities may pose a risk to fauna	
Mitigation: Target/Objective	To ensure that mitigations are implemented before and during construction in particular before and during site clearing and grubbing.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Small mammals within the habitat on and around the affected area are generally mobile and likely to be transient to the area. They will most likely vacate the area once construction commences. As with all construction sites there is a latent risk that there will be some accidental mortalities. Specific measures are made to reduce this risk. The risk of species of Conservation Concern is low, and it is unlikely that there will be any impact to populations of such species because of the activity. • Reptiles such as lizards are less mobile compared to mammals, and some mortalities could arise. It is recommended that a faunal search and rescue be conducted before construction commences, although experience has shown that there could still be some mortalities as these species are mobile and may thus move onto site once construction is underway. A retile handler should be on call for such circumstances. • No animals are to be harmed or killed during the course of operations. • It is important that clearing activities are kept to the minimum and take place in a phased manner. This allows animal species to move into safe areas.	ECO	Duration of construction on site.

• Workers are NOT allowed to collect or snare any faunal species. All fauna remain the property of the landowner and *must* not be disturbed, upset or used without their expressed consent.		
Performance Indicator	Faunal mortalities are not excessive	
Monitoring	• Regular checks on trenches and excavations for trapped animals (daily) • Regular checks of fences for snares (monthly)	

OBJECTIVE: Appropriate handling and management of waste		
Project component/s	WEF	
Potential Impact	Terrestrial Biodiversity Impacts relating to improper or inadequate waste management procedures.	
Activity/risk source	Site clearing and construction activities	
Mitigation: Target/Objective	To ensure that mitigations are implemented to minimise waste and effectively manage waste.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• Excavations may not be used for the dumping of construction wastes. • Waste (non-biodegradable refuse) will not be permitted to be deposited in the excavations and must be disposed of appropriately. • All waste to be collected in an appropriate manner and disposed of correctly at the respective waste disposal facilities.	ECO	Duration of construction.
Performance Indicator	Waste is effectively managed	
Monitoring	• Ensure working plant has no oil or hydraulic leaks (daily & weekly). • Ensure all waste is disposed of correctly and not buried in any excavations.	

OBJECTIVE: Ensure appropriate rehabilitation of disturbed areas such that residual environmental impacts are remediated or curtailed		
Project component/s	WEF	
Potential Impact	Potential impacts include erosion, poor vegetation cover and alien invasive and weed regeneration	
Activity/risk source	Site rehabilitation activities are not implemented in correct manner or timeously.	
Mitigation: Target/Objective	To ensure that mitigations are implemented completion of construction relating to rehabilitation	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• A suitable weed management strategy to be implemented in construction phase. • Alien trees and weeds must be removed from the site as per CARA/NEMBA requirements. • Suitable measures must be implemented in areas that are susceptible to erosion. Areas must be rehabilitated, and a suitable cover crop planted once construction is completed. • Any topsoil stripped during site preparation must be replaced on completion in areas where rehabilitation is required.	ECO	Completion of phased construction into operational phase for duration of aftercare period on completion of construction (2 years recommended)

• If natural vegetation re-establishment does not occur, a suitable grass must be applied. • Stormwater discharge into watercourses to be protected against erosion.		
Performance Indicator	Adequate vegetation cover is achieved, and erosion is effectively managed with no serious erosion incidents	
Monitoring	• Check quality of topsoil and weed free. • Check for weed regrowth and manage timeously, before seed is set (monthly). • If natural revegetation does not occur, reseeding may be required (monitor for 6 – 12 months after completion of construction (depending on time of year that construction is completed, as regrowth will be poor over winter months)	

3.5.3 Operation

OBJECTIVE: Ensure appropriate rehabilitation of disturbed areas such that residual environmental impacts are remediated or curtailed		
Project component/s	WEF	
Potential Impact	Potential impacts include erosion, poor vegetation cover and alien invasive and weed regeneration	
Activity/risk source	Site rehabilitation activities commencing during end phases of construction and continuing into operational phase	
Mitigation: Target/Objective	To ensure that mitigations are implemented after construction relating to rehabilitation of disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
• A suitable weed management strategy to be implemented in construction phase. • Alien trees and weeds must be removed from the site as per CARA/NEMBA requirements on an ongoing basis during operational phase. • Suitable measures must be implemented in areas that are susceptible to erosion. Areas must be rehabilitated, and a suitable cover crop planted once construction is completed. • If natural vegetation re-establishment does not occur, a suitable grass must be applied. • Stormwater discharge into watercourses to be protected against erosion.	ECO	Duration of aftercare period on completion of construction (recommended 2 years)
Performance Indicator	Rehabilitation and vegetation regrowth is achieved in disturbed areas	
Monitoring	• Check for weed regrowth and manage timeously, before seed is set (quarterly during 2-year aftercare period then annually for duration of operations). • If natural revegetation does not occur during aftercare period, reseeding may be required (monitor for 6 – 12 months after completion of construction, depending on time of year that construction is completed, as regrowth will be poor over winter months)	

3.6 Findings and Recommendations

3.6.1 Overview of Findings

The proposed **Emvelo WEF** site is comprised of several farm portions with a total area of approximately 7 020 Ha, of which the approximate total anticipated WEF footprint of 180 Ha will constitute 3.5 % of the farm area. The site is situated within a predominantly commercial farming area, generally comprising beef farming with dryland grazing and dryland pastures and crops including maize. Several coal mines are present in the broader landscape, as well as coal fired power stations. The area falls within a moderate to high summer rainfall area. Emvelo WEF is proposed to comprise 24 turbines with a maximum output capacity of up to 260 MW. The WEF will be located on nineteen (19) land parcels and will have an anticipated lifespan of 20 – 25 years. The final design which will be requested for approval in the EA, has been determined based on the outcome of the specialist studies undertaken for the EIA phase of the development. The proposed turbine footprints and associated facility infrastructure will cover an area of up to 180 ha after rehabilitation, depending on final layout design.

The proposed activity will require the clearing of more than 300 m2 within a designated Critical Biodiversity Area and/or more than 1 Ha of indigenous vegetation and/or an activity in a watercourse in terms of EIA listing notices 1 and 3, hence as a minimum would trigger a Basic Assessment process. The project will also likely require clearing of more than 20 Ha of indigenous vegetation in terms of EIA listing notice 2, hence triggering a full Scoping and EIA process, as the site is not within any designated Renewable Energy Development Zone (REDZ). Additional listed activities that may pertain to the type of activity or other aspects that are not directly related to the terrestrial biodiversity features and risks have not been considered in depth.

Two vegetation units (Table 2, Figure 9) are primarily affected by the proposed project (Mucina & Rutherford, 2006). The site is located within Eastern Highveld Grassland (currently having an *Endangered* conservation status) and Wakkerstroom Montane Grassland (currently having a *Least Concern* conservation status). The Eastern Highveld Grassland tends to be associated with lower lying relatively flat areas, while the Wakkerstroom Montane Grassland is associated with higher elevation mountainous areas, particularly towards the central and south-east of the WEF cluster formed by a series of mountainous ridges as well as the eastern portions of the southern grid connection routes. Being situated on relatively flat areas with good soils and rainfall, the eastern highveld grassland has been subject to significant historical clearing for agricultural activities including pastures, fodder and crops.

One of the vegetation units (Eastern Highveld Grassland) present has an Endangered conservation status, being significantly transformed and highly fragmented regionally, as a result of historical agriculture, mining and rural/urban development, hence remnant intact vegetation patches will have an elevated sensitivity status. This unit generally occurs to the north and the east & west sides of the broader site. The other vegetation unit, comprising the central and southern parts of the site, has a Least Concern status and is not under threat now has high levels of transformation and fragmentation. In broad terms the Eastern Highveld Grassland is associated with flat plains having good soils, hence transformed for agriculture and forestry, whilst the Wakkerstroom Montane Grassland occurs on hill slopes and plateaus with poorer rocky soils. Irreplaceable and Optimal CBA areas are present as well as ESA local and landscape corridors that corresponds to the above remnant patches for Eastern Highveld Grassland as well as a representative portion of the Wakkerstroom Montane Grassland. Irreplaceable CBA areas should be avoided (No-Go), as per the applicable regional planning guidelines. Several rivers and wetlands surround the site or are present within the site boundary. Appropriate buffers to be considered, as per aquatic specialist assessment.

The Eastern Highveld Grassland vegetation unit has an *Endangered* status, indicating that more than 40% has been transformed and there will likely already be some loss or disruptions to ecological functioning which will be exacerbated by further loss. Further loss in remnant areas is not advisable as per the respective guidelines. All measures are taken to minimise this impact. Much of the indicated Eastern Highveld Grassland, comprising a portion of the historical coverage on the site in lower lying valleys, is already transformed as a result and/or comprised of secondary grassland due to historical cultivation. Wakkerstroom Montane Grassland in present in the southern and central area, having a Least Concern status and not under threat. As is evident from land-use coverages, the wider area is highly fragmented because of land-use, including agriculture, mining and urbanisation.

Intact vegetation on the site and surrounding sites is considered to be of conservation value, being generally designated either Irreplaceable or Optimal CBA with Other Natural Area (ONA) associated with transformed (cultivated) land, mostly associated with remnant Eastern Highveld Grassland, being designated Irreplaceable CBA. The degraded, secondary vegetation (old lands) and cultivated areas are generally not designated a CBA status but in some cases are designated ESA: local corridor or ESA: species specific. Specific reasons or sensitivities for these designations are not known at this stage but would require further investigation during the assessment phase to confirm current status and condition of designated areas. Land use guidelines indicates that Irreplaceable CBA sites must be avoided in terms of the mitigation hierarchy, however for Optimal CBA (referred to as Important and necessary in MBCP), the guidelines indicate that, although not desirable, if small-scale land-use change is unavoidable, it must be located and designed to be as biodiversity-sensitive as possible. Portions of the proposed grid connection corridors will also traverse some more extensive designated CBA: Irreplaceable areas. It is not anticipated that the actual footprint or loss within these areas will be significant due to the limited footprint of pylons as well as the corridors generally being near or within existing powerline corridors. ESA areas can accommodate loss, but ecological processes and connectivity must be given consideration.

Several perennial and non-perennial river, watercourses and wetland features occur within the site. These are addressed in more detail in the respective aquatic assessment reporting but are generally regarded as no-go areas as far as possibly in this assessment.

The site is also in proximity to several nature reserves and portions of the site are also designated as NPAES (National Protected Areas Expansion Strategy). Several Species of Conservation Concern are also potentially present that would require appropriate seasonal sampling. The specific type of development (Wind Energy Facility with grid connection and other associated infrastructure) tends to have a dispersed and relatively low footprint area in proportion to the overall project area, in comparison to for example an intensive project such as cultivation where larger areas require clearing. The activity will unlikely have any direct impact on any protected environment, other than where the grid connection will feed into the substation at the south-western end. Indirect and cumulative impacts may require further assessment relating to species and processes associated with protected areas in proximity to the site.

Transformed areas, primarily cultivated lands constitute 27.6 % and Montane Grassland 25.1 percent. Remnant intact Highveld Grassland only constitutes 16.8 % and 14.5 % comprises dense invaded thickets. The entire remining Highveld Grassland (782.1 Ha) on the site constitutes 0.002 % or the entire remaining extent of the vegetation unit (~380 000 Ha or 3 800 km^2). Watercourses and wetlands have been delineated based on vegetation characteristics where they form distinct habitat. Being a terrestrial assessment, these might not include the smallest of aquatic features, which will be subject

to the aquatic assessment protocols and outside the scope of this terrestrial biodiversity assessment. In terms of ecological processes, all watercourses, including these minor drainage lines, should still be avoided as far as possible, inclusive of buffers as per aquatic assessment. This landscape offers suitable habitat for a limited suite of animal species due to homogenous nature of the vegetation, although animals may have been displaced by to some extent in the grassland areas.

Vegetation is typical and representative of the vegetation unit. Exact composition and levels of disturbance are somewhat variable, dependant on various ecological factors, slope, aspect as well as historical and current land use and fire management practices. Due to having a low conservation status, the Montane Grassland would in principle provide a suitable footprint for the proposed activity, while intact Highveld grassland would provide less opportunity. The optimum approach is thus to limit loss of more sensitive habitat, and/or where unavoidable representative areas should be retained as ecological corridors.

Riverine areas should generally not be developed other than for crossings of linear features (access roads), including a 32 m watercourse buffer (or as per aquatic reporting). Where turbines may be in proximity to watercourses or wetlands or buffers, the laydown areas should be orientated away from rather than toward the watercourse (or buffer).

Critically Endangered flora species are likely not present, but Endangered species are known to occur in the vicinity and suitable habitat is present. It is likely that some sporadic clusters of species are present but will require specific footprint surveys during the final walkdown due the extent of the site. It is unlikely that the proposed WEF will pose any risk to Species of Conservation Concern as no substantial populations were found.

The final site visit was undertaken in mid-summer and proved to be a suitable season; however, the final site layout was not available at the time. All reasonable measures were taken to survey the range of habitat represented within the site; however, it is not feasible to sample 70 million square meter site with certainty. It is recommended that a final site walkdown be undertaken in order to inform the final layout design and inform micro0-siting of the footprints. Avoidance and Search and Rescue mitigation measures are deemed adequate to accommodate any small populations of Species of Conservation Concern that might not have been sampled and species that are Endangered or Critically Endangered are not deemed to be of significant concern. Most likely high-risk habitat, which includes remnant pockets of Highveld Grassland in good condition, wetlands and vleis, slopes and rocky outcrops on edges of plateaus have been identified and layout excludes these areas. Where suitable habitat is present (such as Montane Grassland in good condition) that is not excluded, is it deemed to be extensive to the extent that risks to any significant population will be low to negligible. The proposed development of the site for renewable energy provides a conservation opportunity, as it allows the farms to generate income without wide sale clearing of vegetation for agriculture with associated indirect impacts. This reduces the reliance of these farms on agriculture and high levels of utilisation. Furthermore, the development of a renewable facility will allow for the enhancement of any conservation opportunities that are identified during the ongoing construction and operational phases, for example protection of species of conservation concern and improvement of habitat, as outlines in the proposed trade off clearing of wattle thickets. These opportunities far outweigh any risks associated with loss of species of conservation concern, where measures will be in place to accommodate any specific issues during final layout design (walkdown) and construction (flora search and rescue). Wind Energy Facility projects pose a significantly different risk to terrestrial flora compared to other far more destructive development options including Mining, Agriculture (cultivation & high-density livestock), Forestry and Urban development, where extensive areas of habitat are cleared, and habitat is significantly fragmented. Wind Energy Facilities allow for very well-

planned layout design and have specific measures at all stages of the development process to address ecological risks. Conservation objectives are highly compatible with Wind Energy development projects.

Specific faunal risks and mitigations are outlined in the respective faunal and avifaunal assessment reports. With including of the recommended buffers and mitigation measures overall risks to terrestrial biodiversity aspects are thus deemed to be low and within acceptable limits. Additional faunal species and risks as per separate faunal assessments, but buffers and measures are recommended to minimise these risks to acceptable levels within the terrestrial biodiversity context.

Extensive areas of impenetrable invasive tree thickets are present across the site, more extensive in the north. These are comprised of a range of primarily wattle species but also include some eucalyptus and pine. These infestations have a significant effect on natural vegetation and ecological processes. Site observations indicate that there are ongoing efforts to eradicate these infestations but is a slow process. Post removal burning of brushwood also has a negative impact on soil properties, which is not an idea approach for achieving a rehabilitation goal. Several less prominent exotic invasive and other weed species were noted within the site and surrounding area. Proliferation of weedy and exotic species often indicate disturbance especially during or after construction. A list of species is included in Table 8. During construction it is highly likely that species currently not on site could be introduced through the construction process.

Due to the elevated conservation status of Eastern Highveld Grassland, intact remnant pockets of vegetation would be deemed to have a high to very high sensitivity. Where intact patches overlap with designated CBA, they are generally designated very high and high for remining intact areas. Riparian vegetation is also categorised as very high sensitivity due to ecological value and irreplaceable habitat and should be considered No-Go. Natural and near natural Wakkerstroom Montane Grassland would be categorised as moderate sensitivity as it is not deemed irreplaceable. It should be avoided as much as possible and attention must be given to bioregional planning designations, but some loss will not pose a significant risk to the vegetation unit. Transformed habitat would be deemed to have a low sensitivity where no natural vegetation remains. The vegetation sensitivities indicated are based on a hierarchical approach, with high being the most sensitive and low being the least sensitive. The recommended approach will be to avoid higher sensitivity areas as far as is technically possible and prioritise moderate and lower sensitivity areas. The very high sensitivity riverine areas (and buffers) and irreplaceable Highveld Grassland should be avoided in terms of any footprints other than for minimal access road (including watercourse) crossings, which should also prioritise crossing watercourses where there is already disturbance (such as existing road crossings).

Potential No-Go areas would include all designated CBA (Irreplaceable) areas that are confirmed to be near natural or natural, as well as watercourses and wetlands, including any adjacent intact riparian vegetation and associated buffers (as per aquatic assessment). Any populations of Endangered or Critically Endangered species and/or important populations of r Vulnerable species, where relocation is not feasible, would also potentially be considered No-Go areas. No such areas were identified for flora (plant) species. In general, WEF footprints are limited in extend and are not likely to incur significant risks or losses.

A viable development footprint has been identified within the site. Most suitable areas to minimise biodiversity impacts would be transformed areas, including old lands and currently cultivated areas and degraded areas as well as Montane Grassland areas. As evident in the combined WTG sensitivity map (Figure 21), the optimised layout has largely accommodated the sensitivities and avoided as far as

technically possible. Some residual crossings and turbines are within elevated sensitivity areas, but these are deemed to be acceptable and offset measures are prosed to accommodate this nominal loss. These nominal losses are unlikely to significantly compromise any ecological functioning nor conservation targets, as they constitute a very small proportion of both the site as well as the regional coverage or remaining extent of the vegetation. No turbines are situated within the watercourse buffers and the design mitigation strategy has eliminated several crossings from watercourses and buffers. Only necessary access road crossings, mostly along existing farm tracks remain, which are deemed acceptable.

A total of 15 or 22 WTGs are located within low sensitivity transformed habitat (cultivated and invaded). Of the remaining 10, 7 are located within natural Montane Grassland (moderate sensitivity) and none within any high sensitivity areas. Of those located in low sensitivity transformed or invaded habitat, 5 WTGs (WTGs 3, 5, 7, 11 & 15) are situated on edges or marginal to natural Highveld Grassland, where some loss of Highveld Grassland may occur, depending on final footprint configuration, but is avoidable. The access road network generally follows existing roads and tracks and invaded/cultivated areas as far as technically possible and will not significantly increase fragmentation above baseline levels. Portions of roads are aligned near remnant Highveld Grassland but are also mostly following existing roads where it intersects any such pockets. Assuming conservatively that each of the WTGs require clearing of 50 % of its footprint within natural Highveld Grassland and the total loss due to roads might be 10 Ha, a total loss of 12.5 Ha might be expected, although likely to be less with careful micro-siting. Since the entire remaining Highveld Grassland within the site is calculated at ~782.1 Ha, this loss represents only 1.6 % of the remaining Highveld Grassland on the site and only 0.003 % of the entire remaining extent. The loss associated with this nominal footprint is thus negligible and not deemed to be significant and will not pose any risk to the conservation of the vegetation unit. Furthermore, the proposed recommended clearing of densely invaded areas of a 1:3 ratio (i.e. at least ~37.5 Ha) will more than adequately compensate for this loss. Furthermore, the management of the sites under an EMPr rather than just the status quo agriculture will provide management resources that will potentially benefit overall conservation significantly more than what the loss represents on the ground.

Recommended clearing of alien invaded areas in a ratio of 1:3 for direct loss of natural grassland habitat (as a trade-off or offset), in conjunction with the mitigation measures below as well as post construction rehabilitation of the initial temporary disturbance footprint and implementation of a sound environmental management programme for the duration of the project lifespan can potentially and effectively result in a net positive impact. The loss of vegetation as a result of the loss of the expected project footprint (~180 Ha) is far outweighed by the potential improvement that can be achieved on the remaining habitat of the site (~7 000 Ha) through the positive management measures that can be implemented through the EMPr on farmland where there are currently no EMPr in place. With the implementation of the recommended mitigation measures as well as the layout design which has accommodated and avoided most of the important risk areas, all impacts are reduced to acceptable levels after mitigation. With the implementation of additional measures, such as clearing of dense alien wattle at a proposed ratio of 1:3, as well as implementation of an EMPr for the affected properties, it is expected that the overall terrestrial biodiversity impact in terms of loss of habitat can result in a net improvement of the site.

The proposed WEF is unlikely to have significant cumulative impacts, nor result in any unacceptable loss or risk to terrestrial biodiversity on the site or regionally, regardless of the other WEF projects proposed in the area, as the layout has been aligned with minimising impacts and avoiding key ecological processes. WEF facilities generally have a low-density footprint that can accommodate sensitivities, and the overall footprint area is small in comparison to the total coverage area. The current and future threats to the represented grassland vegetation units would be posed by large scale

clearing of habitat, which is usually associated with Agriculture, Mining and Forestry as well as urban development and expansion.

As a gesture of sound environment management, a trade-off measure is recommended whereby alien vegetation clearing is undertaken at a 1:3 ratio for loss of natural Eastern Highveld Grassland and Wakkerstroom Montane Grassland that will result in a net improvement of total habitat across the site. Target areas should be identified during the final walkdown and calculated one the final design footprint is known. Suitable areas should be chosen in consultation with the landowner(s) in order to identify suitable areas that are not priority for future agriculture and where maximum ecological benefits can be attained. Recommended areas include the dense infestation on Emvelo in the vicinity of WTG2 8 – 12 as well as infested areas around WTG 14 around watercourses and on slopes and in the vicinity of WTGs 15 & 16. Preliminary calculations indicate an approximate area of 37.5 Ha for Eastern Highveld Grassland WTG and road loss and a further ~40 – 50 Ha for loss of Wakkerstroom Montane Grassland (road and WTG loss of natural grassland). Alternatively, the entire area (~80 - 90 Ha) can be allocated to clearing of dense alien infestation in Eastern Highveld Grassland. These areas must be selected in areas where future agriculture or cultivation is not proposed. In this instance the improved Highveld Grassland area will represent an area equivalent to ~11 % of the remaining Highveld Grassland on site, which is a significant conservation contribution that can be actively managed for the lifespan of the project.

3.7 Implementation Plans

3.7.1 Site Preparation and Vegetation Clearing Plan

The following flora relocation plan is recommended for inclusion in the EMP and Flora removal permit applications:

- A pre-commencement flora relocation is recommended as several TNCO protected species are present within the proposed footprint.
- A pre-commencement fauna relocation is recommended. Several burrowing faunal species are present and will allow for relocation of less mobile species, although most faunal species in proximity are likely to vacate the area once earth moving equipment commences clearing and construction, however some species may require manual relocation.
- Topsoil must be stripped and stockpiled for replacement after construction of the site. Additional measures should be implemented to stabilise eroded areas where necessary.

3.7.2 Rehabilitation and Landscaping Plan

- On completion of construction, the surface of any work areas, especially if compacted due to hauling and dumping operations shall be scarified to a depth of at least 200 mm and graded to an even surface condition and the previously stored topsoil will be returned to its original depth over the area.
- The disturbed areas can be seeded with suitable local grass seed mix, usually available from a local farmer co-op, if deemed to be required as vegetation is likely to re-establish without input, as is typical in Karoid areas. Species composition of such grass seed mixes is best determined by what local indigenous species are locally, cost effectively and readily available. A mix of several species is recommended rather than a single grass species.
- Excavations may not be used for the dumping of construction wastes.
- Waste (non-biodegradable refuse) will not be permitted to be deposited in the excavations and must be disposed of appropriately.

3.7.3 Alien Vegetation Management Plan

Alien species must be removed from the site as per the National Environmental Management: Biodiversity Act (No. 10 of 2004) requirements. A suitable weed management strategy must be implemented in the construction phase and carried through the operational phase. Weeds and alien species *must* be cleared by hand before the rehabilitation phase of the areas. Recommended that the removal of alien plants are to be done according to the Working for Water Guidelines.

3.7.4 Open Space Management/Conservation Plan

None are applicable for this project.

3.7.5 Maintenance Management Plan

Ongoing maintenance is likely to be required in the long-term, which could include re-excavation of portions of the site for maintenance/replacement of defective components and repairs where applicable, which may include road, turbine footprint and buried infrastructure maintenance and excavation or infill within watercourse crossings.

All measures of this report, including the EMPr should be adhered for any such maintenance requirements. Any excavated areas must be stabilised and rehabilitated as per the measures indicated in this report.

4 Organizational Capacity and Competency

Successful Implementation will be in part be dependent on the organisational capacity and competency of the applicant and any implementing agents. The following aspects are likely to pose risk to the successful mitigation of the project:

- Budget constraints – budget allocated for environmental management tends to be inadequate for construction projects.
- Organisational Structure – implementing agents may or may not have adequate capacity and competency to ensure appropriate and adequate environmental management.

5 Emergency Preparedness and Response

Emergency Preparedness Plan must be included in the EMPr and should address specific measures relating to the following emergency risks:

- Fire management and response
- Spill management and incident response
- Waste management and incident response
- Response to emergency site shutdown, including labour and protest actions.

6 Stakeholder Engagement

Possible Stakeholders relating to Biodiversity could include the following key groups:

- Neighbouring Property Owners
- Local Regional and National Conservation Authorities

No Stakeholder Engagement was conducted specifically by the Specialist. Stakeholder Engagement is undertaken by the EAP as part of the environment application public participatory process. Any comments raised relating to Biodiversity will be addressed by the specialist in the final report.

7 Appendices

7.1 Appendix 1: References

General Reference Sources

- Acocks, J. P. H. 1988. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No 57. Botanical Research Institute, Department of Agriculture and Water Supply, South Africa.
- Atlas and Red List of the Reptiles of South Africa, Lesotho, and Swaziland. 2014. Edited by Michael F. Bates, William R. Branch, Aaron M. Bauer, Marius Burger, Johan Marais, Graham J. Alexander & Marienne S. de Villiers. SANBI, Pretoria.
- Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & Marienne S. de Villiers. (Eds). 2014. *Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland.* SANBI, Pretoria.
- Bromilow, C. 2001. *Problem Plants of South Africa*. A Guide to the Identification and Control of More than 300 Invasive Plants and Other Weeds. Briza Publications. Pp 258
- Child M.F., Roxburgh L., Do Linh San E., Raimondo D., Davies-Mostert H.T. 2016. *The Red List of Mammals of South Africa, Swaziland and Lesotho.* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- Council for Scientific and Industrial Research. NFEPA river FEPAs 2011 [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 20 July 2020.
- Council for Scientific and Industrial Research. NFEPA rivers 2011 [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 20 July 2020.
- Council for Scientific and Industrial Research. NFEPA wetland clusters 2011 [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 20 July 2020.
- Council for Scientific and Industrial Research. NFEPA wetlands vegetation 2011 [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 20 July 2020.
- Cowling, R.M., Richardson, D.M. & Pierce, S.M. 1997. Vegetation of Southern Africa. Cambridge University Press.
- Esler, K.J., Milton, S.J. & Dean, W.R.J. 2006. Karroo Veld: Ecology and Management. Briza Publications.
- Fuggle, R. F. & Rabie, M. A. 2003. *Environmental Management in South Africa*. Juta & Co, Johannesburg.
- Germishuizen, G. & Meyer, N.L. (eds). 2003. *Plants of southern Africa: An annotated checklist*. Strelitzia, 14. Pretoria: National Botanical Institute.
- Golding, J. (Ed.) 2002. *Southern African Plant Red Data Lists*. Southern African Botanical Diversity Network Report No 14.
- Henderson, L. 2001. *Alien Weeds and Invasive Plants*. Plant Protection Research Institute Handbook No 12. Agricultural Research Council. Pp 300.
- Hilton-Taylor, C. 1996. *Red Data List of Southern African Plants*. National Botanical Institute.
- Hockey PAR, Dean WRJ and Ryan PG 2005. Roberts - Birds of southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.
- International Finance Corporation. 2012. Performance Standards on Environmental and Social Sustainability.
- Low, A.B. & Rebelo, A.G. 1998. *Vegetation of South Africa, Lesotho and Swaziland*. Pretoria: Department of Environmental Affairs and Tourism.
- Marnewick MD, Retief EF, Theron NT, Wright DR, Anderson TA. 2015. *Important Bird and Biodiversity Areas of South Africa*. Johannesburg: BirdLife South Africa.
- Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Hening, G.A., Krüger, M., Pringle, R.L., Terblanche, R.F. & Williams, M.C. (Eds). 2013. *Conservation assessment of butterflies of South*

Africa, Lesotho and Swaziland: Red List and atlas. Saftronics (Pty) Ltd., Johannesburg and Animal Demography Unit, Cape Town.

- Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (Eds). 2004. *Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.
- Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.
- Mucina, L. & Rutherford, M.C. (Eds). 2006. *The vegetation of South Africa, Lesotho and Swaziland*, in Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., De Fonseca, G.A.B. & Kent, J. 2000. *Biodiversity hotspots for conservation priorities*. Nature, 403: 853–858.
- Nel, J., Colvin, C., Le Maitre, D., Smith, J., Haines, I. 2013. Defining South Africa's Water Source Areas. WWF South Africa & Council for Scientific & Industrial Research (CSIR).
- Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swart, E.R., Smith-Ado, L.B., Mbona, N., Downsborough, L. & Nienaber, S. 2011. *Technical Report for the National Freshwater Ecosystem Priority Areas project.* Report to the Water Research Commission, WRC Report No. 1801/2/11. ISBN 978-1-4312-0149-5.
- Powrie, L.W. 2013. A database of biodiversity taxon names in South Africa for copy-and-paste into reports or documents. South African National Biodiversity Institute, Cape Town. Obtained from SANBI on 20 July 2020.
- Powrie, L.W. 2013. A list of South African biodiversity terms and common names for spell checking. South African National Biodiversity Institute, Cape Town. Downloaded from www.sanbi.org on 20 July 2020.
- Powrie, L.W. 2013. A list of South African botanical names for spell checking. South African National Biodiversity Institute, Cape Town. Downloaded from www.sanbi.org 18 July 2020.
- Powrie, L.W. 2013. A list of South African physical feature names for spell checking. South African National Biodiversity Institute, Cape Town. Downloaded from www.sanbi.org on 20 July 2020.
- Powrie, L.W. 2013. A list of South African zoological and other (including fungi and lichen) names for spell checking. South African National Biodiversity Institute, Cape Town. Downloaded from www.sanbi.org on 20 July 2020.
- Rouget, M., Reyers, B., Jonas, Z., Desmet, P., Driver, A., Maze, K., Egoh, B. & Cowling, R.M. 2004. *South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component.* Pretoria: South African National Biodiversity Institute.
- Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (Eds.). 2019. *South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm*. South African National Biodiversity Institute, Pretoria. http://hdl.handle.net/20.
- South African National Biodiversity Institute (SANBI). 2019. *National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report.* South African National Biodiversity Institute, an entity of the Department of Environment, Forestry and Fisheries, Pretoria. pp. 1–214.
- Stirton, C. H. 1987. *Plant Invaders: Beautiful, but Dangerous*. The Department of Nature and Environmental Conservation of the Cape Province Administration. Galvin and Sales, Cape Town.
- Taylor, M.R., Peacock, F., and Wanless, R.M. 2015. Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland.
- Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. & Kieswetter, S.L. 1999. *Coordinated waterbird Counts in South Africa, 1992-1997.* Avian Demography Unit, Cape Town.
- Turpie, J.K., Wilson, G. & Van Niekerk, L. 2012. *National Biodiversity Assessment 2011: National Estuary Biodiversity Plan for South Africa*. Anchor Environmental Consulting, Cape Town. Report produced for the Council for Scientific and Industrial Research and the South African National Biodiversity Institute.
- UN Natural Value Initiative. 2009. *The Ecosystem Services Benchmark,* 2009.

- Van Wyk, A.E. & Smith, G.F. 2001. *Regions of Floristic Endemism*: A Review with Emphasis on Succulents, Umdaus Press.
- Weather Bureau. 1988. Climate of South Africa – Climate statistics up to 1984 (WB40). Government Printer, Pretoria.
- Young, D.J., Harrison, J.A, Navarro, R.A., Anderson, M.A., & Colahan, B.D. (Eds). 2003. *Big birds on farms: Mazda CAR Report 1993-2001.* Avian Demography Unit: Cape Town.

Web Databases

- Animal Demographic Unit: http://vmus.adu.org.za
- Conservation International: http://www.biodiversityhotspots.org
- Fitzpatrick Institute of African Ornithology (2023). SpiderMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=SpiderMAP.
- Fitzpatrick Institute of African Ornithology (2023). MammalMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=MammalMAP.
- Fitzpatrick Institute of African Ornithology (2023). OrchidMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=OrchidMAP.
- Fitzpatrick Institute of African Ornithology (2023). PHOWN Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=PHOWN.
- FitzPatrick Institute of African Ornithology (2023). ScorpionMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=ScorpionMAP.
- Global Biodiversity Information Facility (GBIF): http://gbif.org
- International Union for Conservation of Nature (IUCN) Redlist: http://iucnredlist.org
- Millennium Ecosystem Assessment (MEA). 2005: https://www.millenniumassessment.org
- Plants of Southern Africa: http://newposa.sanbi.org
- South African Bird Atlas Project: http://sabap2.birdmap.africa
- South African National Biodiversity Institute (SANBI) Redlist: http://redlist.sanbi.org
- United Nations Environment Programme (UNEP), *A to Z Areas of Biodiversity Importance:* http://www.biodiversitya-z.org
- United Nations Environment Programme (UNEP), *World Database on Protected Areas*, Protected Planet: http://www.protectedplanet.net
- World Resources Institute (WRI): https://www.wri.org

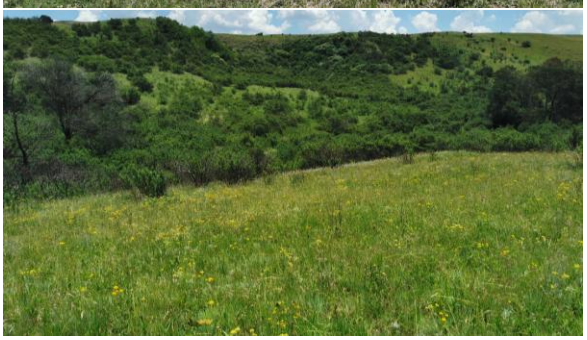
7.2 Appendix 2: Site Photos








































©JamiePote


©Jamie Pote

7.3 Appendix 3: Flora Species Lists

7.3.1 Flora

Marked species were flagged from various database sources as occurring in the region and having an elevated status. All were cross checked for distribution overlay and were actively screened for presence/absence on site during the terrestrial biodiversity and plant species assessment.

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
Acalypha angustata	Euphorbiaceae	LC	Gm 12, Present
Acalypha depressinerva	Euphorbiaceae	LC	Gm 14
Acalypha peduncularis	Euphorbiaceae	LC	Gm 14
Acalypha wilmsii	Euphorbiaceae	LC	Gm 14
Agapanthus inapertus subsp. intermedius	Agapanthaceae	LC	Gm 14, Present
Alloteropsis semialata subsp. eckloniana	Poaceae	LC	Gm 14, Gm 12
Aloe ecklonis	Asphodelaceae	LC, TNCO	Gm 12, Present
Andropogon appendiculatus	Poaceae	LC	Gm 12
Andropogon schirensis	Poaceae	LC	Gm 14, Gm 12, Present
Anthospermum rigidum subsp. pumilum	Rubiaceae	LC	Gm 14, Gm 12, Present
Aristida aequiglumis	Poaceae	LC	Gm 12
Aristida congesta	Poaceae	LC	Gm 12, Present
Aristida junciformis subsp. galpinii	Poaceae	LC	Gm 14, Gm 12, Present
Asclepias aurea	Apocynaceae	LC	Gm 14, Present
Asparagus devenishii	Asparagaceae	LC	Gm 14, Present
Asparagus fractiflexus	Asparagaceae	EN A2c; B1ab(iii), NEST (M)	Gm 14. An extremely rare species from southern Mpumalanga, recorded only four times. Around 80% of its habitat in some parts of its range was transformed around the 1940-50s, which is within the last three generations of this long-lived, resprouter (generation length 50 years). An overall 50% decline across the range is suspected. The open areas between plantations, which served as fire breaks and were important refugia, are now being planted up, causing ongoing loss of habitat. NOT RECORDED.
Aspidoglossum xanthosphaerum	Apocynaceae	VU D2, NEST (M)	Recorded from four locations from a restricted range (EOO<500 km²). Potentially threatened by wetland drainage for crop cultivation and by livestock trampling and grazing. Montane grassland, marshy sites, 1800 m. Preferred habitat (montane wetlands) are excluded from footprints. NOT RECORDED.
Aster bakerianus	Asteraceae	LC	Gm 14, Present
Berkheya onopordifolia var. glabra	Asteraceae	LC	Gm 14, Present
Berkheya setifera	Asteraceae	LC	Gm 14, Gm 12, Present
Bewsia biflora	Poaceae	LC	Gm 12
Bowkeria citrina	Scrophulariaceae	Rare	Gm 14, Not recorded
Brachiaria serrata	Poaceae	LC	Gm 14, Gm 12, Present
Buddleja auriculata	Scrophulariaceae	LC	Gm 14, Present
Buddleja salviifolia	Scrophulariaceae	LC	Gm 14, Present
Canthium ciliatum	Rubiaceae	LC	Gm 14, Present

[15] IUCN – NE – Not Evaluated, Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Least Concern (LC); End – Endemic; TNCO – Transvaal Provincial Nature Conservation Ordinance; Ex, Exotic/Invasive/Weed; NFA – National Forest Act; ToPS – Threatened or Protected Species, Not Threatened – Not an IUCN category.

[16] Common in: Gm 12 - Eastern Highveld Grassland; Gm 14 - Wakkerstroom Montane Grassland

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
Cephalaria natalensis	Dipsacaceae	LC	Gm 14
Chamaecrista mimosoides	Fabaceae	LC	Gm 12, Present
Cheilanthes hirta	Pteridaceae	LC	Gm 14, Present
Cliffortia linearifolia	Rosaceae	LC	Gm 14, Present
Clutia natalensis	Euphorbiaceae	LC	Gm 14
Corycium dracomontanum	Orchidaceae	LC, TNCO	Gm 14, Not recorded
Corycium nigrescens	Orchidaceae	LC, TNCO	Gm 14, Not recorded
Ctenium concinnum	Poaceae	LC	Gm 14, Gm 12
Cymbopogon caesius	Poaceae	LC	Gm 14
Cynodon dactylon	Poaceae	LC	Gm 12, Present
Cyrtanthus tuckii var. transvaalensis	Amaryllidaceae	LC, TNCO	Gm 14, Present
Dicoma anomala	Asteraceae	LC	Gm 12, Present
Digitaria monodactyla	Poaceae	LC	Gm 12
Digitaria tricholaenoides	Poaceae	LC	Gm 14, Gm 12
Diheteropogon amplectens	Poaceae	LC	Gm 14, Gm 12, Present
Diheteropogon filifolius	Poaceae	LC	Gm 14
Diospyros lycioides subsp. guerkei	Ebenaceae	LC	Gm 14, Present
Disa versicolor	Orchidaceae	LC, TNCO	Gm 14, Not recorded
Elionurus muticus	Poaceae	LC	Gm 14, Gm 12, Present
Eragrostis capensis	Poaceae	LC	Gm 14, Gm 12, Present
Eragrostis chloromelas	Poaceae	LC	Gm 14, Gm 12, Present
Eragrostis curvula	Poaceae	LC	Gm 12, Present
Eragrostis gummiflua	Poaceae	LC	Gm 12, Present
Eragrostis patentissima	Poaceae	LC	Gm 12
Eragrostis plana	Poaceae	LC	Gm 14, Gm 12, Present
Eragrostis racemosa	Poaceae	LC	Gm 14, Gm 12, Present
Eragrostis sclerantha	Poaceae	LC	Gm 12, Present
Erica oatesii	Ericaceae	LC	Gm 14
Eriospermum cooperi var. cooperi	Ruscaceae	LC	Gm 14
Euclea crispa subsp. crispa	Ebenaceae	LC	Gm 14, Present
Eucomis bicolor	Hyacinthaceae	NT A2d, TNCO	Gm 14, Not recorded
Eucomis sp.	**Hyacinthaceae**	**TNCO**	**Present on slopes, within designated no-go areas**
Eulalia villosa	Poaceae	LC	Gm 14
Euryops gilfillanii	Asteraceae	LC	Gm 12, Present
Euryops transvaalensis subsp. setilobus	Asteraceae	LC	Gm 14, Gm 12, Present
Felicia filifolia subsp. filifolia	Asteraceae	LC	Gm 14, Present
Festuca scabra	Poaceae	LC	Gm 14, Present
Galium thunbergianum var. thunbergianum	Rubiaceae	LC	Gm 14
Geranium ornithopodioides	Geraniaceae	EN B1ab(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v)	Gm 14, Not recorded
Gerbera aurantiaca	Asteraceae	EN A2ac, NEST (M)	A mistbelt grassland endemic, this species habitat has been over 90% transformed for commercial forestry plantations and crop and pasture cultivation over the past 120 years. There has also been extensive recent loss of habitat in the KwaZulu-Natal Midlands to urban development. Gerbera aurantiaca is a long-lived clonal species whose generation time is suspected to exceed 100 years. Subpopulations are scattered and there isn't a linear relationship between mistbelt grasslands and the presence of subpopulations, we therefore extrapolate a 50% loss of subpopulations from the 90% loss of habitat. Recent studies by I. Johnson and S. Johnson show that this species is a poor recruiter and has low seed viability as a result it is unlikely to be

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
			able to recover from the past loss of individuals. NOT RECORDED.
Geum capense	Rosaceae	LC	Gm 14
Gladiolus crassifolius	Iridaceae	LC	Gm 12, Present
Gladiolus ecklonii	Iridaceae	LC	Gm 14, Present
Gladiolus sericeovillosus subsp. sericeovillosus	Iridaceae	LC	Gm 14
Gymnosporia heterophylla	Celastraceae	LC	Gm 14, Present
Haemanthus humilis subsp. hirsutus	**Amaryllidaceae**	**LC, TNCO**	**Gm 12, Present**
Haplocarpha scaposa	Asteraceae	LC	Gm 12
Harpochloa falx	Poaceae	LC	Gm 14, Gm 12, Present
Helichrysum aureonitens	Asteraceae	LC	Gm 12, Present
Helichrysum aureum var. argenteum	Asteraceae	NE	Gm 14, Present
Helichrysum caespititium	Asteraceae	LC	Gm 12, Present
Helichrysum callicomum	Asteraceae	LC	Gm 12
Helichrysum cephaloideum	Asteraceae	LC	Gm 14
Helichrysum cooperi	Asteraceae	LC	Gm 14, Present
Helichrysum hypoleucum	Asteraceae	LC	Gm 14
Helichrysum melanacme	Asteraceae	LC	Gm 14
Helichrysum monticola	Asteraceae	LC	Gm 14, Present
Helichrysum nudifolium var. nudifolium	Asteraceae	LC	Gm 14, Present
Helichrysum oreophilum	Asteraceae	LC	Gm 14, Gm 12
Helichrysum rugulosum	Asteraceae	LC	Gm 12, Present
Helichrysum simillimum	Asteraceae	LC	Gm 14
Helichrysum splendidum	Asteraceae	LC	Gm 14, Present
Hermannia geniculata	Malvaceae	LC	Gm 14, Present
Hesperantha coccinea	Iridaceae	LC	Gm 14
Heteropogon contortus	Poaceae	LC	Gm 14, Gm 12, Present
Hilliardiella aristata	Asteraceae	LC	Gm 14, Gm 12
Hilliardiella oligocephala	Asteraceae	LC	Gm 12
Hyparrhenia hirta	Poaceae	LC	Gm 14, Present
Hypoxis costata	Hypoxidaceae	LC	Gm 14, Present
Hypoxis rigidula var. pilosissima	Hypoxidaceae	NE, TNCO	Gm 14, Gm 12, Present
Indigofera hybrida	Fabaceae	VU D2, NEST (M)	Known from three locations. Some habitat has been transformed to forestry plantations and agriculture and further habitat loss remains a potential threat. This is a very poorly known species. When Brown described the species in 1925, he speculated that it might be a hybrid because of its similarity to the widespread Indigofera hilaris. The taxon is however still recognised as a distinct species NOT RECORDED.
Inulanthera dregeana	Asteraceae	NE	Gm 14
Ipomoea crassipes	Convolvulaceae	NE	Gm 12, Present
Justicia anagalloides	Acanthaceae	NE	Gm 12, Present
Khadia alticola	Aizoaceae	Rare, NEST (M)	Montane grassland in shallow, sandy, humus-rich soil pockets and crevices between rock plates above 2000 m. Steenkampsberg, Utrecht and Wakkerstroom. NOT RECORDED.
Khadia carolinensis	Aizoaceae	VU A3c, NEST (M)	Coal reserves are found underneath the sandstones on which this species is found. Coal mining has had a small impact to date, but within the last five years many new applications for coal mining has been received. Should these applications be granted (and many more are likely to come in within the next few years), the habitat will be severely impacted by open cast mining. We estimate that up to 45% of the range (EOO) of this species could be destroyed within the next 10-20 years should the current

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
			applications go ahead. Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m. The OHL route does traverse and area having a known population of this species but can be easily avoided as pylons can be carefully micro sited and have a very limited footprint. NOT RECORDED.
Kniphofia linearifolia	Asphodelaceae	TNCO	Gm 14, Present
Ledebouria ovatifolia	Hyacinthaceae	LC	Gm 12, Present
Leucosidea sericea	Rosaceae	LC	Gm 14, Present
Lotononis amajubica	Fabaceae	Rare, NEST (M)	High mountain peaks of southern Mpumalanga, north-western KwaZulu-Natal and eastern Free State. Well-drained, high altitude grassland, 1600-1800 m. NOT RECORDED.
Loudetia simplex	Poaceae	LC	Gm 14, Gm 12
Metalasia densa	Asteraceae	LC	Gm 14, Present
Microchloa caffra	Poaceae	LC	Gm 14, Gm 12
Monocymbium ceresiiforme	Poaceae	LC	Gm 12
Moraea brevistyla	Iridaceae	LC	Gm 14, Present
Nerine platypetala	Amaryllidaceae	VU B1ab(i,ii,iii,iv,v), TNCO	Gm 14, Not recorded
Pachycarpus suaveolens	Apocynaceae	VU B1ab(iii), NEST (M)	A showy plant known from eight historical locations and probably extremely rare. One location, last collected in Gauteng in 1929 has subsequently been lost to urban expansion and this species is likely to be locally extinct in Gauteng. The grasslands habitat across its range (EOO 19 900 km²) is extensively transformed by urban development, crop cultivation, mining and invasive alien plants. Mining is causing a continuing decline in habitat between Witbank and Carolina. Gauteng and Mpumalanga to Swaziland. Threatened by agriculture, mining and aliens. Seventy-five percent of the known localities occur in heavily transformed areas, with about 45% of the habitat within its known range already transformed (M. Lötter, pers. comm.). Around the Witbank-Carolina-Ermelo area there is substantial coal mining already, as well as renewed interest in coal mining. NOT RECORDED.
Panicum natalense	Poaceae	LC	Gm 12, Present
Pelargonium luridum	Geraniaceae	LC	Gm 14, Gm 12, Present
Pentanisia prunelloides subsp. latifolia	Rubiaceae	LC	Gm 14, Gm 12
Plectranthus laxiflorus	Lamiaceae	LC	Gm 14, Present
Printzia pyrifolia	Asteraceae	LC	Gm 14
Protea parvula	Proteaceae	NT A2c, TNCO	Gm 14, Not recorded
Protea subvestita	Proteaceae	LC, TNCO	Gm 14, Not recorded
Rendlia altera	Poaceae	LC	Gm 14, Gm 12
Rhodohypoxis baurii var. confecta	Hypoxidaceae	LC	Gm 14
Rhus discolor	Anacardiaceae	LC	Gm 14, Present
Rhus montana	Anacardiaceae	LC	Gm 14, Present
Rhus rehmanniana	Anacardiaceae	LC	Gm 14, Present
Rhus transvaalensis	Anacardiaceae	LC	Gm 14, Present
Rubus ludwigii subsp. Ludwigii	Rosaceae	LC	Gm 14
Schizachyrium sanguineum	Poaceae	LC	Gm 12
Sebaea leiostyla	Gentianaceae	LC	Gm 14
Sebaea sedoides var. sedoides	Gentianaceae	LC	Gm 14
Selago densiflora	Scrophulariaceae	LC	Gm 14, Gm 12
Selago longicalyx	Scrophulariaceae	LC	Gm 14, Present

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
Senecio coronatus	Asteraceae	LC	Gm 12, Present
Sensitive species 1201	-	VU B1ab(i,ii,iii,iv,v), NEST (M)	Restricted to a small area on the hilly, upper Mpumalanga escarpment (EOO 400 km²), known from six locations. It has lost habitat to commercial forestry plantations and most locations are threatened by encroachment from invasive alien species, especially wattles, which prefer rocky areas where they are protected from fire. It is also under development pressure from golf resorts. . Site is outside of known range & no records in vicinity suggest local occurrence. NOT RECORDED.
Sensitive species 1219	-	VU B1ab(iii)+2ab(iii), TNCO, NEST (M)	Gm 14. A rare species known from only a few, isolated subpopulations. It has a restricted range, with an extent of occurrence of 12 230 km², and an estimated area of occupancy of 104-112 km². It is known from five to ten locations and continue to decline due to ongoing habitat loss and degradation. Occurs in scattered, isolated subpopulations across the Mpumalanga Highveld, from Dullstroom to Graskop, and southwards to Barberton and Wakkerstroom Relatively common in the Wakkerstroom area. Site is outside of known range & no records in vicinity suggest local occurrence. NOT RECORDED.
Sensitive species 1252	-	VU A2cd, TNCO, NEST (M)	There was a large population decline from 1955-1960 as a result of indiscriminate commercial harvesting for diosgenin, a substance that was used to manufacture cortisone and other steroid hormones. Exploitation of tubers for the local medicinal plant trade is ongoing, and is preventing recovery. The overall decline is estimated to be >30% over the past 90 years (generation length estimated to be 30 years). NOT RECORDED.
Sensitive species 321	-	Rare, TNCO, NEST (M)	Drakensberg Mountain Range from Mpumalanga through Lesotho and KwaZulu-Natal to the Eastern Cape. Montane and subalpine grassland 1 600-3 000 m, on grassy and sometimes stony or moist slopes. Not under imminent threat and reasonable widespread. NOT RECORDED.
Sensitive species 41	-	VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v), NEST (M)	A widespread (EOO <19 940 km²), but relatively rare (AOO <2000 km²) habitat specialist, estimated to remain at between six and ten locations and declining due to severe ongoing habitat loss and degradation. This species' habitat is becoming increasingly rare due to ongoing loss and degradation. The main threat is damming of streams feeding into wetlands as well as wetland drainage for agriculture. This species requires year-round moist conditions to flourish but damming and drainage reduce water flow to wetlands causing prolonged dry conditions. Specific habitat is included in no go designation, not at risk. NOT RECORDED.
Sensitive species 691	-	VU B1ab(ii,iii,v), NEST (M)	EOO between 445 and 11 158 km² and suspected to occur at fewer than 10 locations. It has lost habitat to crop cultivation in the past. It is currently threatened by ongoing degradation and habitat loss due to overgrazing and urban development. Crop cultivation is a past threat that led to extensive loss of habitat. At present urban development on the banks of the Vaal Dam

SCIENTIFIC NAME	FAMILY	STATUS[15]	COMMENT/PRESENCE[16]
			are causing ongoing loss of habitat. Invasive alien plants threaten a number of subpopulations. Habitat degradation by livestock has meant that several habitats in western Mpumalanga are currently under threat. This threat is however reversible as one subpopulation in Mpumalanga has had livestock removed and has recovered well. Preferred habitat - undulating grasslands in damp areas (seeps) is generally avoided. NOT RECORDED.
Sensitive species 851	-	VU B1ab(iii), NEST (M)	Suspected to have a very narrow distribution range, but due to taxonomic uncertainty, its range cannot be accurately defined. Its extent of occurrence (EOO) is possibly as small as 6244 km² but could be up to 22 664 km² if records from the eastern Free State and Lesotho are included. It is known from fewer than 10 locations and is declining across its range due to ongoing habitat loss and degradation. Occurs in shallow vleis and marshes in high altitude montane grassland. NOT RECORDED.
Sensitive species 998	-	EN A2bd, NEST (M)	The population is estimated to have declined at least 50% over the last three generations (60 years) due to persistent and consistent harvesting pressures for the medicinal plant trade and some loss of suitable habitat for afforestation and crop cultivation. It is a highly sought-after medicinal plant that has been exploited over its entire range both within and outside of South Africa. Widespread across the eastern highveld of Mpumalanga, the eastern Free State, and north-western KwaZulu-Natal. It occurs along the north and north-eastern borders of Lesotho and is also found in Swaziland, on the Eastern Highlands of Zimbabwe and the Chimanimani Mountains of Mozambique. Forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands. Preferred habitat (montane vleis) is excluded from footprints. NOT RECORDED.
Setaria nigrirostris	Poaceae	LC	Gm 14, Gm 12, Present
Setaria sphacelata	Poaceae	LC	Gm 12, Present
Sporobolus africanus	Poaceae	LC	Gm 12, Present
Sporobolus pectinatus	Poaceae	LC	Gm 12, Present
Stoebe plumosa	Asteraceae	LC	Gm 12
Striga bilabiata subsp. bilabiata	Orobanchaceae	LC	Gm 14, Present
Themeda triandra	Poaceae	LC	Gm 14, Gm 12, Present
Trachypogon spicatus	Poaceae	LC	Gm 14, Gm 12, Present
Tristachya leucothrix	Poaceae	LC	Gm 14, Gm 12, Present
Tristachya rehmannii	Poaceae	LC	Gm 12, Present
Urelytrum agropyroides	Poaceae	LC	Gm 12
Wahlenbergia cuspidata	Campanulaceae	LC	Gm 14, Present
Wahlenbergia undulata	Campanulaceae	LC	Gm 12, Present
Zaluzianskya distans	Scrophulariaceae	Rare, NEST (M)	Zaluzianskya distans is a widespread, but very rare species. It is not suspected to be in danger of extinction. This species occurs from the Mpumalanga Drakensberg Escarpment near Lydenburg southwards to the KwaZulu-Natal Drakensberg foothills near Himeville. Not under imminent threat and reasonable widespread. NOT RECORDED.

7.3.2 Fauna

Marked species were flagged from various database sources as occurring in the region and having an elevated status. All were cross checked for distribution overlay and were screened for presence/absence on site (not a faunal assessment).

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
MAMMALS			
Acinonyx jubatus	Cheetah	Vulnerable (2016)	Not Present
Aepyceros melampus	Impala	Least Concern	Present
Aethomys ineptus	Tete Veld Aethomys	Least Concern (2016)	Present/likely transient
Aethomys namaquensis	Namaqua Rock Mouse	Least Concern	Present/likely transient
Alcelaphus buselaphus caama	Red Hartebeest	Least Concern (2008)	Present
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened (2016)	Present/likely transient
Antidorcas marsupialis	Springbok	Least Concern (2016)	Present
Atelerix frontalis	Southern African Hedgehog	Near Threatened (2016)	Present/likely transient
Atilax paludinosus	Marsh Mongoose	Least Concern (2016)	Present/likely transient
Canis mesomelas	Black-backed Jackal	Least Concern (2016)	Present
Caracal caracal	Caracal	Least Concern (2016)	Present
Chlorocebus pygerythrus	Vervet Monkey	Least Concern (2016)	Present
Chlorocebus pygerythrus pygerythrus	Vervet Monkey (subspecies pygerythrus)	Least Concern (2008)	Present/likely transient
Connochaetes gnou	Black Wildebeest	Least Concern (2016)	Present
Connochaetes taurinus	Blue Wildebeest	Least Concern (ver 3.1, 2017)	Present/likely transient
Crocidura cyanea	Reddish-gray Musk Shrew	Least Concern (2016)	Present/likely transient
Crocidura flavescens	Greater Red Musk Shrew	Least Concern (2016)	Present/likely transient
Crocidura mariquensis	Swamp Musk Shrew	Near Threatened (2016)	Present/likely transient
Cryptomys hottentotus	Southern African Mole-rat	Least Concern (2016)	Present/likely transient
Cynictis penicillata	Yellow Mongoose	Least Concern (2016)	Present
Dama dama	Fallow Deer	Introduced	Present
Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)	Present/likely transient
Dasymys incomtus	Common Dasymys	Near Threatened (2016)	Present/likely transient
Dasymys robertsii	Water Rat	Vulnerable (2016)	Present/likely transient
Dendromus melanotis	Gray African Climbing Mouse	Least Concern (2016)	Present/likely transient
Dendromus mesomelas	Brants's African Climbing Mouse	Least Concern (2016)	Present/likely transient
Dendromus mystacalis	Chestnut African Climbing Mouse	Least Concern (2016)	Present/likely transient
Elephantulus brachyrhynchus	Short-snouted Elephant Shrew	Least Concern (2016)	Present/likely transient
Elephantulus myurus	Eastern Rock Elephant Shrew	Least Concern (2016)	Present/likely transient
Epomophorus wahlbergi	Wahlberg's Epauletted Fruit Bat	Least Concern (2016)	Present/likely transient
Equus quagga	Plains Zebra	Near Threatened (IUCN, 2016)	Present
Felis nigripes	Black-footed Cat	Vulnerable (2016)	Present/likely transient
Felis silvestris	Wildcat	Least Concern (2016)	Present/likely transient
Genetta maculata	Common Large-spotted Genet	Least Concern	Present
Gerbilliscus brantsii	Highveld Gerbil	Least Concern (2016)	Present/likely transient
Graphiurus (Graphiurus) murinus	Forest African Dormouse	Least Concern	Present/likely transient
Graphiurus (Graphiurus) platyops	Flat-headed African Dormouse	Data deficient	Present/likely transient
Herpestes sanguineus	Slender Mongoose	Least Concern (2016)	Present
Hipposideros caffer	Sundevall's Leaf-nosed Bat	Least Concern (2016)	Present/likely transient
Hippotragus niger	Sable Antelope	Least Concern (ver 3.1, 2017)	Present
Hyaena brunnea	Brown Hyena	Near Threatened (2015)	Present/likely transient

[17] IUCN - Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Least Concern (LC); NT – Near Threatened, End – Endemic; TNCO – Transvaal Provincial Nature Conservation Ordinance; Ex, Exotic/Invasive/Weed; NFA – National Forest Act; ToPS – Threatened or Protected Species, Not Threatened – Not an IUCN category.

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Hystrix africaeaustralis	Cape Porcupine	Least Concern	Present
Ichneumia albicauda	White-tailed Mongoose	Least Concern (2016)	Present
Ictonyx striatus	Striped Polecat	Least Concern (2016)	Present
Leptailurus serval	Serval	Near Threatened (2016)	Present/likely transient
Lepus capensis	Cape Hare	Least Concern	Present/likely transient
Lepus saxatilis	Scrub Hare	Least Concern	Present
Lycaon pictus	African wild dog	Endangered (2016)	Not Present
Mastomys natalensis	Natal Mastomys	Least Concern (2016)	Present/likely transient
Mellivora capensis	Honey Badger	Least Concern (2016)	Present/likely transient
Miniopterus fraterculus	Lesser Long-fingered Bat	Least Concern (2016)	Present/likely transient
Miniopterus natalensis	Natal Long-fingered Bat	Least Concern (2016)	Present/likely transient
Mus (Nannomys) minutoides	Southern African Pygmy Mouse	Least Concern	Present/likely transient
Myosorex varius	Forest Shrew	Least Concern (2016)	Present/likely transient
Myotis tricolor	Temminck's Myotis	Least Concern (2016)	Present/likely transient
Mystromys albicaudatus	African White-tailed Rat	Vulnerable (2016)	Present/likely transient
Neoromicia capensis	Cape Serotine	Least Concern (2016)	Present/likely transient
Orycteropus afer	Aardvark	Least Concern (2016)	Present
Oryx gazella	Gemsbok	Least Concern (2016)	Present
Otocyon megalotis	Bat-eared Fox	Least Concern (2016)	Present
Otolemur crassicaudatus	Brown Greater Galago	Least Concern (2016)	Present/likely transient
Otomys angoniensis	Angoni Vlei Rat	Least Concern (2016)	Present/likely transient
Otomys auratus	Southern African Vlei Rat (Grassland type)	Near Threatened (2016)	Present/likely transient
Ourebia ourebi ourebi	Oribi	EN (SA), LC (Intl)	Present. Refer to faunal reporting.
Panthera pardus	Leopard	Vulnerable (2016)	Present/likely transient
Pelea capreolus	Vaal Rhebok	Near Threatened (2016)	Present
Phacochoerus africanus	Common Warthog	Least Concern (2016)	Present
Pipistrellus (Pipistrellus) hesperidus	Dusky Pipistrelle	Least Concern	Present/likely transient
Poecilogale albinucha	African Striped Weasel	Near Threatened (2016)	Present/likely transient
Potamochoerus larvatus	Bush-pig	Least Concern (2016)	Present
Procavia capensis capensis	Cape Rock Hyrax	LC (IUCN 2015, global sp. level)	Present
Pronolagus rupestris	Smith's Red Rock Hare	Least Concern (2016)	Present/likely transient
Proteles cristata	Aardwolf	Least Concern (2016)	Present
Raphicerus campestris	Steenbok	Least Concern (2016)	Present
Rattus rattus	Roof Rat	Least Concern	Present/likely transient
Redunca arundinum	Southern Reedbuck	Least Concern (2016)	Present
Redunca fulvorufula	Mountain Reedbuck	Least Concern	Present
Rhabdomys bechuanae	Striped Mouse	Least Concern (2016)	Present/likely transient
Rhabdomys pumilio	Xeric Four-striped Grass Rat	Least Concern (2016)	Present/likely transient
Rhinolophus blasii	Blasius's Horseshoe Bat	Near Threatened (2016)	Present/likely transient
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	Least Concern (2016)	Present/likely transient
Rhinolophus simulator	Bushveld Horseshoe Bat	Least Concern (2016)	Present/likely transient
Steatomys pratensis	Common African Fat Mouse	Least Concern (2016)	Present/likely transient
Suricata suricatta	Meerkat	Least Concern (2016)	Present
Sylvicapra grimmia	Bush Duiker	Least Concern (2016)	Present/likely transient
Syncerus caffer	African Buffalo	Least Concern (2008)	Present/likely transient
Taurotragus oryx	Common Eland	Least Concern (2016)	Present
Tragelaphus strepsiceros	Greater Kudu	Least Concern (2016)	Present
Vulpes chama	Cape Fox	Least Concern (2016)	Present/likely transient
BIRDS			
Acridotheres tristis	Common Myna	Global: LC; BLSA: LC	Present/likely transient
Acrocephalus gracilirostris	Lesser Swamp- (Cape Reed) Warbler	Global: LC; BLSA: LC	Present/likely transient
Actophilornis africanus	African Jacana	Global: LC; BLSA: LC	Present/likely transient
Alcedo cristata	Malachite Kingfisher	Global: LC; BLSA: LC	Present/likely transient
Alcedo semitorquata	Half-collared Kingfisher	Global: LC; BLSA: NT	Present/likely transient
Alopochen aegyptiaca	Egyptian Goose	Global: LC; BLSA: LC	Present/likely transient
Amaurornis flavirostris	Black Crake	Global: LC; BLSA: LC	Present/likely transient

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Anas erythrorhyncha	Red-billed Teal (Duck)	Global: LC; BLSA: LC	Present/likely transient
Anas smithii	Cape Shoveler	Global: LC; BLSA: LC	Present/likely transient
Anas undulata	Yellow-billed Duck	Global: LC; BLSA: LC	Present/likely transient
Anhinga rufa	African Darter	Global: LC; BLSA: LC	Present/likely transient
Anthropoides paradiseus	Blue Crane	Global: VU; BLSA: NT	Present/likely transient
Anthus cinnamomeus	African (Grassveld/Grassland) Pipit	Global: LC; BLSA: LC	Present/likely transient
Aquila pennatus	Booted Eagle	Global: LC; BLSA: LC	Present/likely transient
Ardea cinerea	Grey Heron	Global: LC; BLSA: LC	Present/likely transient
Ardea goliath	Goliath Heron	Global: LC; BLSA: LC	Present/likely transient
Ardea melanocephala	Black-headed Heron	Global: LC; BLSA: LC	Present/likely transient
Ardea purpurea	Purple Heron	Global: LC; BLSA: LC	Present/likely transient
Ardeola ralloides	Squacco Heron	Global: LC; BLSA: LC	Present/likely transient
Asio capensis	Marsh Owl	Global: LC; BLSA: LC	Present/likely transient
Aviceda cuculoides	African Cuckoo Hawk	Global: LC; BLSA: LC	Present/likely transient
Balearica regulorum	Grey Crowned Crane	Global: EN; BLSA: EN A2acd+4acd, NEST (H)	Present. Refer to Avifaunal reporting.
Bostrychia hagedash	Hadeda Ibis	Global: LC; BLSA: LC	Present/likely transient
Bradornis (Malaenornis) pammelaina	Southern Black-Flycatcher	Global: LC; BLSA: LC	Present/likely transient
Bubo africanus	Spotted Eagle-Owl	Global: LC; BLSA: LC	Present/likely transient
Bubulcus ibis	Cattle Egret	Global: LC; BLSA: LC	Present/likely transient
Buphagus erythrorhynchus	Red-billed Oxpecker	Global: LC; BLSA: LC	Present/likely transient
Burhinus capensis	Spotted Thick-knee (Dikkop)	Global: LC; BLSA: LC	Present/likely transient
Buteo [augur] rufofuscus	Jackal Buzzard	Global: LC; BLSA: LC	Present/likely transient
Buteo buteo	Steppe (Common) Buzzard	Global: LC; BLSA: LC	Present/likely transient
Calandrella [brachydactyla] cinerea	Red-capped Lark	Global: LC; BLSA: LC	Present/likely transient
Calidris minuta	Little Stint	Global: LC; BLSA: LC	Present/likely transient
Cercomela familiaris	Familiar Chat	Global: LC; BLSA: LC	Present/likely transient
Ceryle rudis	Pied Kingfisher	Global: LC; BLSA: LC	Present/likely transient
Charadrius tricollaris	Three-banded Plover	Global: LC; BLSA: LC	Present/likely transient
Chersomanes albofasciata	Spike-heeled Lark	Global: LC; BLSA: LC	Present/likely transient
Chlidonias hybridus	Whiskered Tern	Global: LC; BLSA: LC	Present/likely transient
Chloropeta natalensis	Dark-capped Yellow (Yellow) Warbler	Global: LC; BLSA: LC	Present/likely transient
Chrysococcyx caprius	Dideric (Diederik) Cuckoo	Global: LC; BLSA: LC	Present/likely transient
Ciconia ciconia	White Stork	Global: LC; BLSA: LC	Present/likely transient
Circaetus cinereus	Brown Snake-Eagle	Global: LC; BLSA: LC	Present/likely transient
Cisticola chiniana	Rattling Cisticola	Global: LC; BLSA: LC	Present/likely transient
Cisticola juncidis	Zitting (Fan-tailed) Cisticola	Global: LC; BLSA: LC	Present/likely transient
Cisticola tinniens	Levaillant's (Tinkling) Cisticola	Global: LC; BLSA: LC	Present/likely transient
Colius striatus	Speckled Mousebird	Global: LC; BLSA: LC	Present/likely transient
Corvus albicollis	White-necked Raven	Global: LC; BLSA: LC	Present/likely transient
Corvus albus	Pied Crow	Global: LC; BLSA: LC	Present/likely transient
Dendropicos griseocephalus	Olive Woodpecker	Global: LC; BLSA: LC	Present/likely transient
Egretta alba	Great Egret	Global: LC; BLSA: LC	Present/likely transient
Egretta garzetta	Little Egret	Global: LC; BLSA: LC	Present/likely transient
Elanus caeruleus	Black-shouldered (Winged) Kite	Global: LC; BLSA: LC	Present/likely transient
Emberiza flaviventris	Golden-breasted Bunting	Global: LC; BLSA: LC	Present/likely transient
Estrilda astrild	Common Waxbill	Global: LC; BLSA: LC	Present/likely transient
Euplectes afer	Yellow-crowned (Golden) Bishop	Global: LC; BLSA: LC	Present/likely transient
Euplectes ardens	Red-collared Widowbird	Global: LC; BLSA: LC	Present/likely transient
Euplectes axillaris	Fan-tailed (Red-shouldered) Widowbird	Global: LC; BLSA: LC	Present/likely transient
Euplectes orix	Southern Red (Red) Bishop	Global: LC; BLSA: LC	Present/likely transient
Euplectes progne	Long-tailed Widowbird	Global: LC; BLSA: LC	Present/likely transient
Eupodotis melanogaster	Black-bellied Bustard	Global: LC; BLSA: LC	Present/likely transient
Eupodotis senegalensis	White-bellied Bustard	BLSA VU, NEST (H, M)	Refer to Avifaunal reporting.

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Falco amurensis	Amur (Eastern Red-footed) Falcon (Kestrel)	Global: LC; BLSA: LC	Present/likely transient
Falco rupicolus	Rock Kestrel	Global: LC; BLSA: LC	Present/likely transient
Fulica cristata	Red-knobbed Coot	Global: LC; BLSA: LC	Present/likely transient
Gallinago nigripennis	African (Ethiopian) Snipe	Global: LC; BLSA: LC	Present/likely transient
Gallinula chloropus	Common Moorhen	Global: LC; BLSA: LC	Present/likely transient
Geronticus calvus	Southern Bald Ibis	Global: VU; BLSA: VU C1+2a(ii), NEST (H, M)	Refer to Avifaunal reporting.
Halcyon albiventris	Brown-hooded Kingfisher	Global: LC; BLSA: LC	Present/likely transient
Haliaeetus vocifer	African Fish-Eagle	Global: LC; BLSA: LC	Present/likely transient
Himantopus himantopus	Black-winged Stilt	Global: LC; BLSA: LC	Present/likely transient
Hirundo albigularis	White-throated Swallow	Global: LC; BLSA: LC	Present/likely transient
Hirundo cucullata	Greater Striped-Swallow	Global: LC; BLSA: LC	Present/likely transient
Hirundo rustica	Barn (European) Swallow	Global: LC; BLSA: LC	Present/likely transient
Hydroprogne caspia	Caspian Tern	BLSA VU, NEST (M)	Refer to Avifaunal reporting.
Jynx ruficollis	Red-throated Wryneck	Global: LC; BLSA: LC	Present/likely transient
Lagonosticta rubricata	African (Blue-billed) Firefinch	Global: LC; BLSA: LC	Present/likely transient
Lamprotornis nitens	Cape Glossy (Glossy) Starling	Global: LC; BLSA: LC	Present/likely transient
Lanius collaris	Southern Fiscal	Global: LC; BLSA: LC	Present/likely transient
Lanius collurio	Red-backed Shrike	Global: LC; BLSA: LC	Present/likely transient
Lophaetus occipitalis	Long-crested Eagle	Global: LC; BLSA: LC	Present/likely transient
Lybius torquatus	Black-collared Barbet	Global: LC; BLSA: LC	Present/likely transient
Macronyx capensis	Cape (Orange-throated) Longclaw	Global: LC; BLSA: LC	Present/likely transient
Macronyx croceus	Yellow-throated Longclaw	Global: LC; BLSA: LC	Present/likely transient
Megaceryle maxima (H. maximus)	Giant Kingfisher	Global: LC; BLSA: LC	Present/likely transient
Merops bullockoides	White-fronted Bee-eater	Global: LC; BLSA: LC	Present/likely transient
Mirafra africana	Rufous-naped Lark	Global: LC; BLSA: LC	Present/likely transient
Motacilla capensis	Cape Wagtail	Global: LC; BLSA: LC	Present/likely transient
Muscicapa adusta	African Dusky Flycatcher	Global: LC; BLSA: LC	Present/likely transient
Musophaga porphyreolopha	Purple-crested Turaco	Global: LC; BLSA: LC	Present/likely transient
Myrmecocichla formicivora	Ant-eating Chat	Global: LC; BLSA: LC	Present/likely transient
Nectarinia [Chalcomitra] amethystina	Amethyst (Black) Sunbird	Global: LC; BLSA: LC	Present/likely transient
Neotis denhami	Denhams Bustard	BLSA: NT A2bcd+3bcd+4bcd, NEST (M)	Refer to Avifaunal reporting.
Netta erythrophthalma	Southern Pochard	Global: LC; BLSA: LC	Present/likely transient
Numida meleagris	Helmeted Guineafowl	Global: LC; BLSA: LC	Present/likely transient
Oenanthe (Saxicola) bifasciata	Buff-streaked Chat (Wheatear)	Global: LC; BLSA: LC	Present/likely transient
Oenanthe monticola	Mountain Chat (Wheatear)	Global: LC; BLSA: LC	Present/likely transient
Oenanthe pileata	Capped Wheatear	Global: LC; BLSA: LC	Present/likely transient
Onychognathus morio	Red-winged Starling	Global: LC; BLSA: LC	Present/likely transient
Passer diffusus	Southern Greyheaded Sparrow (split)	Global: LC; BLSA: LC	Present/likely transient
Passer melanurus	Cape Sparrow	Global: LC; BLSA: LC	Present/likely transient
Phalacrocorax africanus	Reed (Long-tailed) Cormorant	Global: LC; BLSA: LC	Present/likely transient
Phalacrocorax lucidus	White-breasted (Great) Cormorant	Global: LC; BLSA: LC	Present/likely transient
Philomachus pugnax	Ruff	Global: LC; BLSA: LC	Present/likely transient
Phoenicopterus minor	Lesser Flamingo	Global: LC; BLSA: LC	Present/likely transient
Phoenicopterus roseus	Greater Flamingo	Global: LC; BLSA: NT	Present/likely transient
Platalea alba	African Spoonbill	Global: LC; BLSA: LC	Present/likely transient
Plectropterus gambensis	Spur-winged Goose	Global: LC; BLSA: LC	Present/likely transient
Plegadis falcinellus	Glossy Ibis	Global: LC; BLSA: LC	Present/likely transient
Ploceus capensis	Cape Weaver	Global: LC; BLSA: LC	Present/likely transient
Ploceus cucullatus	Village (Spotted-backed) Weaver	Global: LC; BLSA: LC	Present/likely transient
Ploceus velatus	Southern Masked-Weaver	Global: LC; BLSA: LC	Present/likely transient
Polyboroides typus	African Harrier-Hawk (Gymnogene)	Global: LC; BLSA: LC	Present/likely transient

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Porphyrio madagascariensis	African Purple (Purple) Swamphen (Gallinule)	Global: LC; BLSA: LC	Present/likely transient
Prinia hypoxantha	Drakensberg Prinia (split)	Global: LC; BLSA: LC	Present/likely transient
Psophocichla litsipsirupa	Groundscraper Thrush	Global: LC; BLSA: LC	Present/likely transient
Pternistis natalensis	Natal Spurfowl (Francolin)	Global: LC; BLSA: LC	Present/likely transient
Pternistis swainsonii	Swainson's Spurfowl (Francolin)	Global: LC; BLSA: LC	Present/likely transient
Pycnonotus tricolor	Dark-capped (Black-eyed) Bulbul	Global: LC; BLSA: LC	Present/likely transient
Quelea quelea	Red-billed Quelea	Global: LC; BLSA: LC	Present/likely transient
Riparia cincta	Banded Martin	Global: LC; BLSA: LC	Present/likely transient
Riparia paludicola	Brown-throated (Plain) Martin	Global: LC; BLSA: LC	Present/likely transient
Riparia riparia	Sand Martin (Bank Swallow)	Global: LC; BLSA: LC	Present/likely transient
Sagittarius serpentarius	Secretary Bird	Global: VU; BLSA: VU A2acde+3cde+4acde, NEST (H, M)	Present. Refer to Avifaunal reporting.
Saxicola torquata	African (Common) Stonechat	Global: LC; BLSA: LC	Present/likely transient
Scleroptila africanus	Grey-winged Francolin	Global: LC; BLSA: LC	Present/likely transient
Scleroptila levaillantii	Red-winged Francolin	Global: LC; BLSA: LC	Present/likely transient
Scopus umbretta	Hamerkop	Global: LC; BLSA: LC	Present/likely transient
Serinus atrogularis	Black-throated Canary	Global: LC; BLSA: LC	Present/likely transient
Serinus canicollis	Cape (Yellow-crowned) Canary	Global: LC; BLSA: LC	Present/likely transient
Serinus mozambicus	Yellow-fronted (eyed) Canary	Global: LC; BLSA: LC	Present/likely transient
Sigelus silens	Fiscal Flycatcher	Global: LC; BLSA: LC	Present/likely transient
Spermestes cucullata	Bronze Mannikin	Global: LC; BLSA: LC	Present/likely transient
Spreo bicolor	Pied (African Pied) Starling	Global: LC; BLSA: LC	Present/likely transient
Stephanoaetus coronatus	African Crowned (Crowned) Eagle	Global: NT; BLSA: VU	Present/likely transient
Struthio camelus	Common Ostrich	Global: LC; BLSA: LC	Present/likely transient
Tachybaptus ruficollis	Little Grebe (Dabchick)	Global: LC; BLSA: LC	Present/likely transient
Tadorna cana	South African Shelduck	Global: LC; BLSA: LC	Present/likely transient
Telophorus zeylonus	Bokmakierie	Global: LC; BLSA: LC	Present/likely transient
Thalassornis leuconotus	White-backed Duck	Global: LC; BLSA: LC	Present/likely transient
Threskiornis aethiopicus	African Sacred (Sacred) Ibis	Global: LC; BLSA: LC	Present/likely transient
Tringa glareola	Wood Sandpiper	Global: LC; BLSA: LC	Present/likely transient
Tringa nebularia	Common Greenshank	Global: LC; BLSA: LC	Present/likely transient
Tyto capensis	African Grass owl	VU, NEST (M)	Present. Refer to Avifaunal reporting.
Upupa africana	African Hoopoe	Global: LC; BLSA: LC	Present/likely transient
Vanellus armatus	Blacksmith Lapwing (Plover)	Global: LC; BLSA: LC	Present/likely transient
Vanellus coronatus	Crowned Lapwing (Plover)	Global: LC; BLSA: LC	Present/likely transient
Vanellus melanopterus	Black-winged Lapwing (Plover)	Global: LC; BLSA: LC	Present/likely transient
Vanellus senegallus	African Wattled Lapwing (Plover)	Global: LC; BLSA: LC	Present/likely transient
Vidua macroura	Pin-tailed Whydah	Global: LC; BLSA: LC	Present/likely transient
REPTILES			
Acanthocercus atricollis	Southern Tree Agama	Least Concern (SARCA 2014)	Present
Acontias gracilicauda	Thin-tailed Legless Skink	Least Concern (SARCA 2014)	Present/likely transient
Acontias wakkerstroomensis	Wakkerstroom Legless Skink	Data Deficient	Present/likely transient
Afrotyphlops bibronii	Bibron's Blind Snake	Least Concern (IUCN 2022)	Present/likely transient
Agama aculeata distanti	Distant's Ground Agama	Least Concern (SARCA 2014)	Present
Agama atra	Southern Rock Agama	Least Concern (SARCA 2014)	Present
Amplorhinus multimaculatus	Many-spotted Snake	Least Concern (SARCA 2014)	Present/likely transient
Aparallactus capensis	Black-headed Centipede-eater	Least Concern (IUCN 2021)	Present/likely transient
Atractaspis bibronii	Bibron's Stiletto Snake	Least Concern (SARCA 2014)	Present/likely transient
Bitis arietans arietans	Puff Adder	Least Concern (SARCA 2014)	Present
Boaedon capensis	Brown House Snake	Least Concern (SARCA 2014)	Present
Bradypodion transvaalense	Wolkberg Dwarf Chameleon	Least Concern (SARCA 2014)	Present/likely transient
Causus rhombeatus	Rhombic Night Adder	Least Concern (SARCA 2014)	Present/likely transient

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Chamaeleo dilepis	Common Flap-neck Chameleon	Least Concern (SARCA 2014)	Present/likely transient
Chamaesaura aenea	Coppery Grass Lizard	Near Threatened (SARCA 2014)	Present/likely transient
Chamaesaura anguina anguina	Cape Grass Lizard	Least Concern (SARCA 2014)	Present/likely transient
Cordylus vittifer	Common Girdled Lizard	Least Concern (SARCA 2014)	Present
Crotaphopeltis hotamboeia	Red-lipped Snake	Least Concern (SARCA 2014)	Present
Dasypeltis inornata	Southern Brown Egg-eater	Least Concern (SARCA 2014)	Present/likely transient
Dasypeltis scabra	Rhombic Egg-eater	Least Concern (SARCA 2014)	Present
Dispholidus typus viridis	Northern Boomslang	Not evaluated	Present
Duberria lutrix lutrix	South African Slug-eater	Least Concern (SARCA 2014)	Present/likely transient
Elapsoidea boulengeri	Boulenger's Garter Snake	Least Concern (SARCA 2014)	Present/likely transient
Elapsoidea sundevallii sundevallii	Sundevall's Garter Snake		Present/likely transient
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	Present/likely transient
Hemachatus haemachatus	Rinkhals	Least Concern (SARCA 2014)	Present
Hemidactylus mabouia	Common Tropical House Gecko	Least Concern (SARCA 2014)	Present
Homopholis wahlbergii	Wahlberg's Velvet Gecko	Least Concern (SARCA 2014)	Present/likely transient
Homoroselaps dorsalis	Striped Harlequin Snake	Near Threatened (SARCA 2014)	Present/likely transient
Homoroselaps lacteus	Spotted Harlequin Snake	Least Concern (SARCA 2014)	Present/likely transient
Inyoka swazicus	Swazi Rock Snake	Least Concern (SARCA 2014)	Present/likely transient
Lamprophis aurora	Aurora House Snake	Least Concern (SARCA 2014)	Present/likely transient
Lamprophis fuscus	Yellow-bellied House Snake	Least Concern (SARCA 2014)	Present/likely transient
Lamprophis guttatus	Spotted House Snake	Least Concern (SARCA 2014)	Present/likely transient
Leptotyphlops scutifrons conjunctus	Eastern Thread Snake		Present/likely transient
Leptotyphlops scutifrons scutifrons	Peters' Thread Snake		Present/likely transient
Lycodonomorphus inornatus	Olive House Snake	Least Concern (SARCA 2014)	Present/likely transient
Lycodonomorphus laevissimus	Dusky-bellied Water Snake	Least Concern (SARCA 2014)	Present/likely transient
Lycodonomorphus rufulus	Brown Water Snake	Least Concern (SARCA 2014)	Present/likely transient
Lycophidion capense capense	Cape Wolf Snake	Least Concern (SARCA 2014)	Present/likely transient
Lygodactylus capensis	Common Dwarf Gecko	Least Concern (SARCA 2014)	Present/likely transient
Lygodactylus ocellatus	Spotted Dwarf Gecko	Least Concern (SARCA 2014)	Present/likely transient
Naja annulifera	Snouted Cobra	Least Concern (SARCA 2014)	Present
Naja mossambica	Mozambique Spitting Cobra	Least Concern (SARCA 2014)	Present
Nucras lalandii	Delalande's Sandveld Lizard	Least Concern (SARCA 2014)	Present/likely transient
Pachydactylus maculatus	Spotted Gecko	Least Concern (SARCA 2014)	Present
Pachydactylus vansoni	Van Son's Gecko	Least Concern (SARCA 2014)	Present/likely transient
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	Least Concern (IUCN 2021)	Present/likely transient
Pedioplanis burchelli	Burchell's Sand Lizard	Least Concern (SARCA 2014)	Present/likely transient
Pelomedusa galeata	South African Marsh Terrapin	Not evaluated	Present
Philothamnus hoplogaster	South Eastern Green Snake	Least Concern (SARCA 2014)	Present/likely transient
Philothamnus occidentalis	Western Natal Green Snake	Least Concern (SARCA 2014)	Present/likely transient
Philothamnus semivariegatus	Spotted Bush Snake	Least Concern (SARCA 2014)	Present/likely transient
Psammophis brevirostris	Short-snouted Grass Snake	Least Concern (SARCA 2014)	Present/likely transient
Psammophis crucifer	Cross-marked Grass Snake	Least Concern (SARCA 2014)	Present/likely transient
Psammophylax rhombeatus	Spotted Grass Snake	Least Concern (SARCA 2014)	Present/likely transient
Psammophylax tritaeniatus	Striped Grass Snake	Least Concern (SARCA 2014)	Present/likely transient
Pseudaspis cana	Mole Snake	Least Concern (SARCA 2014)	Present/likely transient
Pseudocordylus melanotus melanotus	Common Crag Lizard	Least Concern (SARCA 2014)	Present/likely transient
Python natalensis	Southern African Python	Least Concern (SARCA 2014)	Present/likely transient
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Least Concern (SARCA 2014)	Present/likely transient
Scelotes mirus	Montane Dwarf Burrowing Skink	Least Concern (SARCA 2014)	Present/likely transient
Thelotornis capensis capensis	Southern Twig Snake	Least Concern (SARCA 2014)	Present/likely transient
Trachylepis capensis	Cape Skink	Least Concern (SARCA 2014)	Present/likely transient
Trachylepis homalocephala	Red-sided Skink	Least Concern (SARCA 2014)	Present/likely transient

SCIENTIFIC NAME	COMMON NAME	STATUS[17]	COMMENT/PRESENCE
Trachylepis margaritifera	Rainbow Skink	Least Concern (SARCA 2014)	Present/likely transient
Trachylepis punctatissima	Speckled Rock Skink	Least Concern (SARCA 2014)	Present/likely transient
Trachylepis varia sensu lato	Common Variable Skink Complex	Least Concern (SARCA 2014)	Present/likely transient
Varanus niloticus	Water Monitor	Least Concern (SARCA 2014)	Present
AMPHIBIANS			
Amietia delalandii	Delalande's River Frog	Least Concern (2017)	Present/likely transient
Amietia fuscigula	Cape River Frog	Least Concern (2017)	Present/likely transient
Breviceps adspersus	Bushveld Rain Frog	Least Concern	Present
Breviceps mossambicus	Mozambique Rain Frog	Least Concern	Present/likely transient
Cacosternum boettgeri	Common Caco	Least Concern (2013)	Present
Cacosternum nanum	Bronze Caco	Least Concern (2013)	Present/likely transient
Cacosternum parvum	Mountain Caco	Least Concern (2013)	Present/likely transient
Hemisus guttatus	Spotted Shovel-nosed Frog	Vulnerable	Present/likely transient
Hyperolius marmoratus	Painted Reed Frog	Least Concern (IUCN ver 3.1, 2013)	Present
Hyperolius semidiscus	Yellowstriped Reed Frog	Least Concern	Present/likely transient
Kassina senegalensis	Bubbling Kassina	Least Concern	Present/likely transient
Phrynobatrachus mababiensis	Dwarf Puddle Frog	Least Concern (IUCN, 2014)	Present/likely transient
Phrynobatrachus natalensis	Snoring Puddle Frog	Least Concern (IUCN, 2013)	Present/likely transient
Ptychadena anchietae	Plain Grass Frog	Least Concern	Present
Ptychadena oxyrhynchus	Sharpnosed Grass Frog	Least Concern	Present/likely transient
Ptychadena porosissima	Striped Grass Frog	Least Concern	Present/likely transient
Pyxicephalus adspersus	Giant Bull Frog	Near Threatened	Present/likely transient
Schismaderma carens	Red Toad	Least Concern	Present/likely transient
Sclerophrys capensis	Raucous Toad	Least Concern	Present
Sclerophrys gutturalis	Guttural Toad	Least Concern (IUCN, 2016)	Present/likely transient
Sclerophrys pusilla	Flatbacked Toad	Least Concern (IUCN, 2016)	Present/likely transient
Semnodactylus wealii	Rattling Frog	Least Concern	Present
Strongylopus fasciatus	Striped Stream Frog	Least Concern	Present/likely transient
Strongylopus grayii	Clicking Stream Frog	Least Concern	Present/likely transient
Tomopterna cryptotis	Tremelo Sand Frog	Least Concern	Present/likely transient
Tomopterna natalensis	Natal Sand Frog	Least Concern	Present/likely transient
Tomopterna tandyi	Tandy's Sand Frog	Least Concern	Present/likely transient
Xenopus laevis	Common Platanna	Least Concern (IUCN 2020)	Present
REPTILES			
Clonia lalandei	Lalande's Black-winged Clonia	VU B1ab(i,iii)	Refer to faunal reporting.

7.4 Appendix 4: Systematic Conservation Planning: Further Information

7.4.1 Vegetation of Southern Africa

A general description of the vegetation unit is provided below (as per Mucina & Rutherford, 2006) as a reference point for the baseline vegetation composition.

Gm 12

VT 61 Bankenveld (42%), VT 57 North-Eastern Sandy Highveld (33%) (Acocks 1953). LR 38 Moist Sandy Highveld Grassland (69%) (Low & Rebelo 1996).

Distribution Mpumalanga and Gauteng Provinces: Plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. Altitude 1 520–1 780 m, but also as low as 1 300 m.

Vegetation & Landscape Features Slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya* etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Rhus magalismontanum*).

Geology & Soils Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).

Climate Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations. See also climate diagram for Gm 12 (Figure 8.36).

Important Taxa Graminoids: *Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewsia biflora*, *Ctenium concinnum*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Panicum natalense*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*. Herbs: *Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops gilfillanii, E. transvaalensis* subsp. *setilobus, Helichrysum aureonitens*, *H. caespititium*, *H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*. Geophytic Herbs: *Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*. Succulent Herb: *Aloe ecklonis*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumosa*.

Conservation Endangered. Target 24%. Only very small fraction conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Some 44% transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data. No serious alien invasions are reported, but *Acacia mearnsii* can become dominant in disturbed sites. Erosion is very low.

References *Acocks (1953, 1988), Turner (1989), Coetzee (1993), Coetzee et al. (1994, 1995), Smit et al. (1997).*

Gm 14 Wakkerstroom Montane Grassland

VT 57 North-Eastern Sandy Highveld (57%, Acocks 1953). LR 38 Moist Sandy Highveld Grassland (49%), LR 41 Wet Cold Highveld Grassland (27%, Low & Rebelo '96).

Distribution KwaZulu-Natal and Mpumalanga Provinces: Occurring from the Escarpment just north of Sheepmoor (north), to southeast of Utrecht, and then from the vicinity of Volksrust in the west to Mandhlangampisi Mountain near Luneburg in the east. Altitude 1 440–2 200 m.

Vegetation & Landscape Features This unit is a less obvious continuation of the Escarpment that links the southern and northern Drakensberg escarpments. It straddles this divide and is comprised of low mountains and undulating plains. The vegetation comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* thickets occurring along steep, mainly east-facing slopes and drainage areas. *L. sericea* is the dominant woody pioneer species that invades areas as a result of grazing mismanagement.

Geology & Soils The mudstones, sandstones and shale of the Madzaringwe and Volksrust Formations (Karoo Supergroup) were intruded by voluminous Jurassic dolerite dykes and sills. Ac land type is dominant, while Fa and Ca are of subordinate importance.

Climate Rainfall peaks in midsummer. Rainfall 800–1 250 mm per year (MAP 902 mm). This unit experiences an orographic effect which results in a locally higher precipitation than the adjacent areas. Winters are very cold and summers mild (MAT 14°C). See also climate diagram for Gm 14 Wakkerstroom Montane Grassland (Figure 8.36).

Important Taxa Small Trees: *Canthium ciliatum*, *Protea subvestita*. Tall Shrubs: *Buddleja salviifolia* (d), *Leucosidea sericea* (d), *Buddleja auriculata*, *Diospyros lycioides* subsp. *guerkei*, *Euclea crispa* subsp. *crispa*, *Rhus montana*, *R. rehmanniana*, *R. transvaalensis*. Low Shrubs: *Asparagus devenishii* (d), *Cliffortia linearifolia* (d), *Helichrysum melanacme* (d), *H. splendidum* (d), *Anthospermum rigidum* subsp. *pumilum*, *Clutia natalensis*, *Erica oatesii*, *Felicia filifolia* subsp. *filifolia*, *Gymnosporia heterophylla*, *Helichrysum hypoleucum*, *Hermannia geniculata*, *Inulanthera dregeana*, *Metalasia densa*, *Printzia pyrifolia*, *Rhus discolor*, *Rubus ludwigii* subsp. *ludwigii*. Graminoids: *Andropogon schirensis* (d), *Ctenium concinnum* (d), *Cymbopogon caesius* (d), *Digitaria tricholaenoides* (d), *Diheteropogon amplectens* (d), *Eragrostis chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Diheteropogon filifolius*, *Elionurus muticus*, *Eragrostis capensis*, *Eulalia villosa*, *Festuca scabra*, *Loudetia simplex*, *Rendlia altera*, *Setaria nigrirostris*. Herbs: *Berkheya onopordifolia* var. *glabra* (d), *Cephalaria natalensis* (d), *Pelargonium luridum* (d), *Acalypha depressinerva*, *A. peduncularis*, *A. wilmsii*, *Aster bakerianus*, *Berkheya setifera*, *Euryops transvaalensis* subsp. *setilobus*, *Galium thunbergianum* var. *thunbergianum*, *Geranium ornithopodioides*, *Helichrysum cephaloideum*, *H. cooperi*, *H. monticola*, *H. nudifolium* var. *nudifolium*, *H. oreophilum*, *H. simillimum*, *Pentanisia prunelloides* subsp. *latifolia*, *Plectranthus laxiflorus*, *Sebaea leiostyla*, *S. sedoides* var. *sedoides*, *Selago densiflora*, *Vernonia hirsuta*, *V. natalensis*, *Wahlenbergia cuspidata*. Geophytic Herbs: *Hypoxis costata* (d), *Agapanthus inapertus* subsp. *intermedius*, *Asclepias aurea*, *Cheilanthes hirta*, *Corycium dracomontanum*, *C. nigrescens*, *Cyrtanthus tuckii* var. *transvaalensis*, *Disa versicolor*, *Eriospermum cooperi* var. *cooperi*, *Eucomis bicolor*, *Geum capense*, *Gladiolus ecklonii*, *G. sericeovillosus* subsp. *sericeovillosus*, *Hesperantha coccinea*, *Hypoxis rigidula* var. *pilosissima*, *Moraea brevistyla*, *Rhodohypoxis baurii* var. *confecta*. Semiparasitic Herb: *Striga bilabiata* subsp. *bilabiata*.

Biogeographically Important Taxa ([L]Low Escarpment endemic, [N]Northern sourveld endemic) Low Shrubs: *Bowkeria citrina*[L], *Lotononis amajubica*[L], *Protea parvula*[N] . Succulent Herb: *Aloe modesta*[N].

Endemic Taxa Herbs: *Helichrysum aureum* var. *argenteum*, *Selago longicalyx*. Geophytic Herbs: *Kniphofia* sp. nov. ('*laxiflora* Form C'), *Nerine platypetala*. Woody Climber: *Asparagus fractiflexus*.

Conservation Least threatened. Conservation target 27%, less than 1% is statutorily protected in the Paardeplaats Nature Reserve. There are 10 South African Natural Heritage Sites in this unit, although very little of it is formally protected. Land use pressures from agriculture are low (5% cultivated) probably owing to the colder climate and shallower soils. The area is also suited to afforestation, with

more than 1% under *Acacia mearnsii* and *Eucalyptus* plantations. The black wattle (*Acacia mearnsii*) is an aggressive invader of riparian areas. Erosion is very low (78%) and low (19%).

Remarks This unit represents the northernmost distribution limit for many plant taxa that occur on the Drakensberg Escarpment (e.g., *Helichrysum hypoleucum* and *Protea subvestita*) to the south, as well as the southernmost limit for plants occurring on the Northern Escarpment (e.g., *Protea parvula*). It also contains many of its own endemics and is under investigation as a possible centre of endemism. The higher rainfall and more temperate climate on a somewhat raised escarpment have possibly been conducive to the evolution of local endemics. Unlike its adjacent units, the Wakkerstroom Montane Grassland is largely devoid of *Pteridium aquilinum*.

References *Acocks (1953, 1988), Codd (1968), Eckhardt et al. (1997).*

7.4.2 Mpumalanga Biodiversity Sector Plan (MBSP, 2014)

Much of the current conservation effort in South Africa is focused on promoting land-use practices that reconcile development opportunities and spatial planning at a landscape scale, with the over-arching goal of maintaining and increasing the resilience of ecosystems, especially in the face of climate change. This landscape approach to biodiversity conservation involves working within and beyond the boundaries of protected areas to manage biodiversity within a mosaic of land-uses.
One of the primary aims is to achieve economic goals whilst the health of ecosystems is maintained, and the loss of important or threatened species or habitats is avoided. Creating functional connectivity in landscapes is a key aspect of promoting ecosystem resilience (the ability of the ecosystem to absorb a certain amount of change yet remain functional). Ecosystem resilience can be maintained or built through an approach that focuses on intact areas, maintaining biodiversity priority areas in a natural or near-natural state, maximising connectivity between these areas and maximising the diversity of species and ecosystems. Resilient ecosystems can:

- Maintain the ecological and evolutionary processes that allow biodiversity to persist in these ecosystems;
- Better-withstand human-induced pressures (from, for example, too frequent fires);
- Adapt to the impacts of climate change, such as increased rainfall variability;
- Mitigate the effects of climate change by continuing to capture and store carbon;
- Deliver ecosystem services, such as the provision of clean water and flood attenuation.

The main purpose of a biodiversity sector plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land-use and development planning, environmental assessments and authorisations, and natural resource management. A biodiversity sector plan achieves this by providing a map (or maps) of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). The maps are provided together with contextual information on biodiversity, and land-use guidelines that can be incorporated into the policies and decisions of a wide range of sectors. A Biodiversity Sector Plan is based on a fine-scale systematic biodiversity plan (1:50 000 or finer), and has boundaries aligned with administrative boundaries (such as a municipality or groups of municipalities).
A Biodiversity Sector Plan can be used to guide conservation action (such as identifying priority sites for expansion of protected areas), or to feed spatial biodiversity priorities into planning and decision-making in a wide range of cross-sectoral planning processes and instruments such as provincial and municipal integrated development plans and spatial development frameworks, land-use management schemes, environmental management frameworks and environmental management plans. The flowing core categories are designated:

- Protected Areas: Areas that are formally protected by law and recognised in terms of the Protected Areas Act (this includes contract protected areas declared through the biodiversity stewardship programme).
- Critical Biodiversity Areas (CBAs): Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes. These include:
  - All areas required to meet biodiversity pattern targets and to ensure continued existence and functioning of species and ecosystems, special habitats and species of conservation concern.
  - Critically Endangered ecosystems; and
  - Critical linkages (corridor 'pinch-points') to maintain connectivity.

CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species.

- Ecological Support Areas (ESAs): Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. In the terrestrial assessment they support landscape connectivity and strengthen resilience to climate change. ESAs need to be maintained in at least a functional and often natural state, supporting the purpose for which they were identified. They include features such as riparian habitat surrounding rivers or wetlands, corridors, over-wintering sites for Blue Cranes, and so on.
- Other Natural Areas (ONAs): Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.
- Moderately or Heavily Modified Areas (sometimes called 'transformed'): Areas that have been heavily modified by human activity so that they are by-and-large no longer natural, and do not contribute to biodiversity targets. Some of these areas may still provide limited biodiversity and ecological infrastructural functions but, their biodiversity value has been significantly and, in many cases, irreversibly compromised.

Table 12: Summary of map categories shown in the terrestrial CBA map for Mpumalanga, and their meanings.

Map Category	Description	Sub- Category	Description
Protected Areas	Areas that are formally protected by law and recognised in terms of the Protected Areas Act, including contract protected areas declared through the biodiversity stewardship programme.	National Parks & nature Reserves	Includes formally proclaimed national Parks, nature Reserves, Special nature Reserve, and Forest nature Reserves.
		Protected Environments: Natural	Includes Protected Environments, declared in terms of Protected Areas Act (Act 57 of 2003, as amended).
		Protected Environments: Modified	Heavily modified areas in formally proclaimed Protected Environments.
Critical Biodiversity Areas (CBA)	All areas required to meet biodiversity pattern and process targets; critically Endangered ecosystems, critical linkages (corridor pinch-points) to maintain connectivity; CBAs are areas of high biodiversity value that must be maintained in a natural state.	CBA: Irreplaceable	This category includes: (1) Areas required to meet targets and with irreplaceability values of more than 80%. (2) critical linkages or pinch-points in the landscape that must remain natural; (3) critically Endangered Ecosystems.
		CBA: Optimal	The CBA Optimal Areas (previously called 'important and necessary' in the MBCP) are the areas optimally located to meet both the various biodiversity targets and other criteria defined in the analysis. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all biodiversity targets and design criteria.
Ecological Support Areas (ESA)	Areas that are not essential for meeting targets, but that play an important role in supporting the functioning of CBAs and that deliver important ecosystem services	ESA: Landscape corridor	The best option to support landscape-scale ecological processes, especially allowing for adaptation to the impacts of climate change.
		ESA: Local corridor	Finer-scale alternative pathways that build resilience into the corridor network by ensuring connectivity between climate change focal areas, reducing reliance on single landscape-scale corridors.
		ESA: Species Specific	Areas required for the persistence of particular species. Although these may be production landscapes, a change in land-use may result in loss of this species from the area. (Only one species-

Map Category	Description	Sub- Category	Description
			specific ESA was included in the analysis — an over-wintering site for blue cranes).
		ESA: Protected Area Buffers	Areas surrounding protected areas that moderate the impacts of undesirable land-uses that may affect the ecological functioning or tourism potential of PA's. Buffer distance varies according to reserve status: national Parks — 10 km; nature Reserves — 5 km buffer; Protected Environments — 1 km buffer.
Other Natural Areas (ONA)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.		
Moderately or Heavily Modified Areas	Areas in which significant or complete loss of natural habitat and ecological function has taken place due to activities such as ploughing, hardening of surfaces, open-cast mining, cultivation and so on.	Heavily Modified	All areas currently modified to such an extent that any valuable biodiversity and ecological functions have been lost.
		Moderately Modified: Old lands	Old, cultivated lands that have been allowed to recover (within the last 80 years), and support some natural vegetation. Although biodiversity pattern and ecological functioning may have been compromised, the areas may still play a role in supporting biodiversity and providing ecosystem services.

Networks of ecological corridors

Ecological corridors of natural and near-natural land ensure connectivity between various spatial elements in the land- scape. They link key protected areas with climate change refugia and other features of the landscape that promote adaptation to the effects of climate change. Two types of ecological corridors were identified in the MBSP:

- Landscape corridors, which are the best large-scale options for linking areas that are important for climate change resilience across Mpumalanga and adjacent provinces.
- Local corridors, which take effect at a finer scale to make the network of landscape corridors more robust to disturbance; they provide alternative pathways and critical linkages that should not be lost in the land- scape.

Because of the technology used in the development of the MBSP it was possible to minimise the presence of 'narrow bottlenecks' and avoid including large areas of modified land in the network of ecological corridors, wherever possible. Special attention was also paid to ensuring seamless alignment with ecological corridors that have been identified in the biodiversity plans of KwaZulu-Natal, Free State and Gauteng.

Areas important for climate change resilience

The spatial analysis undertaken for the MBSP identified parts of the landscape where it is likely that ecosystems will be most able to maintain a stable ecological composition and structure in the face of climate change, based on a range of possible future climate change scenarios (NBA 2011; Holness, pers. comm.). These areas are referred to as areas important for climate change resilience. They include diverse landscapes such as:

- Local refugia (e.g. kloofs and south facing slopes): Areas important for landscape connectivity (e.g. riparian corridors)
- Areas with steep temperature, precipitation and altitude gradients (e.g. south-facing slopes).
- Areas of high biotic diversity where many different habitat and biome types are found in close proximity and plant endemism is high.

Desired Management Objectives

The desired management objective for a parcel of land, or freshwater feature, refers to the ecological condition in which it should be maintained. These not only determine the ecological state or condition in which the land or freshwater feature should be maintained but also provide the broad direction for appropriate land- or resource-use activities and management practices. Only those land- or resource-

use activities that are compatible with maintaining the desired management objective should be encouraged. Different categories on the CBA maps have specific desired management objectives, according to their biodiversity priority (Table 13). In broad terms, the biodiversity priority areas need to be maintained in a healthy and functioning condition, whilst those that are less important for biodiversity can be used for a variety of other land-uses.

Table 13: Map categories, definitions, and desired management objectives

Map Category	Definition	Desired Management Objectives
Protected Areas	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted Protected Environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
Critical Biodiversity Areas (CBAs)	Areas that are required to meet biodiversity targets, for species, ecosystems, or ecological processes.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
Ecological Support Areas (ESAs)	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
Other natural Areas (OnAs)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

The MBSP Guideline recommendations for these categorisations are described below:

Land-use guidelines for terrestrial Critical Biodiversity Areas (CBAs)

Critical Biodiversity Areas are required to meet biodiversity targets and need to be maintained in a healthy natural state.

Irreplaceable CBAs are the most important biodiversity areas in the province, outside of the protected area network. They represent the last remaining options for securing critical biodiversity and ecosystems and for achieving biodiversity targets. If these areas suffer any further loss of habitat or ecological function, it is likely that the biodiversity targets will not be met, and the status of species and ecosystems will decline.

Some CBAs are considered irreplaceable because they form what are called 'critical linkages or pinch-points, or because they incorporate threatened ecosystems. critical linkages are highly constrained areas within a natural landscape that are vital for maintaining the linkage and ecological integrity of the corridor network. If these critical linkages are lost, it would result in disruption of the corridor network.

Optimal CBAs (previously referred to as 'Important & necessary' in the MBCP) have an irreplaceability of less than 80% but are the most optimally located and the most efficient solution (i.e., occupying the smallest possible area) to meet biodiversity targets as well as other criteria such as avoiding high-cost areas where there are competing land-uses. There may be options to achieve the targets elsewhere, but these will require more land or may lead to increasing conflict between competing land uses.
Permissible land uses are those that are compatible with maintaining the natural vegetation cover of CBAs in a healthy ecological state, and that do not result in loss or degradation of natural habitat. Some low-intensity agricultural land-uses, such as grazing of livestock, may be acceptable in CBAs, on condition that best-practice guidelines aimed at benefiting the biodiversity assets and reducing the vulnerability of each site are implemented. An example of such best-practice guidelines is the recently released grazing and burning guidelines for managing grasslands for biodiversity and livestock production (SANBI, 2014).

Land uses that should not be in terrestrial CBAs because they cause loss of natural habitat or ecosystem functionality, include:

- Any form of mining or prospecting.
- Extensive or intensive grazing that results in species diversity being lost through selective- or over-grazing.
- conversion of natural habitat for intensive agriculture (cultivation) or plantation forestry.
- Expansion of existing settlements or residential, commercial or industrial infrastructure.
- new hard infrastructure, and linear developments such as roads, railways and pipelines.
- complete-barrier fencing (i.e. game-proof fences) in in CBA (or ESA) corridors.
- Linear infrastructure of any sort that disrupts the connectivity of CBA (or ESA) corridors.

More detailed land-use guidelines for working in terrestrial CBAs are provided in Table 14.

Land-use guidelines for terrestrial Ecological Support Areas

- Ecological support areas (ESAs) are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of CBAs and deliver important ecosystem services. They facilitate landscape connectivity, promote resilience to climate change, and buffer elements of the landscape including protected areas and sites that are important for the survival of individual species.

ESA: Landscape and Local Corridors: The purpose of ecological corridors is to provide intact pathways for
long-term biological movement. Landscape-scale corridors represent the best option for promoting resilience to climate change and the persistence of biodiversity as they provide pathways for the movement of plants and animals in response to environmental change. They also support the natural movement of species between populations to ensure population viability. Landscape corridors are aligned with areas that have maximum amounts of remaining natural habitat. Local corridors are fine-scale corridors that contribute to connectivity between climate change refugia. They represent alternative pathways for movement of species and thus lessen impacts on critical linkages and landscape-scale corridors and provide networks that are more resistant to disturbance.

ESA: Species-Specific Sites: These are areas required for the persistence of specific species. Only one area, an important over-wintering site for blue cranes, that is shared with Gauteng, and which comprises a matrix of natural and cultivated lands, was identified as an ESA in the MBSP.

ESA: Protected Area Buffers: These are areas around protected areas where changes in land-use may affect the ecological functioning or tourism potential of the adjacent protected area. The purpose of buffer zones is to reduce the impacts of undesirable land-uses on the environment, and to provide opportunities for tourism. Modification of the natural habitat within the buffer zones may have negative impacts on the zonation and management plan of the adjacent protected area.

Permissible land-uses: There is more flexibility in terms of options for compatible land-uses in ESAs than there is in CBAs. However, ESAs do need to remain ecologically functional, which means that they need to be maintained in at least a near-natural state, although some loss of biodiversity pattern through a variety of land uses is acceptable. Details of land-use guidelines for working within ESAs are provided in Table 16.

Land-use guidelines for terrestrial Other Natural Areas

The overall purpose of these land-use guidelines is to promote the effective management of biodiversity as required in Section 41(a) of the Biodiversity Act (Act 10 of 2004, as amended) and in terms of the National Environmental Management Act (Act 107 of 1998, as amended). The guidelines provide advice on which land-uses and activities are most compatible with maintaining the ecological integrity of CBAs and ESAs, and other parts of the landscape, based on the desired management objectives for the land and the anticipated impact of each land-use activity on biodiversity patterns and ecological processes. The land-use guidelines have been developed in consultation with some planners from other sectors, and in a way that aims to minimise potential conflict between land uses. However, their focus is on identifying land-uses that are biodiversity compatible. They should, therefore, be used in conjunction with any other sector-specific guidelines that may be available for the province.

Land-use guidelines are presented below for terrestrial and freshwater ecosystems. These guidelines are intended primarily to guide planning and decision-making in terrestrial and freshwater Critical Biodiversity Areas and Ecological Support Areas on land outside of protected areas. However, brief guidelines are also provided for certain categories of protected areas, such as Protected Environments, in which a range of land uses other than biodiversity conservation is possible. In the sections that follow, general recommendations are given for each category on the CBA maps, relating to desired management objectives and appropriate land uses, and more detailed guidelines are provided in the accompanying tables (Table 14).
Other natural Areas (OnAs) are not required to meet biodiversity targets and so are not identified as a priority in the MBSP. They do, however, retain much of their natural character. The biodiversity in these non-priority landscapes may still be of value and contribute to maintenance of viable species populations and natural ecosystem functioning and Other natural Areas may provide essential ecological infrastructure and ecosystem services.

Permissible land uses: OnAs offer the greatest flexibility in terms of management objectives and permissible land-uses and are generally recommended (along with Modified Areas) as the sites for higher-impact land-uses. However, because ONAs may still have significant ecological, aesthetic and social value, they should not be regarded as 'ecological wastelands or areas where 'anything goes.' Planners are still required to give due consideration to assessing environmental factors, socio-economic efficiency, aesthetics and impacts on the sense-of-place in making decisions about the

location of land uses in these areas. Environmental authorisation may still be required for high-impact land-us- es in terms of the listed activities in the EIA Regulations, and other relevant legislation.

Land-use guidelines for terrestrial Heavily or Moderately Modified Areas

Heavily modified areas are those in which significant or complete loss of natural habitat and ecological functioning has taken place due to activities such as ploughing,
hardening of surfaces, mining, cultivation, and other activities that modify natural habitat. Even so, they may include small remnants of natural habitat such as the patches or strips of natural habitat that survive between cultivated lands, along river-lines and ridges and in open spaces in towns. These disconnected remnants are often biologically impoverished, highly vulnerable to damage and have limited likelihood of being able to persist but may contain residual biodiversity value or may provide ecological infrastructure or certain ecosystem services.

Moderately Modified - Old Lands (sometimes called 'old fields' in other documents) are those areas that were used for cultivation or mining in the past (within the last 80 years) but are no longer used for these purposes and have been left to re-vegetate. These old lands are areas where biodiversity pattern and ecological function have been seriously compromised in the past, but they may still play an important role in the provision of ecosystem services or may provide important habitats for certain animal species. For example, old lands can provide important feeding grounds for birds such as blue cranes, and disused mine shafts can provide suitable habitats for certain bats.

Permissible land-uses: Heavily modified areas are those preferred for intensive land-uses such as the construction of settlements, industrial development and other.
land-uses that have a high impact. These land-uses should still be located and managed in ways that maintain any residual ecological functionality, and that does not impact negatively on species for which these modified sites may be important. In some cases, restoration may be advisable.

All land-use sectors will benefit from applying the guidelines in this handbook, in conjunction with other codes of best practice such as those that have been developed in the timber growing industry and the Mining and Biodiversity Guidelines (SANBI, 2013) and Grassland Ecosystem Guidelines (SANBI 2013a), to reduce impacts on biodiversity.

Table 14: Land-use guidelines for terrestrial Critical Biodiversity Areas

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
Protected Areas	Must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity. A benchmark for biodiversity.	All operational aspects of managing these areas must be subject to their main purpose, which is to protect and maintain biodiversity and ecological integrity and should be governed by a formally approved management plan and land-use activities that support the primary function of these areas as primary sites for biodiversity conservation. The management plan must identify allowable activities, which should be consistent at least with the CBA Irreplaceable category; the location of these allowable activities should be captured in a zonation plan in the management plan. Activities relating to the construction of roads, administrative or tourism infrastructure and services (such as water reticulation systems, power lines and the likes) that are required to support the primary function of the protected area and its allowable activities, must be subject to at least a basic scoping report, or a full EIA, as specified by NEMA, and the protected area management plan. In the case of Protected Environments, a variety of agricultural land uses may be allowed, such as livestock grazing, plantation forestry and some cultivation. The location of these land-use activities must be informed by the CBA maps and should be specified in the zonation plan of the management plan

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
		for the protected environment. All areas of natural habitat that are zoned for conservation use, should be subject to implementation of the land-use guidelines for protected areas, CBAs, and ESAs.	
Critical Biodiversity Areas (CBAs)	Maintain in a natural state with no further loss of natural habitat.	Allow low-impact land-uses that are compatible with maintaining CBAs in a natural state, with no loss of habitat or species. Earmark CBAs as priority sites for land care projects such as Working for Water, Working for Wetlands, and Working on Fire and other compatible, conservation activities. Avoid activities identified in the three Listing notices (R544, R545 and R546), if possible, as they conflict with the desired management objectives for terrestrial CBAs. Where they cannot be avoided, the impacts of these activities should be minimised and remedied, and EIA conditions should be strictly applied by the competent authority. In larger geographically sensitive areas, environmental management frameworks (provided for under sections 24 (5)(i) and 44 of NEMA) should be developed and implemented to inform environmental authorisations, promote sustainability, secure biodiversity, and ecological functionality, and promote co-operative governance. The information and maps of the MBSP should be used to promote and support compilation of any Environmental Management Frameworks.	
Irreplaceable CBAs	Maintain in a natural state with no further loss of natural habitat.	Biodiversity loss and land-use change in Irreplaceable CBAs should be monitored as a matter of priority, to prevent unauthorised land-use change or degradation by neglect or ignorance. Where appropriate, these areas should be incorporated into the formal Protected Area system through biodiversity stewardship agreements (contract nature Reserves or Protected Environments). Ideally, conservation management activities should be the primary land-use in all irreplaceable areas, or they should at least be managed in ways that have no negative impact on species, ecosystems, or ecosystem services. Extensive (widespread, low intensity) livestock or game ranching, if well-managed, is compatible with the desired management objectives for these areas. These land-uses are acceptable if they consider the specific biodiversity features (e.g., rare species or vegetation remnants) and vulnerabilities (e.g., infestation by invasive alien plants) at each site, if they comply with recommended stocking rates, if any associated infrastructure (required to support the ranching activities) is kept to low levels.	In general, Irreplaceable sites must be avoided in terms of the mitigation hierarchy. A specialist study must be part of the Scoping and EIA process for all land-use applications in these areas, using the services of an experienced and locally knowledgeable biodiversity expert who is approved by the MTPA. Applications for land use of any kind should be referred to the biodiversity specialists in MTPA and DARDLEA for evaluation. Degraded areas included in the land parcel, but not the land-use proposal, should be restored to natural ecosystem functioning where possible. Provision of alternative land as a 'biodiversity offset' in exchange for biodiversity loss in these areas cannot be considered except in exceptional circumstances and would need to be considered on a case-by-case basis.
Optimal CBAs (referred to as Important and necessary in MBCP)	Maintain in a natural state with no further loss of natural habitat.	Acceptable land uses are those that are least harmful to biodiversity, such as conservation management, or extensive livestock or game farming. Large-scale cultivation, mining and urban or	If small-scale land-use change is unavoidable, it must be located and designed to be as biodiversity-sensitive as possible. A specialist study must be part of the scoping and EIA process for all land-use

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
		industrial development are not appropriate. Extensive (widespread, low intensity) livestock and game ranching, if well-managed (see above), is compatible with the desired management objectives for these areas.	applications in these areas, using the services of an experienced and locally knowledgeable biodiversity expert who is SACNASP registered. Provision for biodiversity offsets in exchange for biodiversity loss should only be considered as a last resort and at a ratio consistent with national policy.
Ecological Support Areas (ESAs)	The desired management objective for all ESAs is to maintain the land in a near-natural and ecologically functional state, even if some loss of ecosystem composition or structure takes place		
ESA: Landscape and Local-scale corridors	Maintain ecological functionality in support of biodiversity connectivity by retaining the existing natural vegetation cover in a healthy ecological state and restore 'critical linkages' where necessary.	A greater range of land uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.	certain activities covered under Listing notice 3 trigger the EIA process in ESA corridors. Restoration of corridors is important, particularly in terms of the Working for Water programs. The impact of land-use proposals on the functionality of ecological corridors must be assessed by the relevant biodiversity specialist as part of the EIA/Scoping report. Impenetrable fences that restrict animal movement should be discouraged.
ESA: Species Specific Sites	Maintain the prevailing ecological processes that support the specific species and manage for no further habitat loss.	Although these areas may be in production landscapes, and may be heavily modified in parts, a change in land use to anything other than conservation management should be discouraged as it would most likely result in a loss of the target species from the area.	The impact of any changes in land use on the population viability of listed species, such as blue cranes, should be assessed by a registered specialist. Restoration of degraded areas and invasive alien plant control is recommended, particularly clearing the small wattle 'jungles' that large birds avoid.
ESA: Protected Area Buffers	To minimise the impacts of surrounding land-uses on the ecological integrity, character, and tourism potential of protected areas.	When assessing the impacts of proposed land uses in protected area buffers, consideration needs to be given to both direct (e.g., plantation forestry blocking view-sheds and reducing water flows into a Protected Area) and indirect impacts (e.g., light and noise pollution).	Buffer distances vary according to the nature of the Protected Area, as follows: national Parks: 10 km buffer as indicated in Listing notice 3. nature Reserves: 5 km buffer as indicated in Listing notice 3. Protected Environments: 1 km buffer as these may include production landscapes. Land-use change applications within the buffer zone may be referred to the protected area manager or ecologist for evaluation. A viewshed analysis of the potential visual impact of the proposed land-use on adjacent protected areas should be undertaken where necessary.
Other Natural Areas (ONAs)	The overall objective should be to ensure ecosystem functionality and minimise loss of natural habitat and species through strategic landscape planning.	These areas have the greatest flexibility in terms of management objectives and permissible land-uses. Where possible, avoid modifying any remaining natural habitat by locating land-uses, including cultivation and plantations, in already-modified areas. Authorisation may be required for high-impact land-uses (such as intensive industry or urban development) and standard application of EIA regulations and other planning procedures is required. note: These areas may still contain species of conservation concern but either have not yet been surveyed, or the data were not available for incorporation into the MBSP. The presence or absence of important species should always be established through site visits before proceeding with a land-use change.	
Heavily or Moderately	Manage land-use in a biodiversity-	Areas with no natural habitat remaining are preferred sites for higher-impact land-uses, and new projects should be in these areas before modifying any remaining	

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
Modified Areas	friendly manner, aiming to maximise ecological functionality. In old lands, stabilise ecosystems and manage them to restore ecological functionality, particularly soil carbon and water-related functionality, using indigenous plant cover. Old lands should be burnt and grazed appropriately.	natural habitat. Restoration and re-vegetation should be prioritised where heavily modified areas occur close to land of high biodiversity value or are located such that they could potentially serve useful ecological connectivity functions (such as in ecological corridors). For individual parcels of land identified as having specific actual or potential biodiversity values, develop incentives to restore lost biodiversity and connectivity. When locating land-uses in these modified areas, consider the off-site impacts they may have on neighbouring areas of natural habitat, especially if these are of high biodiversity value. For example, controlling use of pesticides in modified areas, because of the impacts on neighbouring areas of natural habitat. Encourage landowners and developers to use indigenous plants, especially trees, where aesthetic or functional options exist.	

7.4.3 Mpumalanga Biodiversity Sector Plan (MBSP, 2014): Aquatic

Mpumalanga contains over 4 000 wetlands, numerous river systems (including five major catchment areas) and a large proportion of South Africa's Strategic Water Source Areas (areas accounting for more than 50% of annual run-off). Most of the wetlands occur in grasslands of the wetter highveld and escarpment regions, with the greatest concentration of pans in the Chrissiesmeer area near Ermelo. These wetlands represent high value ecological infrastructure for securing water for human use.

The vigorous plant cover of intact wetlands slows run-off, filters and purifies water and reduces the impacts of droughts and floods by behaving like giant sponges. Wetlands are also home to important biodiversity, providing special habitats and breeding grounds for many species of plants and animals. They play a vital role in agro-pastoral production systems and local livelihoods by providing renewable economic resources such as grazing, food, medicinal plants and natural fibre for thatch and craft making.

Most of the wetlands in Mpumalanga fall into the category commonly referred to as 'palustrine', which includes seepage wetlands and pans (See Box 2.2). Although all of them are of high biodiversity and ecological value, there are three wet- land areas that are of particular significance in Mpumalanga:

- The Wakkerstroom wetland complex in the south-east of the province.
- Verloren Valei, on the Steenkampsberg plateau near the town of Dullstroom.
- Chrissiesmeer Pan Area, near Ermelo (also called the Mpumalanga Lake District).

Freshwater Ecosystems

Freshwater Ecosystems comprise the following:

- **Seepage wetlands (sometimes called 'sponges')**: these are generally seasonal, small and widely scattered wetlands formed at valley heads or on hillslopes, largely by the discharge of sub-surface water.
- **Valley-bottom wetlands**: these occur in valley bottoms and are usually wetter.
- for longer periods than seeps. They may be channelled (with at least one or more clearly defined steam channels, but lacking floodplain features), or un-channelled (with no clearly defined stream channel).

- **Floodplain wetlands**: gently sloped, with floodplain features and a distinct stream channel.
- **Pans** (depressions and 'flats'): areas that accumulate surface water, either in depressions, or extensive areas characterised by level, gently undulating or uniformly sloping land; pans are shallow, seasonal or permanent bodies of water that are not directly connected to river systems by surface flow (for example, pans in the Chrissiesmeer area).
- **Lakes and dams**: there are no true lakes in Mpumalanga. Strictly speaking, lakes are natural impoundments within the continuous river line. Dams are artificial impoundments that are not considered as typical wetlands. The small 'lakes' in the Chrissiesmeer area are technically, pans, occasionally interconnected by wet-season overflows.

Aquatic Critical Biodiversity Areas

Development of the freshwater CBA map relied on the recently completed national Freshwater Ecosystems Priority Areas (NFEPA) project (Nel et al., 2011). Because the NFEPA project has been well received in the scientific community, selected data products were incorporated directly (i.e., without further analysis) into the MBSP freshwater assessment.

The freshwater CBA map shows three sub-categories of CBA (CBA Aquatic Species, CBA Rivers and CBA Wetlands) and five sub-categories of ESA (Wetlands, Wetland clusters, Important Sub-catchments, Fish Support Areas and Strategic Water Source Areas). These are described below.

Some of the key improvements that have been made in the development of the CBA maps for the MBSP are, the use of new ecologically based planning units, more recent and accurate land cover data, more and better-quality biodiversity data, an improved ecological corridor network and the inclusion of several new features such as those that are important for landscape connectivity and climate change adaptation.

The MBCP (2008) used uniformly sized hexagons as the planning units, as was standard practice at the time, but this held several disadvantages. In the MBSP (2014), a system of more ecologically based, segmented planning units was used. The planning units were primarily delineated by land cover categories derived automatically from high-definition 2010 satellite imagery of Mpumalanga, but were nested within protected areas, farm boundaries and NFEPA catchments giving them an ecological as well as a real-world character. A total of 90 866 planning units (with areas ranging between 10 and 495 ha, with a mean of 84.2 ha) were used. Importantly, very few planning units included mixtures of modified and unmodified land and their boundaries intuitively make sense when overlain on an aerial or satellite image.

Land-use guidelines for Freshwater CBAs

Freshwater Critical Biodiversity Areas (CBAs) are those freshwater ecosystems required to meet freshwater biodiversity targets as defined in the national Freshwater Ecosystems Priority Areas project (NFEPA, Nel et al., 2011). Freshwater CBAs include CBA Rivers, CBA Wetlands, and CBAs for specific freshwater species not used in NFEPA (such as threatened freshwater-dependent invertebrates).

- CBA Rivers: These are rivers that need to be maintained in a good ecological state in order to meet biodiversity targets for freshwater ecosystems. They include FEPA rivers and all free-flowing rivers (of which there is only a handful left in Mpumalanga).
- CBA Wetlands: These are wetlands that have been identified as freshwater ecosystem priority areas (referred to as FEPA wetlands) that are important for meeting biodiversity targets for freshwater ecosystems. Healthy examples are scarce.
- CBA Aquatic species: These are areas considered critical for meeting the habitat requirements of selected aquatic invertebrate species. These species are all known from only one or two localities and are at risk of extinction if their habitat is lost.

Each of the subcategories of freshwater CBA has unique land-use guidelines and planning requirements (summarised in Table 15). The most common impacts on river and wetland systems, which may also impact on the CBA freshwater species are summarised below:

- Water extraction: cumulative reduction of river flow.
- Open-cast and strip mining (especially of coal): destruction of water table, acid mine drainage, toxic ground-water discharge.
- Planting high water-demand crops (e.g., timber and sugarcane): lowers water table, stream flow reduction, complex soil changes.
- Industrial-scale agriculture causes widespread changes to soil and vegetation cover, with major impacts on soil erosion, infiltration of rainfall, water-table recharge and sedimentation of rivers. A particular goal is the banning of pesticides in the vicinity of the CBA freshwater species areas.
- Atmospheric pollution: changes the chemistry of rainwater (acid rain).
- Hard paving and built structures (urban development): reduced infiltration and water-table recharge, enhanced flooding, erosion and sedimentation of riverbeds, pollution and changes to overall river ecology.
- Point-source pollution from sewage, industrial and mining discharges: toxic to biodiversity and humans, damages ecosystem health.
- Dams and weirs: change downstream hydrology: flow characteristics, water temperature, turbidity and dissolved nutrients; provide a physical barrier to fish.
- Non-point-source pollution (e.g., groundwater and seepage): from dumps (mine, industrial and rubbish), surface runoff (agricultural, mine, industrial and urban), irrigation seepage.
- Engineering/construction/earth moving causes accelerated soil erosion, turbidity (suspended solids) and sedimentation.
- Structures such as bridges, causeways (+ weirs and dams): can change the natural erosion and sedimentation characteristics of a river, causing local and downstream channel modification.

Broad guidelines for locating land-uses relative to freshwater CBAs are provided in Table 17. The NFEPA guidelines for specific land-use practices and activities that impact on water quantity, water quality, or habitat and biota in freshwater CBAs are summarised in Appendix 7.4.

Land-use guidelines for Freshwater ESAs

Ecological Support Areas are not required to meet freshwater biodiversity targets but support the ecological functioning of freshwater CBAs. They are sub-divided into four sub- categories, including: ESA Important sub-catchments and fish support areas; ESA Wetlands; ESA Wetland clusters and ESA Strategic Water Source Areas. These are described briefly below.

- **ESA Wetlands**: This sub-category includes all non-FEPA wetlands. Wetlands in Mpumalanga have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices. Wetlands represent high value infrastructure for delivering, managing and storing good quality water for human use, and they are vulnerable to harmful impacts. It is therefore in the interests of national water security that all wetlands are protected by law (national Water Act, 36 of 1998).
- **ESA Wetland Clusters**: These are clusters of wetlands embedded within a largely natural landscape that function as a unit, and allow for the migration of species such as
- frogs and insects between individual wetlands. They also support other ecological processes that operate at a broader, landscape scale.
- **ESA**: Important Sub-Catchments and Fish Support Areas: This sub-category includes FEPA sub-catchments and Fish Support Areas. A river FEPA is the river reach that is required for meeting biodiversity targets for river ecosystems and threatened fish species. In managing the condition of a river FEPA, it is important to manage not only the river itself, but also the network of streams and wetlands as well as land- based activities in the sub-catchment that supports

the river FEPA. A proportion of tributaries and wetlands need to remain healthy and functional for the river FEPA to be kept in a good ecological condition. This requires that management activities are focussed on maintaining water quantity and quality and the integrity of natural habitat in the sub-catchment.

- **Fish support areas** (that are not already FEPAs) are sub- quaternary catchments that are not in top ecological condition but are still important for supporting threatened and near-threatened indigenous freshwater fish populations that are of conservation concern. This category is similar to FEPAs, except that Fish Support Areas may not always be required to meet proportional targets.
- The fish populations may also not always be present in the main stem river, but in the tributaries within these sub- catchments and are thus able to re-populate main stem rivers after pollution events.
- **ESA - Strategic Water Source Areas**: Strategic Water Source areas produce more than 50% of Mpumalanga's runoff in only 10% of the land surface area. Any land uses that place the continued delivery of an adequate volume of good quality water at risk should be avoided or, at least, mitigated.

Guidelines for locating land-uses in relation to these ESAs are provided below and in Table 17. More detailed guidelines for managing land-use activities that impact on water quantity in sub-quaternary catchments associated with river FEPAs, can be found in the NFEPA Implementation Manual (Driver et al., 2011).

Land-use guidelines for Other Natural Areas and Heavily Modified Freshwater Ecosystems

- **Other Natural Areas**: These are natural areas that are potentially available to changes in land-use, subject to environmental authorisation processes. Although they are not identified to support freshwater CBAs or ESAs, they still provide important ecosystem services. Freshwater ONA's are particularly important in buffers around rivers and wetlands to reduce siltation and improve water quality. Old lands were included under Freshwater OnAs because of their functional importance in supporting and maintaining freshwater CBAs.
- **Heavily Modified areas**: All areas currently modified to such an extent that any valuable biodiversity and ecological function has been lost. Indirect polluting effects from modified surfaces or land-uses need to be assessed, particularly where modified areas occur with freshwater CBAs and ESA sub-catchments.
- **Heavily Modified – Dams**: Although dams are not natural water bodies, they may still have a recharge effect on wetlands, groundwater and river systems and may support river- or water-dependent fauna and flora, such as waterbirds and wetland vegetation. For this reason, it is important to manage them carefully and avoid negative impacts on water quantity and quality in particular.

Table 15: Land-use guidelines for aquatic Critical Biodiversity Areas.

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
All freshwater CBAs	Maintain in a natural state with no loss of ecosystems, functionality or species. Where they are currently degraded, they should be rehabilitated, with	Freshwater CBAs should be maintained in good ecological condition, and those that are degraded should ideally be rehabilitated to a good condition. Land-use practices or activities that will lead to deterioration in the current condition of a freshwater CBA, or that will make rehabilitation difficult, are not acceptable.	All questions about land-use change and its impact on water supplies must be referred to the Department of Water Affairs and Sanitation (DWS). national Water Quality Standards are set by DWS and return flows (of effluent) from any land-use, are subject to these. The process of determining the 'Ecological Reserve' flow, developed by DWS, is an

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
	no further degradation of ecosystem condition.	Any proposed land-use change must be subject to an EIA as it is likely to impact on the ecological drivers of the river or wetland ecosystem and can, potentially, alter its functioning or lead to loss of species. Specialist studies by a freshwater ecologist should be conducted if there is a watercourse that is likely to be affected.	essential tool in managing water use so that rivers can survive as ecosystems. All land-use activities should also be subject to the accepted standards set for construction of structures like bridges, culverts and dams. Ideally, effluent should be reflective of Resource Quality Objectives, as determined by a Reserve Determination, or determined on the basis of species sensitivities. A buffer of 100 m should be used to buffer rivers and wetlands, unless DWS's river / wetland buffer tool has been applied. Mining should not take place within 1 000 m of a freshwater CBA buffer.
CBA Rivers	Maintain in a natural state with no loss of ecosystems, functionality or species.	There is no flexibility in land-use options in this category. Any activities that may impact on CBA rivers, even upstream or in sub-catchments, need to be avoided, or impacts mitigated if they cannot be avoided. Any damaging activities within CBA river buffers must be avoided. A 100 m buffer is the greater of the delineated riparian area or 100 m measured from the top of bank.	
CBA Aquatic species	Maintain in a natural state with no loss of species or ecosystems.	Avoid the use of pollutants such as pesticides and other agricultural toxins. There are few appropriate land-use options as any loss of habitat could result in extinction of threatened freshwater - dependent invertebrate species.	
CBA Wetlands	Maintain in a natural state with no loss of species or ecosystems.	If the current ecological condition is good (either natural and unmodified, or largely natural with only small change in habitats and biota), then this condition needs to be maintained. If the current ecological condition is fair to poor (i.e., moderately to severely degraded with significant loss of natural habitat, biota and ecosystem functions), then this needs to be improved through rehabilitation measures. Refer to the NFEPA Implementation Manual for specific guidelines (for example, mining should not take place within 1 km of the boundary of the buffer around a wetland). note that the generic buffer is 100 m measured from the outside edge of the wetland.	
ESA Important Sub-catchments and Fish Support Areas	Minimise habitat and species loss through judicious planning and maintain basic ecosystem functionality and ecological condition within the surrounding landscape (sub catchment).	Manage the cumulative impacts of land-use activities in the sub-catchment (including land-based activities), ensuring no further deterioration of the ecological state of river or wetland CBAs. In the case of Fish Support Areas, apply authorisation requirements more stringently. Ensure that aquatic specialist studies are conducted in ESA Fish Support Areas. Maintain flow rates in streams in agricultural catchments in good condition, by managing land-use practices to mitigate the impacts of stream-flow reduction and ensuring that the extent of agriculture in the catchment does not exceed. 30-50% of land surface areas. Generic buffers of 100 m should be established around streams and wetlands within these catchments. These buff- ers can be refined based on a site visit and applying DWS's wetland delineation tool. Land-use practices or activities that are not consistent with keeping natural habitat and biota intact in ESA Important sub- catchments are not acceptable.	
ESA Wetland clusters	Manage to maximise potential for movements of species between	Wetland clusters should not be further fragmented but should be managed as a unit.	

Map Category	Desired Management Objective	General guidelines	Specific guidelines for meeting minimum requirements
	wetlands in the cluster, and maintenance of landscape-scale ecological processes; avoid fragmentation of natural habitat within which the wetlands are embedded.	Land-uses that disrupt the possibility of migration, or the functioning of other ecological processes, across the cluster should not be allowed and sensitivity to disruption must be assessed in the EIA process. Delineate all wetlands within 500 m of a land-use activity and apply for a Water Use Licence if needed. conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status.	
ESA Wetlands	Maintain in a natural, functional state. Limited loss of ecosystems or functionality is acceptable, as long as the present ecological state is not lowered.	All wetlands are protected under the national Water Act (Act 36 of 1998). In terms of the national Water Act, freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category). conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status. Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetland.	
ESA Strategic Water Source Areas	Maintain ecological integrity across the entire sub-catchment, paying particular attention to maintaining water quantity, water quality and habitat integrity	Strategic Water Source Areas tend to be favoured for plantation forestry and the application of best-practice management is encouraged. Mining places the delivery of good quality water in adequate quantities at risk, and any cumulative impact of mines needs to be assessed and considered when processing mining applications. The clearing of invasive alien plants from drainage lines and wetlands within these areas must be a provincial priority. Restoration of wetlands and degraded areas within these catchments is encouraged	

7.4.4 Vegetation & Ecological Principles

Critical Biodiversity Areas

Given that the objective of CBAs is to identify biodiversity priority areas which should be maintained in a natural to near natural state, development within these areas is not encouraged. The following issues need to be considered when considering development within a CBA:

- Are there alternative areas within the site but outside of the CBA that could be developed?
- Does the project undermine the overall ecological functioning of the broad CBA area?
- Can mitigation measures reduce the impact of the development on ecological processes?

Ecosystem Processes

Distinct ecological processes are generally associated with surface geology and soils, climate, topography, drainage systems, and the make-up of the remaining native vegetation. These features could be missed or only partly incorporated into land use plans unless they are specifically identified and targeted. Ideally, areas maintaining adaptive diversification (e.g., environmental gradients) or containing historically isolated populations should be identified and protected. The spatial aspect of ecological processes also needs to be determined, and such insights incorporated in conservation planning. Finally, connectivity within these areas should be ensured to maintain species migration and gene flow. However, the spatial components of processes have rarely been considered in conservation

planning – an approach that is also especially useful for development planning in biodiversity hotspots. Three types of ecological processes are discussed below.

Ecosystem Services

"Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services, recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling". (Millennium Ecosystem Assessment (MEA), 2005). Terrestrial (or land) ecosystems provide valuable ecosystem services that contribute to human well-being. They can provide[18]:

- buffers against natural hazards such as fire and floods
- carbon sequestration (storage), important for reducing the impacts of climate change.
- regulation of water supply(e)
- grazing for wild animals and livestock
- natural spaces for recreation & tourism
- the air we breathe(e)
- spiritual, ritual and ceremonies
- horticultural & wildflower industries
- natural heritage
- food, timber, fibre, and medicinal plants

Rivers are central to human welfare and economic development. They provide:

- water for agricultural, industrial, and domestic uses
- flood attenuation and regulation(e)
- food and medicinal plants
- transport and/or purification of biodegradable wastes(e)
- tourism, recreational and cultural use
- enhanced property values

Estuaries, together with an associated buffer of natural vegetation, perform several valuable functions, especially in relation to:

- subsistence fishing
- commercial fisheries (as they provide a refuge for commercial fishes when they are young)
- wildlife habitat e.g., nursery and refuge (providing habitat for amphibians, birds, fish and mammals for all or portions of their life cycles)
- tourism, recreational, cultural use, and craft materials
- enhanced property values

Ecological corridors provide valuable ecosystem services that are often impossible or very costly to replicate or offset. For example, they:

- support the migration (movement) and long-term survival of plant and animal species and their ecological processes (e.g., fire, pollination, seed dispersal), in response to global climate change.
- are important areas for storing carbon to reduce the impacts of global climate change?
- are important areas for regulating water supply (e.g., filtering and storing drinking water, keeping excess nutrients out of wetlands and rivers, ensuring a high-water yield from mountain catchments)

[18] Within the study area, terrestrial ecosystem services that are likely provided are marked (e).

- supply good quality water from mountain catchment areas, both surface and groundwater.
- the supply of water quality and quantity is not only for human consumption but for ensuring the survival of downstream estuaries, wetlands (vleis) and streams (which in turn provide us with other ecosystem services).
- are of important scenic value, contributing to tourism and the 'sense of place'.
- Coastal & marine areas
- Subsistence & commercial fishing (food)
- Medicinal & Cosmetic resources e.g., kelp & microscopic plants for the feed, food, cosmetics, & pharmaceutical industries.
- Mining (sand and heavy mineral)
- Recreational value (sport and fishing)
- Retail value (market-value of housing)

Net Primary production: This critical ecological process involves the process of photosynthesis – which translates into the amount of carbon plants can fix on an annual basis. This is important for each LM within the district as the amount of carbon fixed translates directly into the amount of forage produced and thus made available for grazing. Consequently, livestock management directly impacts upon forage production as overgrazing reduces the vegetations' ability to maintain this ecosystem process. This ecological process is especially significant for the ORT, as the main land use comprises of livestock grazing. Therefore, this factor has a direct bearing on both the amount of food available for livestock, and the amount of plant material available regarding reducing runoff in wetland areas.
Water production: In more arid areas, many municipalities and towns rely on groundwater or local water resources to supply to town with drinking water. Thus, the higher rainfall areas are key recharge zones for these groundwater resources. Consequently, land use management of these catchment areas are critical for the maintenance of the quality and quantity of water sourced from each area. For example, water courses and wetlands that have been cleared for agricultural purposes, or overgrazed, will not only cause soil erosion, but most importantly cause increased water runoff, thus reducing the amount of water that feeds back into the water table for consumption. Groundwater is also a critical resource for agriculture and food production.
Species movement corridors and climatic refuges: Global climate change is undoubtedly a threat in the coming decades. A key action to mitigate its effects is the maintenance of species' ability to migrate to new locations as the climatic conditions which they require move across the landscape. These corridor and refuge migration strategies occur on both a micro and macro level. On the macro scale corridors provide for species movement at landscape scales. This entails the ability of fauna and flora to undertake large scale movements towards areas which continue to provide the conditions required by a species for growth and reproduction. Movements could entail migrations of up to hundreds of kilometres, and corridors of mostly natural or near natural vegetation across the landscape are needed to permit this to occur. Climactic refuges can be localized areas that have moderated climates – such as mountain kloofs and south facing slopes. These areas provide cooler habitats where species under threat from changing climates can colonise or species and vegetation not widely found in surrounding area.

Ecological Support Areas

These include supporting zones required to prevent the degradation of Critical Biodiversity Areas and Protected Areas. An ESA may be an ecological process area that connects and therefore sustains Critical Biodiversity Areas or a terrestrial feature. ESAs are generally extensions to the CBA area incorporating small areas that are perhaps no longer natural, or are comprised of secondary vegetation, generally following the drainage line ecological corridors within the wider surrounding landscape that will improve connectivity.

7.5 Appendix 5: Abbreviations & Glossary

7.5.1 Abbreviations

CARA	Conservation of Agricultural Resources Act, Act 43 of 1983
CBA	Critical Biodiversity Area
DARDLEA	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs
DEA	Department of Environmental Affairs (*now DFFE, see below*)
DFFE	The Department of Environmental Affairs (DEA) was renamed the Department of Forestry and Fisheries and the Environment (DFFE), incorporating the forestry and fisheries functions from the previous Department of Agriculture, Forestry and Fisheries.
DEMC	Desired Ecological Management Class
DWS	Department of Water Affairs and Sanitation
DWAF	Department of Water Affairs and Forestry (former department name)
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMC	Ecological Management Class
EMP	Environmental Management Plan
EMPr	Environmental Management Programme report
ER	Environmental Representative
ESS	Ecosystem Services
IAP's	Interested and Affected Parties
IEM	Integrated Environmental Management
LM	Local Municipality
masl	meters above sea level
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act, Act 107 of 1998
NFA	National Forests Act
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NFA	National Forest Act, Act 84 of 1998
PEMC	Present Ecological Management Class
PES	Present Ecological State
PNCO	Provincial Nature and Environment Conservation Ordinance (No. 19 of 1974).
RDL	Red Data List
RHS	Right Hand Side
RoD	Record of Decision
SANBI	South African National Biodiversity Institute
SDF	Spatial Development Framework
SoER	State of the Environment Report
SSC	Species of Special Concern
ToPS	Threatened of Protected Species
ToR	Terms of Reference
+ve	Positive
-ve	Negative

7.5.2 Glossary

Alien Invasive Species (AIS)	An alien species whose introduction and/or spread threaten biological diversity (Convention on Biological Diversity). Note: "*Alien invasive species*" is considered to be equivalent to "*invasive alien species*". An alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity (*IUCN*).
Best Environmental Practice	The application of the most appropriate combination of environmental control measures and strategies (Stockholm Convention).
Best Management Practice	Established techniques or methodologies that, through experience and research, have proven to lead to a desired result (BBOP).
Biodiversity	Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.
Biodiversity Offset	Measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure and ecosystem function and people's use and cultural values associated with biodiversity (BBOP).
Bioremediation	The use of organisms such as plants or microorganisms to aid in removing hazardous substances from an area. Any process that uses microorganisms, fungi, green plants, or their enzymes to return the natural environment altered by contaminants to its original condition.
Boundary	Landscape patches have a boundary between them which can be defined or fuzzy (Sanderson and Harris, 2000). The zone composed of the edges of adjacent ecosystems is the boundary.
Connectivity	The measure of how connected or spatially continuous a corridor, network, or matrix is. For example, a forested landscape (the matrix) with fewer gaps in forest cover (open patches) will have higher connectivity.
Corridors	Have important functions as strips of a landscape differing from adjacent land on both sides. Habitat, ecosystems, or undeveloped areas that physically connect habitat patches. Smaller, intervening patches of surviving habitat can also serve as "steppingstones" that link fragmented ecosystems by ensuring that certain ecological processes are maintained within and between groups of habitat fragments.
Critically Endangered (CR)	A category on the IUCN Red List of Threatened Species which indicates a taxon is facing an extremely high risk of extinction in the wild (*IUCN*).
Cultural Ecosystem Services	The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values (Millennium Ecosystem Assessment).
Cumulative Impacts	The total impact arising from the project (under the control of the developer), other activities (that may be under the control of others, including other developers, local communities, government) and other background pressures and trends which may be unregulated. The project's impact is therefore one part of the total cumulative impact on the environment. The analysis of a project's incremental impacts combined with the effects of other projects can often give a more accurate understanding of the likely results of the project's presence than just considering its impacts in isolation (BBOP).
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well

	known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat(*IUCN*).
Degraded Habitat/Land	Land that has been impacted upon by human activities (including introduction of invasive alien plants, light to moderate overgrazing, accelerated soil erosion, dumping of waste), but still retains a degree of its original structure and species composition (although some species loss would have occurred) and where ecological processes still occur (albeit in an altered way). Degraded land is capable of being restored to a near-natural state with appropriate ecological management.
Disturbance	An event that significantly alters the pattern of variation in the structure or function of a system, while fragmentation is the breaking up of a habitat, ecosystem, or land-use type into smaller parcels. Disturbance is generally considered a natural process.
Ecological Processes	Ecological processes typically only function well where natural vegetation remains, and where the remaining vegetation is well-connected with other nearby patches of natural vegetation. Loss and fragmentation of natural habitat severely threatens the integrity of ecological processes. Where basic processes are intact, ecosystems are likely to recover more easily from disturbances or inappropriate actions if the actions themselves are not permanent. Conversely, the more interference there has been with basic processes, the greater the severity (and longevity) of effects. Natural processes are complex and interdependent, and it is not possible to predict all the consequences of loss of biodiversity or ecosystem integrity. When a region's natural or historic level of diversity and integrity is maintained, higher levels of system productivity are supported in the long run and the overall effects of disturbances may be dampened.
Ecosystem Status	Ecosystem status of terrestrial ecosystems is based on the degree of habitat loss that has occurred in each ecosystem, relative to two thresholds: one for maintaining healthy ecosystem functioning, and one for conserving most species associated with the ecosystem. As natural habitat is lost in an ecosystem, its functioning is increasingly compromised, leading eventually to the collapse of the ecosystem and to loss of species associated with that ecosystem (Millennium Ecosystem Assessment).
Ecosystem Services	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Supporting Ecosystem services are those that are necessary for the maintenance of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.
Ecosystem	All the organisms of a habitat, such as a lake or forest, together with the physical environment in which they live. A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecotone	The transitional zone between two communities. Ecotones can arise naturally, such as a lakeshore, or can be human created, such as a cleared agricultural field from a forest. The ecotonal community retains characteristics of each bordering community and often contains species not found in the adjacent communities. Classic examples of ecotones include fencerows; forest to marshlands transitions; forest to grassland transitions; or land-water interfaces such as riparian zones in forests. Characteristics of ecotones include vegetational sharpness, physiognomic change, and occurrence of a spatial community mosaic, many exotic species, ecotonal species, spatial mass effect, and species richness higher or lower than either side of the ecotone.
Edge	The portion of an ecosystem near its perimeter, where influences of the adjacent patches can cause an environmental difference between the interior of the patch and its edge. This edge effect includes a distinctive species composition or abundance in the outer part of the landscape patch. For example, when a landscape is a mosaic of perceptibly different types, such as a forest adjacent to a grassland, the edge is the location where the two types adjoin. In a continuous landscape, such as a forest giving way to open woodland, the exact edge location is fuzzy and is sometimes determined by a local gradient exceeding a threshold, as an example, the point where the tree cover falls below thirty-five percent.

Emergent Tree	Trees that grow above the top of the canopy
Endangered (En)	Endangered terrestrial ecosystems have lost significant amounts (more than 60 % lost) of their original natural habitat, so their functioning is compromised. A taxon (species) is Endangered when the best available evidence indicates that it meets any of the criteria for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild (*IUCN*).
Endemic	A plant or animal species, or a vegetation type, which is naturally restricted to a defined region or limited geographical area. Many endemic species have widespread distributions and are common and thus are not considered to be under any threat. They are however noted to be unique to a region, which can include South Africa, a specific province or a bioregion, vegetation type, or a localised area. In cases where it is highly localised or known only from a few or a few localities, and is under threat, it may be red listed either in terms of the South Africa Threatened Species Programme, NEMBA Threatened or Protected Species (ToPS) or the IUCN Red List of Threated Species.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Exotic	Non-indigenous; introduced from elsewhere, may also be a *weed* or alien *invasive* species. Exotic species may be invasive or non-invasive.
Ecological Structure	The composition, or configuration, and the proportion of different patches across the landscape. Relates to species diversity, the greater the diversity, the more complex the structure. A description of the organisms and physical features of environment including nutrients and climatic conditions.
Ecological Function	How each of the elements in the landscape interacts based on its life cycle events [Producers, Consumers, Decomposers Transformers]. Includes the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly.
Ecological Pattern	The contents and internal order of the landscape, or its spatial (and temporal) components. May be homogenous or heterogenous. Result from the ecological processes that produce them.
Ecological Process	Includes *Physical processes* [Climate (precipitation, insolation), hydrology, geomorphology]; *Biological processes* [Photosynthesis, respiration, reproduction]; *Ecological processes* [Competition, predator-prey interactions, environmental gradients, life histories]
Fragmentation (Habitat Fragmentation)	The 'breaking apart' of continuous habitat into distinct pieces. Causes land transformation, an important current process in landscapes as more and more development occurs.
Habitat Banking	A market where credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time (IEEP).
Habitat	The home of a plant or animal species. Generally, those features of an area inhabited by animal or plant which are essential to its survival.
IFC PS6	International Finance Corporation Performance Standard 6 – A standard guiding biodiversity conservation and sustainable management of living natural resources for projects financed by the International Finance Corporation (IFC)
Indicator	Information based on measured data used to represent an attribute, characteristic, or property of a system.
Indicator species	A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem. They reflect the quality and changes in environmental conditions as well as aspects of community composition.
Indigenous	Native; occurring naturally in a defined area.
Indigenous Species	A species that has been observed in the form of a naturally occurring and self-sustaining population in historical times (*Bern Convention 1979*).

(Native species)	A species or lower taxon living within its natural range (past or present) including the area which it can reach and occupy using its natural dispersal systems (*modified after the Convention on Biological Diversity*)
Indirect Impact	Impacts triggered in response to the presence of a project, rather than being directly caused by the project's own operations (BBOP)
Intact Habitat / Vegetation	Land that has not been significantly impacted upon by man's activities. These are ecosystems that are in a near-pristine condition in terms of structure, species composition and functioning of ecological processes.
Intrinsic Value	The inherent worth of something, independent of its value to anyone or anything else.
Keystone Species	Species whose influence on ecosystem function and diversity are disproportionate to their numerical abundance. Although all species interact, the interactions of some species are more profound and far-reaching than others, such that their elimination from an ecosystem often triggers cascades of direct and indirect changes on more than a single trophic level, leading eventually to losses of habitats and extirpation of other species in the food web.
Landscape	An area of land that contains a mosaic of ecosystems, including human-dominated ecosystems (Millennium Ecosystem Assessment).
Landscape Approach	Dealing with large-scale processes in an integrated and multidisciplinary manner, combining natural resources management with environmental and livelihood considerations (FAO).
Landscape connectivity	The degree to which the landscape facilitates or impedes movement among resource patches.
Least threatened / Least Concern (LC)	These ecosystems have lost only a small proportion (more than 80 % remains) of their original natural habitat and are largely intact (although they may be degraded to varying degrees, for example by invasive alien species, overgrazing, or overharvesting from the wild). A taxon (species) is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category (*IUCN*).
Matrix	The "*background ecological system*" of a landscape with a high degree of connectivity.
Natural Forest (Indigenous Forest)	The definition of "*natural forest*" in the National Forests Act of 1998 (NFA) Section 2(1)(xx) is as follows: 'A natural forest means a group of indigenous trees • whose crowns are largely contiguous • or which have been declared by the Minister to be a natural forest under section 7(2) This definition should be read in conjunction with Section 2(1)(x) which states that 'Forest' includes: • A natural forest, a woodland, and a plantation • The forest-produce in it; and • The ecosystems which it makes up. The legal definition must be supported by a technical definition, as demonstrated by a court case in the Umzimkulu magisterial district, relating to the illegal felling of Yellowwood (*Podocarpus latifolius*) and other species in the Gonqogonqo forest. From scientific definitions (also see Appendix B) we can define natural forest as: • A generally multi-layered vegetation unit • Dominated by trees that are largely evergreen or semi-deciduous. • The combined tree strata have overlapping crowns, and crown cover is >75% • Grasses in the herbaceous stratum (if present) are generally rare. • Fire does not normally play a major role in forest function and dynamics except at the fringes. • The species of all plant growth forms must be typical of natural forest (check for indicator species)

	• The forest must be one of the national forest types
Near Threatened (NT)	A taxon (species) is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future (*IUCN*).
Patch	A term fundamental to landscape ecology, is defined as a relatively homogeneous area that differs from its surroundings. Patches are the basic unit of the landscape that change and fluctuate, a process called patch dynamics. Patches have a definite shape and spatial configuration and can be described compositionally by internal variables such as number of trees, number of tree species, height of trees, or other similar measurements.
Protected Area	A clearly defined geographical space, recognised, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.
Range restricted species	Species with a geographically restricted area of distribution. Note: Within the IFC PS6, restricted range refers to a limited extent of occurrence (EOO): • For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometres (km2).
Refugia	A location which supports an isolated or relict population of a once more widespread species. This isolation can be due to climatic changes, geography, or human activities such as deforestation and overhunting.
Resilience	The capacity of a natural system to recover from disturbance (OECD).
Rehabilitation	Measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised. Rehabilitation emphasizes the reparation of ecosystem processes, productivity, and services, whereas the goals of restoration also include the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure (BBOP).
Restoration	The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. An ecosystem has recovered when it contains sufficient biotic and abiotic resources to continue its development without further assistance or subsidy. It would sustain itself structurally and functionally, demonstrate resilience to normal ranges of environmental stress and disturbance, and interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions (IFC).
Riparian	Pertaining to, situated on, or associated with the banks of a watercourse, usually a river or stream.
River Corridors	River corridors perform several ecological functions such as modulating stream flow, storing water, removing harmful materials from water, and providing habitat for aquatic and terrestrial plants and animals. These corridors also have vegetation and soil characteristics distinctly different from surrounding uplands and support higher levels of species diversity, species densities, and rates of biological productivity than most other landscape elements. Rivers provide for migration and exchange between inland and coastal biotas.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED).
Terrestrial	Occurring on, or inhabiting, land.
Threatened Species	Umbrella term for any species categorised as Critically Endangered, Endangered or Vulnerable by the IUCN Red List of Threatened Species (*IUCN*). Any species that is likely to become extinct within the foreseeable future throughout all or part of its range and whose survival is unlikely if the factors causing numerical decline or habitat degradation continue to operate (EU).

Traditional Ecological Knowledge	Knowledge, innovations, and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language, and agricultural practices, including the development of plant species and animal breeds. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health, horticulture, and forestry (CBD).
Transformation	In ecology, transformation refers to adverse changes to biodiversity, typically habitats or ecosystems, through processes such as cultivation, forestry, drainage of wetlands, urban development or invasion by alien plants or animals. Transformation results in habitat fragmentation – the breaking up of a continuous habitat, ecosystem, or land-use type into smaller fragments.
Transformed Habitat/Land	Land that has been significantly impacted upon because of human interferences/disturbances (such as cultivation, urban development, mining, landscaping, severe overgrazing), and where the original structure, species composition and functioning of ecological processes have been irreversibly altered. Transformed habitats are not capable of being restored to their original states.
Tributary	A small stream or river flowing into a larger one.
Untransformed Habitat/Land	Land that has not been significantly impacted upon by man's activities. These are ecosystems that are in a near-pristine condition in terms of structure, species composition and functioning of ecological processes.
Vulnerable (Vu)	Vulnerable terrestrial ecosystems have lost some (more than 60 % remains) of their original natural habitat and their functioning will be compromised if they continue to lose natural habitat. A taxon (species) is Vulnerable when the best available evidence indicates that it meets any of the criteria for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild (*IUCN*).
Watercourse	Natural or man-made channel through or along which water may flow. 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 a reference to a watercourse includes, where relevant, its bed and banks;
Weed	An indigenous or non-indigenous plant that grows and reproduces aggressively, usually a ruderal pioneer of disturbed areas. Weeds may be unwanted because they are unsightly, or they limit the growth of other plants by blocking light or using up nutrients from the soil. They can also harbour and spread plant pathogens. Weeds are generally known to proliferate through the production of large quantities of seed.
Wetlands	A collective term used to describe lands that are sometimes or always covered by shallow water or have saturated soils, and where plants adapted for life in wet conditions usually grow.
Catchment	In relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.
Estuary	a partially or fully enclosed body of water - (a) which is open to the sea permanently or periodically; and (b) within which the sea water can be diluted, to an extent that is measurable, with fresh water drained from land.
Instream habitat	Includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse;
Riparian Habitat	Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

7.6 Appendix 6: Biodiversity Environmental Management Plan

Specific measures relating to management of Biodiversity Impacts that must be included I the project Environmental Management Programme (EMPr). This Environmental Management Plan (EMP) contains guidelines, operating procedures and rehabilitation control requirements, which will be binding on the holder of the environmental authorisation after approval of the EMP. The impacts identified and listed will be managed / controlled as set out under mitigating measures and as detailed in this section for the more significant impacts during the operational phase.

7.6.1 Protection of Flora and Fauna

The following actions must be implemented at construction phase.

- Search and rescue operations for Species of Conservation Concern *must* be undertaken before the commencement of site clearing activities.
- Indigenous vegetation encountered on the sites that are to be conserved and left intact.
- It is important that clearing activities are kept to the minimum and take place in a phased manner. This allows animal species to move into safe areas and prevents wind and water erosion of the cleared areas.
- Stripped vegetation *should* be temporarily stored during operations and to be used later to stabilise slopes. This excludes exotic invasive species.
- No animals are to be harmed or killed during the course of operations.
- Workers are NOT allowed to collect any flora or snare any faunal species. All flora and fauna remain the property of the landowner and *must* not be disturbed, upset or used without their expressed consent.
- It is the responsibility of the Developer to provide sufficient fuel for cooking and heated as needed by the staff.
- No domestic animals are permitted on the sites.
- Trees and shrubs that are directly affected by the operations may be felled or cleared but only by the expressed written permission of the ECO.
- Rehabilitation of vegetation of the site *must* be done as described in the Rehabilitation Plans.

Flora search and Rescue

The following flora relocation plan is recommended:

- Once the final layout has been determined the botanist will be consulted in order to finalise the plant relocation and vegetation clearing plan.
- Respective permits to be obtained.
- Flora search and rescue is to be conducted before vegetation clearing takes place.
- Areas should only be stripped of vegetation as and when required and once species of Conservation Concern have been relocated for that area.
- Once site clearing is to commence, the area to be cleared of vegetation will be surveyed by the vegetation and plant search and rescue team clearing under the supervision of the botanist to identify and remove species suitable for rescue and commence removal of plants.
- These species are to be replanted immediately in a suitable area of similar vegetation, where future development is unlikely to occur, or within a protected area.

7.6.2 Alien and Invasive Plan Management Plan

The following mitigation measures have been identified in order to ensure that the introduction and spread of alien invasive vegetation is minimised:

- Alien species must be removed from the site as per the National Environmental Management: Biodiversity Act (No. 10 of 2004) requirements.
- A suitable weed management strategy must be implemented in the construction phase and carried through the operational phase.

- Weeds and alien species *must* be cleared by hand before the rehabilitation phase of the areas. Removal of alien plants are to be done according to the Working for Water Guidelines.
- The Developer is responsible for the removal of alien species within all areas disturbed during construction activities. Disturbed areas include (but are not limited to) access roads, construction camps, site areas and temporary storage areas.
- In consultation with relevant authorities, the ECO may order the removal of alien plants (when necessary). Areas within the confines of the site are to be included.
- All alien plant material (including brushwood and seeds) should be removed from site and disposed of at a registered waste disposal site. Should brushwood be utilised for soil stabilization or mulching, it must be seed free.
- After clearing is completed, an appropriate cover crop may be required, should natural re-establishment of grasses not take place in a timely manner.

7.6.3 Fires

- The Developer must ensure that an emergency preparedness plan is in place in order to fight accidental fires or veld fires, should they occur. The adjacent landowners/users/managers *should* also be informed or otherwise involved.
- Enclosed areas for food preparation should be provided and the Developer *must* strictly prohibit the use of open fires for cooking and heating purposes.
- The use of branches of trees and shrubs for fire-making *must* be strictly prohibited.
- The Developer *should* take all reasonable and active steps to avoid increasing the risk of fire through their activities on-site. No fires may be lit except at places approved by the ECO.
- The Developer *must* ensure that the basic fire-fighting equipment is to the satisfaction of the Local Emergency Services.
- The Developer *must* supply all living quarters, site offices, kitchen areas, workshop areas, materials, stores and any other relevant areas with tested and approved fire-fighting equipment.
- Fires and "hot work" *must* be restricted to demarcated areas.
- A braai facility may be considered at the discretion of the Developer and in consultation with the ECO. The area *must* be away from flammable stores. All events must be under management's supervision and a fire extinguisher *will* be immediately available. "Low-smoke" fuels must be used (e.g., charcoal) and smoke control regulations, if applicable, must be considered.
- The Developer *must* take precautions when working with welding or grinding equipment near potential sources of combustion. Such precautions include having a suitable, tested and approved fire extinguisher immediately at hand and the use of welding curtains.

7.6.4 Soil Aspects

- Sufficient topsoil must be stored for later use during decommissioning, particularly from outcrop areas.
- Topsoil shall be removed from all areas where physical disturbance of the surface will occur.
- All available topsoil shall be removed after consultation with the botanist and horticulturalist prior to commencement of any operations.
- The removed topsoil shall be stored on high ground within the site footprint outside the 1:50 flood level within demarcated areas.
- Topsoil shall be kept separate from overburden and shall not be used for building or maintenance of roads.
- The stockpiled topsoil shall be protected from being blown away or being eroded. The application of a suitable grass seed/runner mix will facilitate this and reduce the minimise weeds.

7.6.5 Dust

- To manage complaints relation to impacts on the nearby communities, a dust register *will* be developed.

- If required, water spray vehicles *will* be used to control wind cause by strong winds during activities on the works.
- No over-watering of the site or road surfaces.
- Wind screens *should* be used to reduce wind and dust in open areas.

7.6.6 Infrastructural Requirements

Topsoil

- Topsoil shall be removed from all areas where physical disturbance of the surface will occur.
- All available topsoil shall be removed after consultation with the Regional Manager prior to commencement of any operations.
- The removed topsoil shall be stored on high ground within the footprint outside the 1:50 flood level within demarcated areas (Appendix 1)
- Topsoil shall be kept separate from overburden and shall not be used for building or maintenance of roads.
- The stockpiled topsoil shall be protected from being blown away or being eroded. The use of a suitable grass seed/runner mix will facilitate soil protection and minimise weeds/weed growth.

Stormwater and Erosion Control

- Stormwater Management Plans *must* be developed for the site and should include the following:
- The management of stormwater during construction.
- The installation of stormwater and erosion control infrastructure.
- The management of infrastructure after completion of construction.
- Temporary drainage works may be required to prevent stormwater to prevent silt laden surface water from draining into river systems in proximity to the site. Stormwater *must* be prevented from entering or running off site.
- To ensure that site is not subjected to excessive erosion and capable of drainage runoff with minimum risk of scour, their slopes *should* be profiled at a maximum 1:3 gradient.
- Diversion channels *should* be constructed ahead of the open cuts, and above emplacement areas and stockpiles to intercept clean runoff and divert it around disturbed areas into the natural drainage system downstream of the site.
- Rehabilitation is necessary to control erosion and sedimentation of all eroded areas (where works will take place).
- Existing vegetation *must* be retained as far as possible to minimise erosion problems.
- It is importation that the rehabilitation of site is planned and completed in such a way that the runoff water will not cause erosion.
- Visual inspections *will* be done on a regular basis with regard to the stability of water control structure, erosion and siltation.
- Sediment-laden runoff from cleared areas *must* be prevented from entering rivers and streams.
- No river or surface water may be affected by silt emanating from the site.

Site Office / Camp Sites

- No site offices or camp sites will be constructed on the site under current operating conditions, existing structures will be used.

Operating Procedures in the Site

- Construction shall only take place within the approved demarcated site.
- Construction may be limited to the areas indicated by the Regional Manager on assessment of the application.
- The holder of the environmental authorisation shall ensure that operations take place only in the demarcated areas as described in this report.

- Watering to minimise the effect of dust generation should be carried out as frequently as necessary. Noise should also be kept within reason.
- No workers will be allowed to damage or collect any indigenous plant or snare any animal.
- Grass and vegetation of the immediate environment or adapted grass / vegetation will be re-established on completion of construction activities, where applicable.
- No firewood to be collected on site and the lighting of fires must be prohibited.
- Cognisance is to be taken of the potential for endangered species occurring in the area. It is considered unlikely, however, that these species will be affected by the proposed activity.

Excavations

Whenever any excavation is undertaken, the following procedures shall be adhered to:

- Topsoil shall be handled as described in this EMP.
- Excavations shall take place only within the approved demarcated site.
- Excavations must follow the contour lines where possible.
- The construction site will not be left in any way to deteriorate into an unacceptable state.
- The excavated area must serve as a final depositing area for waste rock and overburden during the rehabilitation process.
- Once excavations have been filled with overburden, rocks and coarse natural materials and profiled with acceptable contours (including erosion control measures), the previous stored topsoil shall be returned to its original depth over the area.
- The area shall be fertilised, if necessary, to allow vegetation to establish rapidly. The site shall be seeded with a local or adapted indigenous seed mix in order to propagate the locally occurring flora.

Rehabilitation of Processing and Excavation Areas

- On completion of construction, the surface of the processing areas especially if compacted due to hauling and dumping operations shall be scarified to a depth of at least 200 mm and graded to an even surface condition and the previously stored topsoil will be returned to its original depth over the area.
- The area shall be fertilised, if necessary, to allow vegetation to establish rapidly. The site shall be seeded with suitable grasses and local indigenous seed mix.
- Excavations may be used for the dumping of construction wastes. This *shall* be done in such a way as to aid rehabilitation.
- Waste (non-biodegradable refuse) will not be permitted to be deposited in the excavations.
- If a reasonable assessment indicates that the re-establishment of vegetation is unacceptably slow, the Regional Manager may require that the soil be analysed and any deleterious effects on the soil arising from the activity, be corrected and the area be seeded with a vegetation seed mix to his or her satisfaction. This *must* be done in conjunction with the ECO.
- Final rehabilitation *must* comply with the requirements mention in the Rehabilitation Plan.

7.6.7 Rehabilitation Plan

Rehabilitation Objective

The overall objective of the rehabilitation plan is to minimize adverse environmental impacts associated with the activity whilst maximizing the future utilization of the property. Significant aspects to be borne in mind in this regard is, revegetation of undeveloped footprint and stability and environmental risk. The depression and immediate area of the working must also be free of alien vegetation. Additional broad rehabilitation strategies / objectives include the following:

- Rehabilitating the worked-out areas to take place concurrently within prescribed framework established in the EMP.
- All infrastructure, equipment, plant and other items used during the construction period will be removed from the site.

- Waste material of any description, including scrap, rubble and tyres, will be removed entirely from the site and disposed of at a recognised landfill facility. It will not be permitted to be buried or burned on site.
- Final rehabilitation shall be completed within a period specified by the Regional Manager.

Topsoil and Subsoil Replacement

Topsoil and subsoil will be stripped and stockpiled separately and only used in rehabilitation work towards the end of the operation. This is in contract to the gravel activity where rehabilitation and topsoil replacement was earmarked at the completion of each phase.

Stripped overburden will be backfilled into the worked-out areas where needed. Stripped topsoil will be spread over the re-profiled areas to an adequate depth to encourage plant regrowth. The vegetative cover will be stripped with the thin topsoil layer to provide organic matter to the relayed material and to ensure that the seed store contained in the topsoil is not diminished. Reseeding may be required should the stockpiles stand for too long and be considered barren from a seed bank point of view. Stockpiles should ideally be stored for no longer than a year.

The topsoil and overburden will be keyed into the reprofiled surfaces to ensure that they are not eroded or washed away. The topsoiled surface will be left fairly rough to enhance seedling establishment, reduce water runoff and increase infiltration.

Revegetation

All prepared surfaces will be seeded with suitable grass species to provide an initial ground cover and stabilize the soil surface. The following grass seed that is commonly available and suitable.

Botanical name	Common name	Approx seed mixture /Ha
Cynodon dactylon	Kweek	12 kg/ Ha
Eragrostis curvula	Weeping Love Grass	6 kg/ Ha
Eragrostis tef	Teff	2 kg/ Ha
Digitaria eriantha	Smuts Grass	4 kg/ Ha
Other indigenous veld grasses can be added to the seed mix		± 4 kg/Ha

The overall revegetation plan will, therefore, be as follows:

- Ameliorate the aesthetic impact of the site
- Stabilise disturbed soil and rock faces
- Minimize surface erosion and consequent siltation of natural water course located on site
- Control wind-blown dust problems
- Enhance the physical properties of the soil
- Re-establish nutrient cycling
- Re-establish a stable ecological system
- Every effort must be made to avoid unnecessary disturbance of the natural vegetation during operations.

Drainage and Erosion Control

To control the drainage and erosion at site the following procedures will be adopted:

- Areas where construction is completed should be rehabilitated immediately.
- Areas to be disturbed in future activities will be kept as small as possible (i.e., conducting the operations in phases), thereby limiting the scale of erosion.
- Slopes will be profiled to ensure that they are not subjected to excessive erosion but capable of drainage runoff with minimum risk of scour (maximum 1:3 gradient).
- All existing disturbed areas will be re-vegetated to control erosion and sedimentation
- Existing vegetation will be retained as far as possible to minimize erosion problems.

Visual Impacts Amelioration

The overall visual impact of the proposed activities will be minimised by the following mitigating measures:

- Confining the footprint to an area as small as possible
- Re-topsoiling and vegetating all disturbed areas

7.6.8 Monitoring and Reporting

Adequate management, maintenance and monitoring will be carried out annually by the applicant to ensure successful rehabilitation of the property until a closure certificate is obtained.

To minimise adverse environmental impacts associated with operations it is intended to adopt a progressive rehabilitation programme, which will entail carrying out the proposed rehabilitation procedures concurrently with activity.

7.6.9 Closure objectives and extent of alignment to pre-construction environment

Closure Objectives

The closure of the site will involve removal of all debris and rehabilitation of areas disturbed during the construction phase of the project. This will comprise the scarification of compacted areas, reshaping of areas, topsoiling and rehabilitating all prepared surfaces.

7.7 Appendix 7: Specialist Declaration, Profile & Registration

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
Mulilo Amsterdam WEF Complex: Emvelo

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with *'the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)'*, where applicable.

1. SPECIALIST INFORMATION

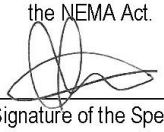
Title of Specialist Assessment	Terrestrial Biodiversity Assessment
Specialist Company Name	
Specialist Name	Jamie Pote
Specialist Identity Number	740515 5152 089
Specialist Qualifications:	BSc (Hons)
Professional affiliation/registration:	SACNASP (115233)
Physical address:	
Postal address:	Postnet Suite 57, P Bag X13130, Humewood
Postal address	Port Elizabeth
Telephone	
Cell phone	076 888 9890
E-mail	jamiepote@gmail.com

SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Jamie Pote declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
  - any decision to be taken with respect to the application by the competent authority; and;
  - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

N/A

Name of Company:

22 Nov 2024

Date

SPECIALIST DECLARATION FORM – AUGUST 2023

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Mr Jamie Pote _____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

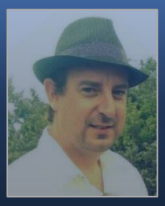
N/A
Name of Company

22/11/2024
Date

7066659-8
N IZALLY - SGT
Signature of the Commissioner of Oaths

2024 -11- 22

22/11/2024
Date



Jamie Pote

BIODIVERSITY ADVISOR, ECOLOGIST AND ENVIRONMENTAL SCIENTIST

CONTACT

(+27) 76 888 9890
jamiepote@live.co.za
Port Elizabeth, South Africa
Linkedin.com
Jamiepote
Bluesky-SA

ABOUT ME

18 years broad professional experience in Biodiversity, Ecological and Vegetation Assessments on over 250 projects in southern, western and central Africa. Environmental Assessment Practitioner on over 50 projects in the mining, infrastructure, housing and agricultural sectors. Environmental monitoring and auditing on over 50 civil infrastructure and construction projects. Have managed all aspects of projects from inception through to implementation. Advanced GIS mapping tools and Analysis.

EDUCATION

Bachelor of Science
Rhodes University
2002 (Botany & Environmental Science)

Bachelor of Science (Honours)
Rhodes University
2003 (Botany)

Professional Natural Scientist
SACNASP: 2016 (Ecological Science)

SERVICES

Terrestrial Biodiversity Specialist Assessments
IFC PS6 Biodiversity & Critical Habitat Assessments
Terrestrial Biodiversity Compliance Statements
Geographic Information Systems
Environmental Management Plans & Programmes
Environmental Compliance & Monitoring
Independent Environmental & Ecological reviews
Bioremediation, Restoration & Rehabilitation Plans
Permit and License applications (Flora & Fauna)
Flora Search & Rescue Plans & Relocations
Invasive Alien Plant Control & Management Plans
Environmental & Mining Applications

EXPERIENCE AND CLIENTS

Key Sectors

- *Wind, Solar Energy Facilities*
- *Infrastructure and Housing*
- *Agriculture and Forestry*
- *Mining and Industrial*

Key Projects

- *Over 250 independent Biodiversity/Ecological Assessments throughout southern, western and central Africa.*
- *Basic Assessments, Mining applications and compliance monitoring on over 50 projects for various clients including the Eastern Cape Department of Roads and Public Works, Department of Transport and the South African National Roads Agency (SANRAL) throughout the Eastern Cape, including over 300 individual borrow pits.*
- *South-End Precinct Mixed Use Development for Mandela Bay Development Agency - Environmental application, Ecological assessments and Pre-Construction compliance.*
- *Coega Development Corporation IDZ projects – Ecological assessments, Flora search & rescue and Construction monitoring.*
- *Environmental applications, construction monitoring and auditing for a wide range of projects, including infrastructure and housing clients.*
- *Various agricultural expansion and infrastructure projects.*
- *Various wind and solar energy and associated infrastructure projects.*
- *Numerous infrastructure projects including electrical, water and roads.*
- *Various Environmental Management and Rehabilitation Plans.*

24/06/2021

SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Jamie Robert Claude Pote

Registration Number: 115233

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Ecological Science (Professional Natural Scientist)

Effective **20 July 2016** Expires **31 March 2026**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

Mr Jamie Pote (BSc (Hons) PR. Sci. Nat.

PROJECT EXPERIENCE

ENERGY PROJECTS (WIND FARM AND PHOTOVOLTAIC INFRASTRUCTURE)

- Terrestrial Biodiversity Screening for proposed WEF, Beaufort West, Western Cape (ZA) 2023
- Terrestrial Biodiversity Walkdown for Koup 1 & 2 WEF, Beaufort West, Western Cape (ZA) 2023
- Terrestrial Biodiversity Assessment for Harmony Kalgold PV, Mahikeng, North West (ZA) 2022
- Terrestrial Biodiversity Assessment for Bonsmara PV, Kroonstad, Free State (ZA) 2023
- Terrestrial Biodiversity Screening for proposed WEF, Springbok, Northern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Harmony Chemwes PV, Klerksdorp, North West (ZA) 2022
- Terrestrial Biodiversity Assessment for Harmony Target PV, Welkom, Free State (ZA) 2022
- Terrestrial Biodiversity Assessment for MTN Mast, Louterwater, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for MTN Mast, Mount Stewart, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for MTN Mast, Pearston, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for MTN Mast, Roussouw, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Screening for proposed PV & WEF, Beaufort West, Western Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for WKN Soutrivier WEF, Victoria West, Northern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for WKN Taaibos WEF, Victoria West, Northern Cape (ZA) 2022
- Terrestrial Biodiversity Screening for proposed PV, Beaufort West, Western Cape (ZA) 2022
- Terrestrial Biodiversity Screening for proposed WEF & PV, Secunda, Mpumalanga (ZA) 2022
- Terrestrial Biodiversity Screening for proposed WEF, Standerton, Mpumalanga (ZA) 2022
- Terrestrial Biodiversity Walkdown for Phezukomoya WEF, Noupoort, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Walkdown for San Kraal WEF, Noupoort, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Walkdown for Hartebeeshoek WEF, Noupoort, Eastern Cape (ZA) 2023
- Terrestrial Biodiversity Amendment for Banna ba Pifhu WEF, Humansdorp, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Seekoei PV, Middleburg, Northern Cape (ZA) 2022
- Terrestrial Biodiversity Screening for proposed PV, Kroonstad, Free State (ZA) 2022
- Terrestrial Biodiversity Assessment for Paulputs WEF, Pofadder, NC (ZA) 2021
- Terrestrial Biodiversity Assessment for Komas WEF, Kleinsee, NC (ZA) 2021
- Preliminary Biodiversity Screening and GIS mapping for Balekani Photovoltaic Solar Project (SZ) 2020
- Preliminary Biodiversity Screening and GIS mapping for Sihhoye Photovoltaic Solar Project (SZ) 2020
- Preliminary Biodiversity Screening and GIS mapping Mpaka Photovoltaic Solar Project (SZ) 2020
- Preliminary Biodiversity Screening and GIS mapping for Chiwelwa Hydroelectric project (ZM) 2020
- Ecological Assessment for Vermaak Boerdery Hydro Turbine (Cookhouse), Eastern Cape 2020
- Ecological Assessment for Windcurrent Wind Farm, Eastern Cape 2012
- Ecological Assessment for Universal Windfarm, NMB (ZA) 2011
- Ecological Assessment for Inca Energy Windfarm, Northern Cape 2011
- Ecological Assessment for Broadlands Photovoltaic Farm, Eastern Cape 2011
- Botanical Assessment for Electrawinds Windfarm Coega, NMB 2010

TERRESTRIAL BIODIVERSITY ASSESSMENTS AND COMPLIANCE STATEMENTS

- Terrestrial Biodiversity Assessment for Glen Ewan Private School, Komani (ZA) 2023
- Terrestrial Biodiversity Assessment for Hard Rock Agriculture, Addo, EC (ZA) 2022
- Terrestrial Biodiversity Assessment for Coegakammakloof Chicken Houses, Addo, EC (ZA) 2022
- Terrestrial Biodiversity Assessment for Umziwabantu Agriculture, Addo, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Compliance Statement for Middledrift PV, Addo, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Compliance Statement for Disco PV, Addo, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Mbashe AmaXhosa Royal House, Mbashe, Eastern Cape 2022
- Terrestrial Biodiversity Assessment for Nordex Roggeveld CTF, Western Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Erf 805 Amsterdamhoek, Eastern Cape (ZA) 2022

Mr Jamie Pote (BSc (Hons) PR. Sci. Nat.

- Terrestrial Biodiversity Assessment for Addo Fuel Depot, Addo, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Tsomo WTW, CHDM, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Beacon Bay Memorial Park, Buffalo City, Eastern Cape 2022
- Terrestrial Biodiversity Assessment for Ph 5 Nxamagele Reservoir & Pipeline, CHDM, EC (ZA) 2022
- Terrestrial Biodiversity Assessment for Ph 9 Water Pipeline to Sada WTW, Hewu, Eastern Cape 2022
- Terrestrial Biodiversity Assessment for Erf 5707 Beacon Bay, Buffalo City, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Erf 8077 Uitenhage Fuel Station, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Farm 3/599 Buffalo City, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Sontule Citrus expansion, Addo, Eastern Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Kurland WTW and Pipeline, Western Cape (ZA) 2022
- Terrestrial Biodiversity Assessment for Addo Offices, Addo, Eastern Cape (ZA) 2021
- Terrestrial Biodiversity Assessment for Blaauwater Farms, Eastern Cape 2021
- Terrestrial Biodiversity Assessment for Buffelshoek Farm, Loerie, Eastern Cape 2021
- Terrestrial Biodiversity & Aquatic Assessment & Review, Falcon Ridge Dam, Addo, EC 2021
- Terrestrial Biodiversity Assessment for Gubenxa Valley Deciduous Fruit, Eastern Cape 2021
- Terrestrial Biodiversity Assessment (Little Chelsea Mixed-use) 2021
- Terrestrial Biodiversity Compliance Statement (Maidenhead Farm) 2021
- Terrestrial Biodiversity Review, Mulilo Total Hydra Storage Project Grid Interconnection 2021
- Terrestrial Biodiversity Compliance Statement (Lahlangubo River Bridge) 2021
- Terrestrial Biodiversity Assessment (Mbashe access roads - 3 sites) 2021
- Terrestrial Biodiversity Assessment for Burlington Farm Citrus Development, Cookhouse, EC 2020
- Terrestrial Biodiversity Compliance Statement: CHDM Cluster 9 Phase 3D Pipeline 2020
- Terrestrial Biodiversity Review, Mulilo Total Hydra Storage Project BESS 2020
- Terrestrial Biodiversity Assessment (Mbashe housing projects, Dutywa & Willowvale) 2020
- Terrestrial Biodiversity Assessment (Helpmekaar Dam, Tarkastad) 2020
- Terrestrial Biodiversity Assessment (Herbertsdale pipeline, Mossel Bay) 2020
- Terrestrial Biodiversity Assessment (Keurbooms Erf 155, Keurboomstrand) 2020
- Terrestrial Biodiversity Assessment (Lowmar Hydroelectric Project, Cradock) 2020
- Terrestrial Biodiversity Assessment (Mossel Bay Gas Power Plant) 2020
- Terrestrial Biodiversity Assessment (Erf 1820, Mthatha) 2020
- Terrestrial Biodiversity Assessment (Newlyn Manganese Terminal, Coega SEZ) 2020
- Terrestrial Biodiversity Assessment Thornhill Phase 2 Sanitation Link 2020

- Botanical Assessment and Open Space Management Plan for Mainstream WEF Phase 2, Eastern Cape 2010

PERFORMANCE STANDARD BIODIVERSITY AND CRITICAL HABITAT ASSESSMENTS (IFC PS6)

- DBSA Environmental & Social Safeguards Standards 9: Biodiversity Conservation and Sustainable Management Assessment: The Ilitha Fibre Project, Ethekwini 2021
- Critical Habitat & Biodiversity Assessment - KruiseVallei Hydroelectrical Energy Project 2020
- Critical Habitat & Biodiversity Assessment & Walkdown- Brandvallei WEF, Northern Cape 2021
- Critical Habitat & Biodiversity Assessment & Walkdown- Rietkloof WEF, Northern Cape 2021
- Critical Habitat & Biodiversity Assessment & Walkdown- Karreebosch Grid Connection, NC 2021
- Critical Habitat & Biodiversity Assessment & Walkdown- Karreebosch WEF, Northern Cape 2021
- Critical Habitat & Biodiversity Assessment - Roggeveld Wind Energy Project 2020
- Biodiversity Assessment for Kalukundi Copper/Cobalt Mine, Democratic Republic of Congo 2008

SPECIALISED ECOLOGICAL REPORTS AND REVIEWS

- Section 24G Assessment and Rehabilitation Plan for Burlington Farm, Cookhouse, Eastern Cape 2022
- Alien Invasive Plant (AIP) Compliance Screening, Astron Depot, Cape Town, Western Cape (ZA) 2022
- Alien Invasive Plant (AIP) Compliance Screening, Astron Depot, Buffalo City, Eastern Cape (ZA) 2022

- Alien Invasive Plant (AIP) Compliance Screening, Astron Depot, Gqeberha, Eastern Cape (ZA) 2022
- Rebels Vlei Riparian delineation, Kirkwood, Eastern Cape 2021
- Buck Kraal Dam Rehabilitation Plan Review, Addo, Eastern Cape 2020
- Rehabilitation Plan for Hitgeheim Farm (Farm 960), Sunland, Eastern Cape 2017
- Green Star Rating Ecological Assessment for SANRAL office, Bay West City, NMB 2015
- Section 24G Assessment and Rehabilitation Plan for Bingo Farm, Eastern Cape 2014
- Mapping and Ecological services for Congo Agriculture, Republic of Congo 2013
- Rehabilitation Plan for Nieu Bethesda, Eastern Cape 2011
- Mapping of pipeline for Kenton Water Board, Eastern Cape 2010
- Rehabilitation Plan for N2 Upgrade - Coega to Colchester, NMB 2010
- Representative for landowner group for Seaview burial Park, NMB 2010
- Botanical Sensitivity Analysis for LSDF, Greenbushes-Hunters Retreat, NMB 2008
- Forestry Rehabilitation Assessment Report for Amahlathi Forest Rehabilitation, Eastern Cape 2007
- Botanical & Riparian Assessment for Orange River Weirs-Boegoeberg, Douglas Dam and Sendelingsdrif, Northern Cape 2006
- Botanical Assessment for State of the Environment Report for Chris Hani District Municipality SoER, Eastern Cape 2003

ROAD AND RAILWAY INFRASTRUCTURE PROJECTS

- Terrestrial Biodiversity Amendment for Transnet/Portnet CDC SEZ Mn Terminal 2023
- Terrestrial Biodiversity Assessment for Machani to Taleni SPS Access Road (SPM) 2022
- Terrestrial Biodiversity Assessment for Matonga to Mantlaneni Access Road (SPM) 2022
- Terrestrial Biodiversity Assessment for Newlyn Mn Terminal & conveyor (CDC IDZ), NMB 2021
- Ecological Assessment for CDC IDZ Mn Terminal, conveyor and railway line, NMB 2013
- Ecological Assessment Review for Penhoek Road widening, Eastern Cape 2012
- Ecological Assessment for R61 road widening, Eastern Cape 2012
- Botanical Assessment for Chelsea RD - Walker Drive Ext., NMB 2010
- Botanical Assessment for Motherwell - Blue Water Bay Road, NMB 2010
- Ecological Assessment for Port St John Road, Eastern Cape 2010
- Botanical Basic Assessment for Bholani Village Rd, Port St Johns, Eastern Cape 2009
- Botanical Report, EMP and Rehab Plan for Coega-Colchester N2 Upgrade, NMB 2009
- Botanical Assessment for Manganese Conveyor Screening Report, NMB 2008
- Ecological Assessment for Road Layout for Whiskey Creek- Kenton, Eastern Cape 2006

MINING PROJECTS

- Ecological Assessment for Bochum Borrow Pits, Limpopo 2013
- Ecological Assessment and Mining and Rehabilitation Plan for Greater Soutpansberg Mining Project, Limpopo (3 proposed Mines) 2013
- Ecological Assessment for Thulwe Road Borrow Pits, Limpopo 2013
- Ecological Assessment and Mining and Rehabilitation Plan for Baghana Mining, Ghana 2010
- Botanical Assessment for Zwartenbosch Quarry, Eastern Cape 2008
- Botanical description & map production for Quarry - Rudman Quarry, Eastern Cape 2008
- Botanical Basic Assessment, Rehab Plan & Maps for Borrow Pit - Rocklands/Patensie, Eastern Cape 2008
- Botanical Assessment & Maps for Sandman Sand Gravel Mine, Eastern Cape 2008
- Botanical Assessment & GIS maps for Shamwari Borrow Pit, Eastern Cape 2008
- Detailed Botanical Assessment, EMP and Rehab Plan for Kalukundi Copper/Cobalt Mine, Democratic Republic of Congo 2008
- Botanical Assessment, Rehab Plan & Maps for Borrow Pit Humansdorp/Oyster Bay, Eastern Cape 2008

- Botanical Assessment, Rehab Plan & Maps for AWRM - Cala, Eastern Cape 2008
- Botanical Assessment, Rehab Plan & Maps for AWRM - Camdeboo, Eastern Cape 2008
- Botanical Assessment, Rehab Plan & Maps for AWRM - Somerset East, Eastern Cape 2008
- Botanical Assessment, Rehab Plan & Maps for AWRM - Nkonkobe, Eastern Cape 2008
- Botanical Assessment, Rehab Plan & Maps for AWRM - Ndlambe, Eastern Cape 2008
- Botanical Assessment, Rehab Plan & Maps for AWRM - Blue Crane Route, Eastern Cape 2008
- Botanical Assessment, EMP and Rehabilitation Plan for AWRM - Cathcart, Eastern Cape 2008
- Botanical Assessment, GIS maps and Rehab Plan for Mthatha Prospecting, Eastern Cape 2008
- Regional Botanical Map for mining prospecting permit, Welkom 2008
- Botanical Assessment for Scoping Report and Detailed Botanical Assessment and Rehab Plan for Elitheni Coal Mine, Eastern Cape 2007
- Botanical Assessment, Rehab Plan & Maps for Borrow Pit - Oyster Bay, Eastern Cape 2007
- Botanical Assessment, Rehab Plan & Maps for Borrow Pit - Bathurst/GHT, Eastern Cape 2007
- Botanical Assessment, Rehab Plan & Maps for Borrow Pit – Jeffreys Bay, Eastern Cape 2007
- Botanical Assessment, Rehab Plan & Maps for Borrow Pit - Storms River/Kareedouw, Eastern Cape 2007
- Biophysical Assessment for Humansdorp Quarry, Eastern Cape 2006
- Botanical Assessment, Rehab Plan & Maps for Quarry-Cathcart & Somerset East, Eastern Cape 2006
- Botanical Assessment, Rehab Plan & Maps for Quarry - Despatch Quarry, NMB 2006
- GIS Mapping & Botanical Assessment and Rehab Plan for Quarry - JBay Crushers, Eastern Cape 2006
- Botanical Assessment, EMP and Rehabilitation Plan for Polokwane Silicon Smelter, Limpopo 2006
- Application for Mining Permit for Bruce Howarth Quarry, Eastern Cape 2006

POWERLINE INFRASTRUCTURE PROJECTS

- Terrestrial Biodiversity Assessment for Paulputs WEF Grid connection, Pofadder, NC (ZA) 2021
- Terrestrial Biodiversity Assessment for Komas WEF Grid connection, Kleinsee, NC (ZA) 2021
- Ecological Assessment: Dieprivier-Karreedouw 132kV Powerline realignment, Kouga LM 2016
- Eskom Ecological Walkdown: Dieprivier-Karreedouw 132 kV Powerline, Kouga LM 2016
- Eskom Solar one Ecological Walkdown: Nieuwehoop 400 kV powerline, NC 2015
- Rehabilitation Plan and Auditing for Grassridge-Poseidon Powerline Rehab, Eastern Cape 2013
- Ecological Assessment for Dieprivier Karreedouw 132kV Powerline, EC 2012
- Flora and Fauna search and Rescue plan for Van Stadens Windfarm Powerline, NMB 2012
- Botanical Assessment for Dedisa-Grassridge Powerline, EC 2010
- Ecological Assessment for Grahamstown-Kowie Powerline, EC 2010
- Species of Special Concern Mapping Transmission Line for San Souci to Nivens Drift 132kV powerline, NMB 2009
- Botanical Assessment for Eskom Powerline - Albany-Kowie, EC 2009
- Botanical Assessment for Eskom 132 kV Dedisa Grassridge Power line-Coega, NMB 2006
- Botanical Assessment for Eskom Power line – Tyalara-Wilo, Eastern Cape 2006
- Botanical Assessment for Steynsburg - Teebus 132 kV powerline, Eastern Cape 2004

PIPELINE INFRASTRUCTURE PROJECTS

- Terrestrial Biodiversity Assessment for Hewu Phase 9 Raw Water Pipeline to Sada WTW 2022
- Terrestrial Biodiversity Assessment for CHDM Ph 5 Nxamagele Reservoir & Pipeline (ZA) 2022
- Terrestrial Biodiversity Assessment for Thornhill Phase 2 Sanitation Link, Ndlambe, Eastern Cape 2020
- Botanical Assessment for Ngqamakhwe Regional Water Supply Scheme (Phase 3) 2018
- Ecological Assessment for Butterworth Emergency Bulk Water Supply Scheme 2017
- Ecological Assessment for Karringmelkspruit Emergency Bulk Water Supply (Lady Grey) 2017
- Ecological Assessment for Wanhoop-Willowmore Bulk Water Supply, Eastern Cape 2016

- Ecological Assessment for Steytlerville Bulk Water Supply, Eastern Cape (Phase 4) 2013
- Ecological Assessment for Steytlerville Bulk Water Supply, Eastern Cape (Phase 5) 2013
- Detailed Ecological Assessment for Suikerbos Pipeline, Gauteng 2012
- Basic Botanical Assessment for Wanhoop farm pipeline, Eastern Cape 2010
- Basic Botanical Assessment for Chatty Sewer, NMB 2010
- Species of Special Concern Mapping for Seaview Pipeline, NMB 2009
- Species of Special Concern Mapping for Chelsea Bulk Water Pipeline, NMB 2009
- Map Production for Russell Rd Stormwater, NMB 2008
- Basic Botanical Assessment for Albany Pipeline, Eastern Cape 2008
- Environmental Risk Assessment for Elands River pipeline, Eastern Cape 2007
- Detailed Botanical Assessment for Motherwell Pipeline, NMB 2007
- Detailed Botanical Assessment, GIS maps for Erasmuskloof Pipeline, Eastern Cape 2007
- Botanical & Floristic Report for Hankey pipeline, Eastern Cape 2006
- Detailed Botanical Assessment for Port Alfred water pipeline, Eastern Cape 2004

GENERAL INFRASTRUCTURE DEVELOPMENT PROJECTS

- Ecological Assessment for Amalinda crossing, BCM, Eastern Cape 2019
- Ecological Assessment for Cookhouse Bridge rehabilitation and temporary deviation, Eastern Cape 2019
- Ecological Assessment for Nelson Mandela University Access Road, NMB 2019
- Botanical Assessment for Zachtevlei Dam (Lady Grey), Eastern Cape 2017
- Botanical Assessment for Gcebula River bridge (Peddie), Eastern Cape 2017
- Botanical Assessment for Kouga Dam wall upgrade, Eastern Cape 2012
- Botanical Assessment for Jansenville Cemetery, Eastern Cape 2009
- Botanical Assessment for Radar Mast construction for South African Weather Service – BCM & NMB 2008
- Botanical Assessment and GIS mapping for golf course realignment for East London Golf Course, BCM, Eastern Cape 2007
- Botanical Assessment for PE Airport Extention, NMB 2006
- Botanical Assessment for Kidd's Beach Desalination Plant, BCM, Eastern Cape 2006

HOUSING DEVELOPMENT PROJECTS

- Terrestrial Biodiversity Assessment for Erf 1820 Mthatha, KSDM, Eastern Cape 2020
- Ecological Assessment for Erf 599 Walmer Mixed Use Development, Nelson Mandela Bay 2019
- Ecological Assessment Portion 21-23 and 41 of Farm 807, Gonubie, Buffalo City 2019
- Ecological Assessment for Emerald Sky Housing Project, BCMM 2019
- Ecological Assessment for Erf 14, Kabega, Port Elizabeth 2017
- Ecological Assessment for Fairwest Rental Housing, Port Elizabeth 2017
- Ecological Assessment for Hankey Housing, Kouga District Municipality 2015
- Ecological Assessment for Lebowakgoma Housing, Limpopo 2013
- Ecological Assessment for Giyani Development, Limpopo 2013
- Ecological Assessment for Palmietfontein Development, Limpopo 2013
- Ecological Assessment for Seshego Development, Limpopo 2013
- Botanical Assessment for Sheerness Road, BCM, Eastern Cape 2013
- Ecological Assessment for Ethembeni Housing, NMB 2012
- Ecological Assessment for Pelana Housing, Limpopo 2012
- Flora Search and Rescue Plan for Kwanobuhle Housing, Western Cape 2011
- Botanical Assessment for The Crags 288/03, Western Cape 2010
- Ecological Assessment Revision Report for Fairview Housing, NMB 2010

- Botanical Assessment, EMP and Open Space Management Plan for Hornlee Housing Development, Western Cape 2010
- Botanical Assessment for Little Ladywood, Western Cape 2010
- Botanical Assessment and Open Space Management Plan for Motherwell NU31, NMB 2010
- Botanical Assessment and Open Space Management Plan for Plett 443/07, Western Cape 2010
- Botanical Assessment for Willow Tree Farm, NMB 2010
- Botanical Assessment for Kouga RDP Housing, Eastern Cape 2009
- Botanical Assessment for Fairview Erf 1226 (Wonderwonings), NMB 2009
- Species List Compilation for Zeekoerivier Humansdorp, Eastern Cape 2009
- Botanical Assessment for Woodlands Golf Estate (Farm 858), BCM, Eastern Cape 2009
- Botanical Assessment for Plettenberg Bay - 438/4, Western Cape 2009
- Vegetation Assessment for Kwanokuthula RDP housing project, Western Cape 2008
- Site screening assessment for Greenbushes Site screening, NMB 2008
- Botanical Assessment for Fairfax development, Eastern Cape 2008
- Botanical Assessment for Plettenberg Bay Brakkloof 50&51, Western Cape 2008
- Botanical Assessment, GIS mapping for Theescombe Erf 325, NMB 2008
- Site Screening for Mount Road, NMB 2008
- Botanical Assessment for Greenbushes Farm 40 Swinburne 404, NMB 2008
- Botanical Assessment for Greenbushes 130, NMB 2008
- Botanical Assessment for Greenbushes Kuyga no. 10, NMB 2008
- Botanical Assessment for Plettenberg Bay - 438/24, Western Cape 2007
- Botanical Assessment for Plettenberg Bay - Olive Hills 438/7, Western Cape 2007
- Botanical Assessment for Gonubie Portion 809/9, BCM, Eastern Cape 2006
- Botanical Assessment for Glengariff Farm 723, BCM, Eastern Cape 2006
- Botanical Assessment for Gonubie Portion 809/10, BCM, Eastern Cape 2006
- Botanical Assessment for Gonubie Portion 809/4 & 5, BCM, Eastern Cape 2006
- Botanical Assessment for Plettenberg bay - Ladywood 438/1&3, Western Cape 2006
- Botanical Assessment and Rehab Plan for Winterstrand Desalination Plant, BCM 2006
- Botanical Assessment for Bosch Hoogte, NMB 2006
- Botanical Assessment for Plettenberg bay Farm 444/38, Western Cape 2006
- Botanical Assessment for Plettenberg Bay - 444/27, Western Cape 2006
- Botanical Assessment for Leisure Homes, BCM, Eastern Cape 2006
- Botanical Basic Assessment for Trailees Wetland Assessment, Eastern Cape 2005
- Botanical Assessment and Rehab Plan for Arlington Racecourse - PE, NMB 2005
- Botanical Assessment for Smart Stone, NMB 2005
- Botanical Assessment for Peninsular Farm (Port Alfred), Eastern Cape 2005
- Botanical Assessment for Mount Pleasant - Bathurst, Eastern Cape 2005
- Botanical Assessment and RoD amendments for Colchester Erven 1617 & 1618 (Riverside), NMB 2005
- Basic Botanical Assessment for Parsonsvlei 3/4, Eastern Cape 2005
- Botanical Assessment for Bridgemead – Malabar PE, NMB 2004

AGRICULTURAL PROJECTS

- Preliminary Biodiversity Screening for Chrisdelina Ranch Agricultural Project, Kizenga District • 2020
- Ecological Assessment for Vermaak Boerdery Hydro Turbine (Cookhouse)2020 2020
- Thornhill Eggland Specialist Ecological Assessment 2020
- Ecological Assessment for Citrus expansion on Hitgeheim Farm, Sunland, Eastern Cape 2015
- Ecological Assessment for Citrus expansion on farm 960, Patensie (AIN du Preez Boerdery) 2014
- Ecological Assessment for Doornkraal Pivot (Hankey), Eastern Cape 2014
- Ecological Assessment for Tzaneen Chicken Farm, Limpopo 2013
- Botanical Assessment and Open Space Management Plan for Kudukloof, NMB 2010

- Botanical Assessment and Open Space Management Plan for Landros Veeplaats, NMB 2010
- Botanical Assessment and Flora Relocation Plan for Wildemans Plaas, NMB 2006

GOLF ESTATE AND RESORT DEVELOPMENT PROJECTS

- Species List& Comments Report for Kidds Beach Golf Course, BCM, Eastern Cape 2009
- Botanical Assessment for Plettenberg Bay -Farm 288/03, Western Cape 2009
- Botanical Assessment for Rockcliff Golf Course, BCM, Eastern Cape 2008
- Botanical Assessment for Rockcliff Resort Development, BCM, Eastern Cape 2007
- Botanical Assessment, EMP and Rehabilitation Plan for Tiffendel Ski Resort, Eastern Cape 2006

MIXED USE DEVELOPMENT PROJECTS

- Ecological Assessment for South-End Precinct Mixed Use Development, Nelson Mandela Bay 2018
- Botanical Assessment, EMP and Open Space Management Plan for Bay West City, NMB 2010
- Botanical Assessment, GIS maps, Open Space and Rehab Plans for Fairview Erf 1082, NMB 2009
- Botanical Assessment and GIS maps for Utopia Estate PE, NMB 2008
- Botanical Assessment and GIS mapping for Madiba Bay Leisure Park, NMB 2007
- Botanical Assessment and GIS mapping for Madiba Bay Leisure Park, NMB 2007
- Botanical Basic Assessment for Cuyler Manor (Farm 320), Uitenhage, NMB 2007

BUSINESS AND INDUSTRIAL DEVELOPMENT PROJECTS

- Ecological Assessment for Parsonsvlei Erf 984 & 1134 Parsonsvlei, NMB 2020
- Mthatha Retails and Service Center 2020
- Ecological Assessment for Walmer Erf 11667 - Bidfood Warehousing Development, NMB 2020
- Ecological Assessment for Portion 87 of the Farm Little Chelsea No 10, NMB 2020
- Ecological Assessment for Bay West City ENGEN Service Station, NMB 2015
- Ecological Assessment for Green Star grading for SANRAL, NMB 2014
- Ecological Assessment for OTGC Tank Farm, NMB 2012
- Botanical Assessment and Open Space Management Plan for Petro SA Refinery, Coega IDZ, NMB 2010
- Botanical Assessment for Bluewater Bay Erf 805, NMB 2009
- Ecological Assessment for Bay West City, NMB 2007
- Botanical Assessment for Kenton Petrol Station, Eastern Cape 2005
- Botanical Assessment and RoD amendments for Colchester Petrol Station, NMB 2005

ECO-ESTATE DEVELOPMENT PROJECTS

- Botanical Re-Assessment of Swanlake Eco Estate, Aston Bay, Eastern Cape 2018
- Detailed Botanical Assessment and Open Space Management Plan for Olive Hills, Western Cape 2010
- Botanical Assessment and EMP for Zwartenbosch Road, Eastern Cape 2010
- Botanical Assessment - Poultry Farm for Coega Kammaskloof Farm 191, NMB 2008
- Botanical Assessment - Housing development for Coega Ridge, NMB 2008
- Botanical Assessment, Rehabilitation Plan, EMP and GIS maps for Amanzi Estate, NMB, 2008
- Botanical Assessment for Roydon Game farm, Queenstown, Eastern Cape 2007
- Botanical Assessment for Winterstrand Estate (Farm 1008), BCM, Eastern Cape 2007
- Botanical Assessment for Homeleigh Farm 820, BCM, Eastern Cape 2007
- Botanical Basic Assessment, Rehab Plan & Maps for Candlewood, Tsitsikamma, Western Cape 2007
- Botanical Assessment, EMP and Rehab Plan for Carpe Diem Eco development, Eastern Cape 2007
- Botanical Assessment, EMP and Rehabilitation Plan for Seaview Eco-estate, NMB 2006

- Botanical Assessment for Kidd's Beach portion 1076, BCM, Eastern Cape 2006
- Botanical Assessment for Palm Springs, Kidds Beach East London, BCM, Eastern Cape 2006
- Botanical Assessment for Nahoon Farm 29082, BCM, Eastern Cape 2006
- Botanical Assessment for Rosehill Farm, Eastern Cape 2005
- Botanical Assessment for Resolution Game Farm, Eastern Cape 2005
- Botanical Assessment for Gonubie Portion 809/11, BCM, Eastern Cape 2005
- Botanical Assessment for Kidd's Beach portion 1075, BCM, Eastern Cape 2005

FLORA AND FAUNA RELOCATION PLANS, PERMITS AND IMPLEMENTATION

- Flora Search and Rescue for Nelson Mandela University Phase 2 & 3 Residences, Eastern Cape 2020
- Flora Search and Rescue for Fairwest Housing Estate, Nelson Mandela Bay, Eastern Cape 2019
- Flora Search and Rescue for Utopia Estate, Nelson Mandela Bay, Eastern Cape 2019
- Flora Search and Rescue for Citrus expansion on Boschkraal Citrus Farm, Sunland, Eastern Cape 2018
- Flora Search and Rescue for Wanhoop pipeline, Willowmore, Eastern Cape 2018
- Flora Search and Rescue for Wilgekloof pipeline, Willowmore, Eastern Cape 2018
- Flora Search and Rescue for Citrus expansion on Hitgeheim Farm (Farm 960), Sunland, Eastern Cape 2017
- Flora Search and Rescue for Steytlerville Bulk Water Supply, Eastern Cape (Phase 5) 2016
- Flora Search and Rescue for Citrus expansion on Farm 960, Patensie (AIN du Preez Boerdery) 2016
- Flora Search and Rescue for Steytlerville Bulk Water Supply & WTW, Eastern Cape (Phase 4) 2015
- Flora and Fauna Search and Rescue for Riversbend Citrus Farm, NMB 2014
- Flora and Fauna Search and Rescue for Mainstream Windfarm, Eastern Cape 2013
- Flora Search and Rescue for Steytlerville Bulk Water Supply, Eastern Cape (Phase 1, 2 & 3) 2013
- Flora and Fauna Search and Rescue for OTGC Tank Farm, Coega IDZ, NMB 2013
- Flora and Fauna Search and Rescue for Jeffreys Bay School, Eastern Cape 2013
- Flora Search and Rescue Plan for Red Cap Wind Farm, Eastern Cape 2012
- Flora Relocation for Disco Poultry Farm, NMB 2010
- Flora Relocation for Mainstream Windfarm, Eastern Cape 2010

ENVIRONMENTAL MANAGEMENT PLANS

- Final Environmental Management Programme (EMPr) and Maintenance Management Plan for South End Precinct Mixed Use Zone, Nelson Mandala Bay Municipality 2020
- Final Environmental Management Programme (EMPr) for Coega Land-Based Aquaculture Development Zone (ADZ), Coega Industrial Development Zone (IDZ), Nelson Mandela Bay Municipality 2019
- Basic Botanical Assessment for Kromensee EMP (Jeffries Bay), Eastern Cape 2010
- Wetland Management Plan for NMB Portnet, NMB 2010
- Baseline Botanical Study, Vegetation mapping and EMP for Local Nature Reserve for Plettenberg Bay Lookout LNA, Western Cape 2009
- Biodiversity & Ecological Processes for Bathurst-Commonage, Eastern Cape 2006
- EMP for Kromensee EMP (Jeffries Bay), Eastern Cape 2006
- Floral Survey for Mbotyi Conservation Assessment, Eastern Cape 2005
- Identifying and Assessment on Aquatic Weeds for Pumba Private Game Reserve, Eastern Cape 2005

BASIC ASSESSMENT APPLICATION PROJECTS (DEDEAT)

- Basic Assessment Application for Parsonsvlei Erf 984 & 1134 Parsonsvlei 2020
- Construction of Deviation and Rehabilitation of Bridge along DR02481 road 2020
- Basic Assessment Application for Vermaak Boerdery Hydro Turbine (Cookhouse) 2020

- Basic Assessment Application for Walmer Erf 11667 Bidfood Warehousing Development 2020
- Basic Assessment Application for Portion 87 of the Farm Little Chelsea No 10 2020
- Basic Assessment Application for Nelson Mandela University Access Road, NMB 2019
- Basic Assessment, WULA and Borrow Pit/Quarry Mining Application, Clarkebury Rd, Idutywa 2019

- Basic Assessment Application for Erf 599 Walmer Mixed Use Development, Nelson Mandela Bay 2019
- Basic Assessment Application for Cookhouse Bridge rehabilitation and temporary deviation 2019
- Basic Assessment Application for Erf 14 Kabega, NMBM 2017
- Basic Assessment Application for Hankey Housing, Kouga District Municipality 2017
- Basic Assessment Application for Fairwest Rental Housing, Nelson Mandela Bay 2017
- Basic Assessment Application for Citrus expansion on Hitgeheim Farm, Sunland, Eastern Cape 2015
- Basic Assessment Application for Hankey Housing, Kouga District Municipality 2015
- Basic Assessment Application for Citrus expansion on farm 960, Patensie (AIN du Preez Boerdery) 2014
- Basic Assessment Application for South-End Precinct Mixed Use Development, Nelson Mandela Bay 2018

MINING PERMIT/ENVIRONMENTAL MANAGEMENT PROGRAMME APPLICATIONS (DMR)

- Mining BAR/EMP's for 24 Borrow Pits in 6 districts within the Eastern Cape– (SANRAL) 2019
- Mining BAR/EMP's for Ingquza Hill LM Borrow Pits – (SANRAL) 2018
- Mining BAR/EMP's for Baviaans LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Senqu LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Kouga/Koukamma LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Inkwanca (Enoch Mgijima) LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Kouga/Koukamma LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Sakhisizwe/Engcobo LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Raymond Mahlaba LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Camdeboo LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Elundini LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Emalahleni/Intsika Yethu LM Borrow Pits – (DRPW) 2017
- Mining BAR/EMP's for Blue Crane Route & Camdeboo LM 12 Borrow Pits – (DoT) 2016
- Mining BAR/EMP's for Elundini LM 6 Borrow Pits (DoT) 2016
- Mining BAR/EMP's for Baviaans LM 6 Borrow Pits (DoT) 2016
- Mining BAR/EMP's for Kouga & Koukamma LM 12 Borrow Pits (DoT) 2016
- Mining BAR/EMP's for Sakhisizwe & Engcobo LM 12 Borrow Pits (DoT) 2016
- Mining BAR/EMP's for Senqu LM 12 Borrow Pits (DoT) 2016
- Mining BAR/EMP's for Nkonkobe LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Mbhashe LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Mbizana LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Senqu LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Elundini LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Emalahleni LM Borrow Pits – (SANRAL) 2016
- Mining BAR/EMP's for Emalahleni LM Borrow Pits – (DRPW) 2016
- Mining BAR/EMP's for Ikwezi/Baviaans LM Borrow Pits – (DRPW) 2016
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - MR00716 (Tarkastad) (DRPW) 2015
- Mining BAR/EMP's for Chris Hani DM Borrow Pits – Intsika Yethu and Emalahleni (DRPW) 2015
- Mining BAR/EMP's for Joe Gqabi DM Borrow Pits – Senqu (DRPW) 2015
- Mining BAR/EMP's for Makana/Ndlambe LM Borrow Pits – Sarah Baartman (DRPW) 2015
- Mining BAR/EMP's for Amahlathi LM Borrow Pits – Amatole (DRPW) 2015
- Mining BAR/EMP's for Mbashe/Mqume LM Borrow Pits – Amatole (DRPW) 2015

- Mining BAR/EMP's for Sundays River Valley LM Borrow Pits – Sarah Baartman (DRPW) 2015
- Mining BAR/EMP's for Kouga LM Borrow Pits – Sarah Baartman (DRPW) 2015
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - MR00716 (DRPW) 2014
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - DR02581 (DRPW) 2014
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - DR08041, DR08247, DR08248 & DR08504 (DRPW) 2014
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - DR08599, DR08601 & DR08570 (DRPW) 2014
- Mining BAR/EMP's for Chris Hani DM Borrow Pits - DR08235, DR08551 & DR08038 (DRPW) 2014
- Mining BAR/EMP's for Alfred Nzo DM Borrow Pits - DR08092, DR08093 & DR08649 (DRPW) 2014
- Mining BAR/EMP's for Alfred Nzo DM Borrow Pits - DR08090, DR08412, DR08425, DR08129, DR08109, DR08106, DR08104 & DR08099 – Matatiele (DRPW) 2014

ENVIRONMENTAL COMPLIANCE AUDITING

- Environmental Compliance Audit (Habata Boerdery) 2021
- Environmental Compliance Audit (Sontule Farm) 2021

ENVIRONMENTAL MANAGEMENT, AUDITING, COMPLIANCE AND MONITORING PROJECTS

- Environmental Auditing Services Construction (Intsomi Citrus) 2021
- Environmental Auditing Services Pre-construction and Construction (Rocky Coast Farm) 2021
- Environmental Auditing Services (Middledrift Breeder Facility) 2021
- Coega Aquaculture Development Zone Environmental Compliance and Monitoring for Construction (24 Months) 2020
- Construction of NMU West End Student Residences Phases 1 & 3 Environmental Control Office (30 Months) 2020
- Environmental Auditing and construction monitoring for construction of Phase 1 River Park (South End Precinct) 2020
- Waste Management License audit for Bedford Recycling project 2020
- Auditing for Construction of Fairwest Village Housing Project 2019
- Auditing for Construction of Utopia Estate monthly auditing 2019
- ECO for DRPW IRM Road Maintenance projects, Baviaans LM 2019
- ECO for DRPW IRM Road Maintenance projects, Senqu LM 2019
- ECO for DRPW IRM Road Maintenance projects, Kouga/Koukamma LM 2019
- ECO for DRPW IRM Road Maintenance projects, Sakhisizwe/Engcobo LM 2019
- ECO for DRPW IRM Road Maintenance projects, Elundini LM 2019
- ECO for DRPW IRM Road Maintenance projects, Emalahleni/Intsika Yethu LM 2019
- ECO for Construction of Fairwest Village Housing Project 2019
- ECO for Construction of Utopia Estate Mixed Use Project 2019
- ECO for Construction of NMU West End Student Residences Phases 1 & 3 2019
- ECO for Construction of Eco-Pullets pullet rearing facility, Paterson 2018
- ECO for DRPW IRM Road Maintenance projects, Raymond Mahlaba LM 2018
- ECO for DRPW IRM Road Maintenance projects, Inkwanca (Enoch Mgijima) LM 2018
- ECO for Citrus expansion on Farm 960, Patensie (AIN du Preez Boerdery) 2017
- ECO for Citrus expansion on Hitgeheim Farm (Farm 960), Sunland, Eastern Cape 2017
- DEO for improvement of national route R67 section 5 from Whittlesea (km 0.00) to Swart Kei river (km 15.40) – Murray & Roberts 2017
- ECO for SANRAL RRP Road Maintenance projects, Mbizana LM 2017
- ECO and Botanical Specialist for the special maintenance of national route R61 Section 2 from Elinus Farm (km 42.2) to N10 (km 85.0) (SANRAL) 2016
- Environmental Control Officer (ECO): Construction of NSRI Slipway - Port Elizabeth Harbour 2016
- ECO for SANRAL RRP Road Maintenance projects, Mbashe LM 2016

- ECO for SANRAL RRP Road Maintenance projects, Nkonkobe LM 2016
- ECO for SANRAL RRP Road Maintenance projects, Mbizana LM 2016
- ECO for SANRAL RRP Road Maintenance projects, Senqu LM 2016
- ECO for SANRAL RRP Road Maintenance projects, Elundini LM 2016
- ECO and Environmental Management for closure of Bushmans River Landfill site 2016
- ECO for DRPW IRM Road Maintenance projects, Amahlathi Municipality 2015
- ECO for DRPW IRM Road Maintenance projects, Makana/Ndlambe Municipality 2015
- ECO for DRPW IRM Road Maintenance projects, Mbashe/Mqume Municipality 2015
- ECO for DRPW IRM Road Maintenance projects, Port St Johns, Mbizana, Ingquza Hill LM's 2015
- ECO for Riversbend Citrus Farm, NMB 2014
- ECO for Alfred Nzo DM Road resurfacing - DR08071, DR08649, DR08092, DR08418, DR08452, DR08015, DR08085, DR08639 & DR08073, Eastern Cape - MSBA 2014
- ECO Audits for Koukamma Flood Damage Road Repairs – Hatch Goba 2014
- EMP and ECO for Utopia Estate, NMB 2013
- Final EMPr submission for Seaview Garden Estate, NMB 2012
- ECO audits for NMB Road surfacing, NMB (multiple contacts) 2011
- EMPr submission and ECO for Seaview Garden Estate, NMB 2010
- ECO for Mainstream Windfarm wind monitoring mast installation, Eastern Cape 2010
- EMP and ECO for Sinati Golf Estate EMP, BCM, Eastern Cape 2009
- Flora Relocation Plan and Permit application for Wildemans Plaas, NMB 2006

ENVIRONMENTAL SCREENING PROJECTS

- Somerset East Stormwater Environmental Screening Report 2021
- Woodlands Diary Road Upgrade Environmental Screening Report, Kouga LM 2021
- Risk Assessment and Screening for proposed Heatherbank access road, NMB 2020
- Environmental Screening Report for Proposed Life Hospital parking expansion, NMB 2019
- Environmental Screening Report for Erf 984 & 1134 development, Parsonsvlei, NMB 2019
- Environmental Screening Report for proposed Khayalethu School, Buffalo City 2018
- Environmental Screening Report for Proposed Housing Development of Erf 8700, Kabega Park, NMB 2017
- Environmental Screening Report for Proposed Housing Development of Erf 14, Kabega Park, NMB 2017
- Environmental Screening Report for Proposed Fairwest Social Housing project, Fairview, NMB 2016
- Environmental Screening Report for Development of Little Chelsea No 25, NMB 2016
- Terrestrial Vegetation Risk Assessment for proposed Skietnek Citrus Farm development (Kirkwood) 2015
- Preliminary Environmental Risk Assessment: NSRI Slipway Port Elizabeth 2015
- Environmental Screening Report for Proposed Development of a Dwelling on Erf 899, Theescombe 2015
- Environmental Screening Report for Proposed Development on Erf 559, Walmer, Port Elizabeth 2015
- Environmental Screening Report for Proposed Housing Scheme Development of Erf 8709, Wells Estate 2015
- Environmental Screening Report for Development of Portion 10 of Little Chelsea No 87, NMB 2015

SECTION 24G APPLICATIONS

- 12 000 ML Dam constructed on farm 960, Patensie (MGM Trust) 2015
- Illegal clearing of 20 Ha of lands on Hitgeheim Farm, Sunland, Eastern Cape 2015

CONFERENCES AND PUBLICATIONS

- Pote, J., Shackleton, C.M., Cocks, M. & Lubke, R. 2006. *Fuelwood harvesting and selection in Valley Thicket*, South Africa. Journal of Arid Environments, 67: 270-287.
- Pote, J., Cocks, M., Dold, T., Lubke, R.A. and Shackleton, C. 2004. *The homegarden cultivation of indigenous medicinal plants in the Eastern Cape*. Indigenous Plant Use Forum, 5 - 8 July 2004, Augsburg Agricultural School, Clanwilliam, Western Cape.
- Pote, J. & Lubke, R.A. 2003. *The selection of indigenous species suitable for use as fuelwood and building materials as a replacement of invasive species that are currently used by the under-privileged in the Grahamstown commonage.* Working for Water Inaugural Research Symposium 19 - 21 August 2003, Kirstenbosch. Poster presentation.
- Pote, J. & Lubke, R.A. 2003. *The screening of indigenous pioneer species for use as a substitute cover crop for rehabilitation after removal of woody alien species by WfW in the grassy fynbos biome in the Eastern Cape*. Working for Water Inaugural Research Symposium 19 - 21 August 2003, Kirstenbosch, South Africa.

OTHER RESEARCH EXPERIENCE

- Resource assessment of bark stripped trees in indigenous forests in Weza/Kokstad area (June 2000; Dr C. Geldenhuis & Mr. M. Kaplin).
- Working for Water research project for indigenous trees for woodlots (December 2000/January 2001; Prof R.A. Lubke, Rhodes University).
- Project coordinator and leader of the REFYN project – A BP conservation gold award: Conservation and Restoration of Grassy-Fynbos. A multidisciplinary project focusing on management, restoration and public awareness/education (2001 – 2002).
- Conservation Project Management Training Workshops: Royal Geographical Society, London 2001 – Fieldwork Techniques, Habitat Assessment, Biological Surveys, Project Planning, Public Relations and Communications, Risk Assessment, Conservation Education
- Selection and availability of wood in Crossroads village, Eastern Cape, South Africa. Honours Research Project 2002. Supervisors: Prof. R.A. Lubke & Prof. C. Shackleton.
- Floral Morphology, Pollination and Reproduction in Cyphia (LOBELIACEAE). Honours Research Project 2002. Supervisor: Mr. P. Phillipson.
- Forestry resource assessment of bark-stripped species in Amatola District (December 2002; Prof R.A. Lubke).
- Homegarden Cultivation of Medicinal Plants in the Amathole area. Postgraduate Research Project (2003-2005; Prof R.A. Lubke, Prof C.M. Shackleton and Ms C.M., Cocks).

7.8 Appendix 8: Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity

SCOPE

The protocol (*Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation (GN 320, 20 March 2020)*) provides the criteria for the assessment and reporting of impacts on terrestrial biodiversity for activities requiring environmental authorisation.

The protocol (*Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of sections 24(5)(a) and (h) and 44 of NEMA, gazetted on 30 October 2020*), provides the criteria for the assessment and reporting of impacts on plant and animal species for activities requiring environmental authorisation.

These protocols replace the requirements of Appendix 6 of the Environmental Impact Assessment Regulation19.

The assessment and minimum reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (https://screening.environment.gov.za/screeningtool). The requirements for terrestrial biodiversity are for landscapes or sites which support various levels of biodiversity. The relevant terrestrial biodiversity data in the screening tool has been provided by the South African National Biodiversity Institute20.

SITE SENSITIVITY VERIFICATION AND MINIMUM REPORT CONTENT REQUIREMENTS

Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool must be confirmed by undertaking a site sensitivity verification.

1. The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.
2. The site sensitivity verification must be undertaken using:
    a. a desk top analysis, using satellite imagery,
    b. a preliminary on-site inspection; and
    c. any other available and relevant information.
3. The outcome of the site sensitivity verification must be recorded in the form of a report that:
    a. confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.
    b. contains a motivation and evidence (e.g., photographs) of either the verified or different use of the land and environmental sensitivity; and
    c. is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

19 The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act 107 of 1998).

20 The biodiversity dataset has been provided by the South African National Biodiversity Institute (for details of the dataset, click on the options button to the right of the various biodiversity layers on ther screening tool).

TERRESTRIAL BIODIVERSITY SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
1	General Information	
1.1	An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified on the screening tool as being "very high sensitivity" for terrestrial biodiversity, must submit a Terrestrial Biodiversity Specialist Assessment.	✓
1.2	An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being 'low sensitivity' for terrestrial biodiversity, must submit a Terrestrial Biodiversity Compliance Statement.	✓
1.3	However, where the information gathered from the site sensitivity verification differs from the designation of 'very high' terrestrial biodiversity sensitivity on the screening tool and it is found to be of a 'low' sensitivity, then a Terrestrial Biodiversity Compliance Statement must be submitted.	✓
1.4	Similarly, where the information gathered from the site sensitivity verification differs from that identified as having a 'low' terrestrial biodiversity sensitivity on the screening tool, a Terrestrial Biodiversity Specialist Assessment must be conducted.	✓
1.5	If any part of the proposed development footprint falls within an area of 'very high' sensitivity, the assessment and reporting requirements prescribed for the 'very high' sensitivity apply to the entire footprint, excluding linear activities for which impacts on terrestrial biodiversity are temporary and the land in the opinion of the terrestrial biodiversity specialist, based on the mitigation and remedial measures, can be returned to the current state within two years of the completion of the construction phase, in which case a compliance statement applies. Development footprint in the context of this protocol means the area on which the proposed development will take place and includes any area that will be disturbed.	✓
	VERY HIGH SENSITIVITY RATING for terrestrial biodiversity features	
2	Terrestrial Biodiversity Specialist Assessment	
2.1	The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of terrestrial biodiversity.	✓
2.2	The assessment must be undertaken on the preferred site and within the proposed development footprint.	✓
2.3	The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:	✓
2.3.1	a description of the ecological drivers or processes of the system and how the proposed development with impact these;	✓
2.3.2	ecological functioning and ecological processes (e.g., fire, migration, pollination, etc.) that operate within the preferred site;	✓
2.3.3	the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;	✓
2.3.4	the description of any significant terrestrial landscape features (including rare or important flora-faunal associations, presence of strategic water source areas (SWSAs) or freshwater ecosystem priority area (FEPA) sub catchments);	✓

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
2.3.5	a description of terrestrial biodiversity and ecosystems on the preferred site, including:	✓
(a)	main vegetation types;	✓
(b)	threatened ecosystems, including fisted ecosystems as well as locally important habitat types identified;	✓
(c)	ecological connectivity, habitat fragmentation, ecological processes and fine-scale habitats; and	✓
(d)	species, distribution, important habitats (e.g., feeding grounds, nesting sites, etc.) and movement patterns identified;	✓
2.3.6	the assessment must identify any alternative development footprints within the preferred site which would be of 'low' sensitivity as identified by the screening tool and verified through the site sensitivity verification; and	✓
2.3.7	the assessment must be based on the results of a site inspection undertaken on the preferred site and must identify:	✓
2.3.7.1	terrestrial critical biodiversity areas (CBAs), including:	✓
(a)	the reasons why an area has been identified as a CBA;	✓
(b)	an indication of whether or not the proposed development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation;	✓
(c)	the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to remaining extent of the ecosystem type(s);	✓
(d)	the impact on ecosystem threat status;	✓
(e)	the impact on explicit subtypes in the vegetation;	✓
(f)	the impact on overall species and ecosystem diversity of the site; and	✓
(g)	the impact on any changes to threat status of populations of species of conservation concern in the CBA;	✓
2.3.7.2	terrestrial ecological support areas (ESAs), including:	✓
(a)	the impact on the ecological processes that operate within or across the site;	✓
(b)	the extent the proposed development will impact on the functionality of the ESA; and	✓
(c)	loss of ecological connectivity (on site, and in relation to the broader landscape) due to the degradation and severing of ecological corridors or introducing barriers that impede migration | and movement of flora and fauna;	✓
2.3.7.3	protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including	✓
(a)	an opinion on whether the proposed development aligns with the objectives or purpose of the protected area and the zoning as per the protected area management plan;	✓
2.3.7.4	priority areas for protected area expansion, including-	✓
(a)	the way in which in which the proposed development will compromise or contribute to the expansion of the protected area I network;	✓
2.3.7.5	Strategic Water Source Areas (SWSAs) including:	✓
(a)	the impact(s) on the terrestrial habitat of SWSA; and	✓

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
(b)	the impacts of the proposed development on the SWSA water quality and quantity (e.g., describing potential increased runoff leading to increased sediment load in water courses),	✓
2.3.7.6	FEPA sub catchments, including-	✓
(a)	the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;	✓
2.3.7.7	indigenous forests, including:	✓
(a)	impact on the ecological integrity of the forest and	✓
(b)	percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.	✓
2.4	The findings of the assessment must be written up in a Terrestrial Biodiversity Specialist Assessment Report	✓
3	Terrestrial Biodiversity Specialist Assessment Report	
3.1	The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:	✓
3.1.1	contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	✓
3.1.2	a signed statement of independence by the specialist;	✓
3.1.3	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment,	✓
3.1.4	description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modeling used, where relevant;	✓
3.1.5	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	✓
3.1.6	a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	✓
3.1.7	additional environmental impacts expected from the proposed development;	✓
3.1.8	any direct, indirect, and cumulative impacts of the proposed development;	✓
3.1.9	the degree to which impacts, and risks can be mitigated;	✓
3.1.10	the degree to which the impacts and risks can be reversed;	✓
3.1.11	the degree to which the impacts and risks can cause loss of irreplaceable resources;	✓
3.1.12	proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr),	✓
3.1.13	a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a 'low' terrestrial biodiversity sensitivity and that were not considered appropriate,	✓
3.1.14	a substantiated statement based on the findings of the specialist assessment, regarding the acceptability, or not. of the proposed development if it should receive approval a not; and	✓
3.1.15	any conditions to which this statement is subjected.	✓

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
3.2	The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr where relevant.	✓
3.3	A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	✓
	LOW SENSITIVITY RATING – for terrestrial biodiversity features	
4	Terrestrial Biodiversity Compliance Statement	✓
4.1	The compliance statement must be prepared by a specialist registered with the SACNASP and having expertise in the field of ecological sciences.	✓
4.2	The compliance statement must:	✓
4.2.1	be applicable to the preferred site and proposed development footprint;	✓
4.2.2	confirm that the site is of 'low' sensitivity for terrestrial biodiversity; and	✓
4.2.3	indicate whether or not the proposed development will have any impact on the biodiversity feature.	✓
4.3	The compliance statement must contain, as a minimum, the following information:	✓
4.3.1	the contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	✓
4.3.2	a signed statement of independence by the specialist;	✓
4.3.3	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	✓
4.3.4	a baseline profile description of biodiversity and ecosystems of the site;	✓
4.3.5	the methodology used to verify the sensitivities of the terrestrial biodiversity features on the site, including equipment and modeling used, where relevant;	✓
4.3.6	in the case of a linear activity, confirmation from the terrestrial biodiversity specialist that, in their opinion, based on the mitigation and remedial measures propped, the land can be returned to the current state within two years of completion of the construction phase;	✓
4.3.7	where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr;	✓
4.3.8	a description of the assumptions made and any uncertainties or gaps in knowledge or data; and	✓
4.3.9	any conditions to which this statement is subjected.	✓
4.4	A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	✓

PLANT SPECIES SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
1	General Information	
1.1	An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of "very high" or "high" sensitivity for terrestrial plant species must submit a Terrestrial Plant Species Specialist Assessment Report.	✓

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
1.2	An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of "medium sensitivity" for terrestrial plant species must submit either a Terrestrial Plant Species Specialist Assessment Report or a Terrestrial Plant Species Compliance Statement, depending on the outcome of a site inspection undertaken in accordance with paragraph 4.	✓
1.3	An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of "low" sensitivity for terrestrial plant species must submit a Terrestrial Plant Species Compliance Statement.	✓
1.4	Where the information gathered from the site sensitivity verification differs from the screening tool designation of "very high" or "high", for terrestrial plant species sensitivity and it is found to be of a "low" sensitivity, then a Terrestrial Plant Species Compliance Statement must be submitted.	✓
1.5	Where the information gathered from the site sensitivity verification differs from the screening tool designation of "low" terrestrial plant species sensitivity and it is found to be of a "very high" or "high" terrestrial plant species sensitivity, a Terrestrial Plant Species Specialist Assessment must be conducted.	✓
1.6	If any part of the development falls within an area of confirmed "very high" or "high" sensitivity, the assessment and reporting requirements prescribed for the "very high" or "high" sensitivity, apply to the entire development footprint. Development footprint in the context of this protocol means, the area on which the proposed development will take place and includes the area that will be disturbed or impacted.	✓
1.7	The Terrestrial Plant Species Specialist Assessment and the Terrestrial Plant Species Compliance Statement must be undertaken within the study area.	✓
1.8	Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.	✓
1.9	Where the nature of the activity is expected to have an impact on SCC beyond the boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with Species Environmental Assessment Guideline21, and the study area must include the PAOI, as determined.	✓
	VERY HIGH AND HIGH SENSITIVITY RATING for terrestrial plant species	
2	Terrestrial Plant Species Specialist Assessment	✓
	VERY HIGH SENSITIVITY RATING Critical habitat for range-restricted species22 of conservation concern, that have a global range of less than 10 km2. SCC listed on the IUCN Red List of Threatened Species23 or on South Africa's National Red List website24 as Critically Endangered, Endangered or Vulnerable	✓

21 Available at https://bgis.sanbi.org/
22 Species with a geographically restricted area of distribution.
23 https://www.iucnredlist.org/
24 This category includes the categories Extremely Rare, Critically Rare, and Rare

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
	according to the IUCN Red List 3.1. Categories and Criteria or listed as Nationally Rare. Species aggregations that represent ≥1% of the global population size of a species, over a season, and during one or more key stages of its life cycle. The number of mature individuals that ranks the site among the largest 10 aggregations known for the species. These areas are irreplaceable for SCC. **HIGH SENSITIVITY RATING** Confirmed habitat for SCC. SCC, listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable, according to the IUCN Red List 3.1. Categories and Criteria and under the national category of Rare. These areas are unsuitable for development due to a very likely impact on SCC.	
2.1	The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with a field of practical experience relevant to the taxonomic group ("taxa") for which the assessment is being undertaken.	✓
2.2	The assessment must be undertaken within the study area.	✓
2.3	The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline25; and must:	✓
2.3.1	Identify the SCC which were found, observed or are likely to occur within the study area;	✓
2.3.2	provide evidence (photographs) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility26, immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);	✓
2.3.3	identify the distribution, location, viability27 and provide a detailed description of population size of the SCC, identified within the study area;	✓
2.3.4	identify the nature and the extent of the potential impact of the proposed development on the population of the SCC located within the study area;	✓
2.3.5	determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases, including the IUCN Red List of Threatened Species, South African Red List of Species, and/or other relevant databases;	✓
2.3.6	determine the potential impact of the proposed development on the habitat of the SCC located within the study area;	✓
2.3.7	include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, include a motivation for the deviation;	✓

25 Available at https://bgis.sanbi.org/
26 The preferred platform is iNaturalist.org but any other national or international virtual museum.
27 the ability to survive and reproduce in the long term.

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
2.3.8	identify any dynamic ecological processes occurring within the broader landscape that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems;	✓
2.3.9	identify any potential impact of ecological connectivity in relation to the broader landscape, resulting in impacts on the identified SCC and its long-term viability;	✓
2.3.10	determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC;	✓
2.3.11	discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species28;	✓
2.3.12	identify any alternative development footprints within the preferred site which would be of "low" or "medium" sensitivity as identified by the screening tool and verified through the site sensitivity verification.	✓
2.4	The findings of the assessment must be written up in a Terrestrial Plant Species Specialist Assessment Report.	✓
3	Terrestrial Plant Species Specialist Assessment Report	✓
3.1	This report must include as a minimum the following information:	✓
3.1.1	contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;	✓
3.1.2	a signed statement of independence by the specialist;	✓
3.1.3	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	✓
3.1.4	a description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;	✓
3.1.5	a description of the assumptions made and any uncertainties or gaps in knowledge or data;	✓
3.1.6	a description of the mean density of observations/number of sample sites per unit area29 and the site inspection observations;	✓
3.1.7	details of all SCC found or suspected to occur on site, ensuring sensitive species30 are appropriately reported;	✓
3.1.8	the online database name, hyperlink, and record accession numbers for disseminated evidence of SCC found within the study area;	✓
3.1.9	the location of areas not suitable for development and to be avoided during construction where relevant;	✓
3.1.10	a discussion on the cumulative impacts;	✓
3.1.11	impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	✓
3.1.12	a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development	✓

28 Undescribed species are to be assessed as "High Sensitivity".
29 Species Environmental Assessment Guideline
30 The actual name of the sensitive species may not appear in the final EIA report nor any of the specialist reports released into the public domain. It should be referred to as a sensitive plant or animal and its IUCN extinction risk category should be included e.g., Critically Endangered sensitive plant or Endangered sensitive butterfly.

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
	should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and	
3.1.13	a motivation must be provided if there were any development footprints identified as per paragraph 2.3.12 above that were identified as having "low" or "medium" terrestrial plant species sensitivity and were not considered appropriate.	✓
3.2	A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	✓
4	MEDIUM SENSITIVITY SPECIES OF CONSERVATION CONCERN CONFIRMATION	
	MEDIUM SENSITIVITY RATING – for terrestrial plant species: Suspected habitat for SCC based either on there being records for this species collected in the past, prior to 2002, or being a natural area included in a habitat suitability model31. SCC listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria and under the national category of Rare.	✓
4.1	Medium sensitivity data represents suspected habitat for SCC based on occurrence records for these species collected prior to 2002 or is based on habitat suitability modelling.	✓
4.2	The presence or likely presence of the SCC identified by the screening tool must be investigated through a site inspection by a specialist registered with the SACNASP with a field of practice relevant to the taxonomic groups ("taxa") for which the assessment is being undertaken.	✓
4.3	The assessment must be undertaken within the study area.	✓
4.4	The site inspection to determine the presence or likely presence of SCC must be undertaken in accordance with the Species Environmental Assessment Guidelines.	✓
4.5	The site inspection is to confirm the presence, likely presence or confirmed absence of a SCC identified within the site identified as "medium" sensitivity by the screening tool.	✓
4.6	Where SCC are found on site or have been confirmed to be likely present, a Terrestrial Plant Species Specialist Assessment must be submitted in accordance with the requirements specified for "very high" and "high" sensitivity in this protocol.	✓
4.7	Similarly, where no SCC are found on site during the site inspection or the presence is confirmed to be unlikely, a Terrestrial Plant Species Compliance Statement must be submitted.	✓
5	LOW SENSITIVITY RATING – for terrestrial plant species	
	Terrestrial Plant Species Compliance Statement Areas where no natural habitat remains. Natural areas where there is no suspected occurrence of SCC.	✓

31 The methodology by which habitat suitability models have been developed are explained within the Species Environmental Assessment Guideline.

TABLE 1:	ASSESSMENT AND REPORTING OF IMPACTS ON TERRESTRIAL BIODIVERSITY	REPORT REF
5.1	The compliance statement must be prepared by a SACNASP registered specialist under one of the two fields of practice (Botanical Science or Ecological Science).	✓
5.2	The compliance statement must:	✓
5.2.1	be applicable to the study area;	✓
5.2.2	confirm that the study area, is of "low" sensitivity for terrestrial plant species; and	✓
5.2.3	indicate whether or not the proposed development will have any impact on SCC.	✓
5.3	The compliance statement32 must contain, as a minimum, the following information:	✓
5.3.1	contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the compliance statement including a curriculum vitae;	✓
5.3.2	a signed statement of independence by the specialist;	✓
5.3.3	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	✓
5.3.4	a description of the methodology used to undertake the site survey and prepare the compliance statement, including equipment and modelling used where relevant;	✓
5.3.5	where required, proposed impact management actions and outcomes or any monitoring requirements for inclusion in the EMPr;	✓
5.3.6	a description of the assumptions made and any uncertainties or gaps in knowledge or data;	✓
5.3.7	the mean density of observations/ number of samples sites per unit area33; and	✓
5.3.8	any conditions to which the compliance statement is subjected.	✓
6	A signed copy of the Terrestrial Plant Species Compliance Statement must be appended to the Basic Assessment Report or the Environmental Impact Assessment Report.	✓

ANIMAL SPECIES SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS

Refer to separate faunal reporting.

32 An example of a what is contained in a Compliance Statement for Plant Species Impact Assessment can be found in the Species Environmental Impact Assessment Guideline
33 Refer to the Species Environmental Assessment Guideline

PAGE INTENTIONALLY LEFT BLANK

END