Appendix H-4

TERRESTRIAL BIODIVERSITY STUDY

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE IMPUMELELO WIND ENERGY FACILITY LOCATED NEAR SECUNDA, MPUMALANGA

TERRESTRIAL BIODIVERSITY AND SPECIES: SPECIALIST ASSESSMENT

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EXECUTIVE SUMMARY

Background

Impumelelo Wind (Pty) Ltd proposes to develop the Impumelelo Wind Energy Facility (up to 200 MW) and its associated infrastructure near Greylingstad in Mpumalanga.

This report has been prepared in terms of the Environmental Impact Assessment (EIA) Regulations under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017) and the gazetted '*Procedures for the assessment and minimum criteria for reporting on identified environmental themes* (Government Gazette 43110, No. 320, 20 March 2020 (NEMA 2020a). Note that this protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations.

*Note: This specialist assessment was commissioned on **25 October 2020** prior to the gazetting of the 'Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species' and the 'Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant Species' (GG 43855 / GN R1150, 30 October 2020)* (NEMA 2020b). The gazetted procedures published on 30 October 2020 make the following provision for specialists appointed prior to 30 October 2020: ***"The requirements of these protocols will apply from the date of publication, except where the applicant provides proof to the competent authority that the specialist assessment affected by these protocols had been commissioned by the date of publication of these protocols in the Government Gazette, in which case Appendix 6 of the Environmental impact Assessment Regulations, 2014, as amended, will apply to such applications."***

The approach, methodology and regulatory framework is explained in Chapters 2 and 3 of the report.

Location, topography, climate, geology and soils

The Impumelelo site covers an area of approximately 2840 ha and is located northeast of Greylingstad on the farms (or portions of) Platkop 543 IR, Hartbeesfontein 522 IR and Mahemsfontein 544 IR. The area falls within the Gert Sibande District Municipality and the Dipaleseng Local Municipality in the Mpumalanga province, with the central part of the site located at 26° 39' 52.8" S; 28° 50' 57.0" E. The site is characterised by grassland on gently undulating plains. Altitude ranges from about 1600 m in the west along the Grootspruit up to approximately 1640 m in the northeast of the site. The site is drained from north to south by the Grootspruit and its tributaries in the west and the Ouhoutspruit and its tributaries in the east.

Most of the site is underlain by dolerite (Jd) while sandstone, shale and coal beds of the Vryheid Formation, Ecca Group (Pv) occur locally in the west and southeast of the site. Some alluvium occurs along the drainage lines. The Ea Land Type covers the entire site and occurs on undifferentiated soils and consists of one or more vertic, melanic, red structured, diagnostic horizons.

The mean annual rainfall as measured at Secunda is 693 mm with the rainy season predominantly from October to March when about 86% of the annual rainfall occurs. The mean annual temperature at Secunda is 15.8°C with the extreme maximum and minimum temperatures 33.0°C and -4.3°C respectively.

Vegetation and flora

The Impumelelo site falls in the Grassland Biome and more specifically in the Mesic Highveld Grassland Bioregion. It is located in the Soweto Highveld Grassland (Gm8) national vegetation type which has a "Vulnerable" conservation status because almost half of it has been transformed mostly by cultivation, plantations, mining and urbanisation. The Tsakane Clay Grassland Vegetation Type, which has an Endangered status, covers a minute portion of the site in the west. Based on species composition, six habitats (plant communities) were distinguished, described and

mapped for the Impumelelo site. A further four units were also distinguished, i.e. croplands, infrastructure, disturbed areas and dams. The site does not fall within any Centre of Endemism.

During the field surveys, 290 plant species were recorded on the three Enertrag sites (Vhuvhili, Mukondeleli and Impumelelo). Combined, the checklist generated by the NewPosa database for the region, the red-list for Mpumalanga intersecting the sites (Lötter 2015) and the list for the current field study yielded 396 species for the region of which 30 are protected species according to the MNCA (1998).

Twelve of the 30 Mpumalanga protected plant species (Schedule 11) were recorded during the site surveys with nine of these species found on Impumelelo (*Aloe transvaalensis, Boophone disticha, Crinum bulbispermum, Eucomis autumnalis, Gladiolus crassifolius, Gladiolus dalenii, Gladiolus robertsoniae, Haemanthus* sp. and *Huernia hystrix*. Seven species occurring in the region are on the Mpumalanga Red list (Lötter 2015) (*Boophone disticha, Eucomis autumnalis, Gladiolus robertsoniae, Hypoxis hemerocallidea, Khadia beswickii, Nerine gracilis and Trachyandra erythrorhiza)* although not included in the MNCA (1998) list for Mpumalanga. The geophyte *Gladiolus robertsoniae* was the only one of seven SCC (*sensu* SANBI SCC definition) listed for the region that was recorded during the site survey although there are records of *Nerine gracilis* and *Kniphofia typhoides* on site (data provided by MTPA). No threatened or protected species (ToPS listed) under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) is listed for the Impumelelo site and none were found at the site. Thirteen (13) CITES Appendix II species are listed for the region including mostly (10) species of the Orchidaceae. However only two CITES species were recorded on the Impumelelo site, *viz. Aloe transvaalensis* and *Euphorbia clavarioides*. No nationally protected tree species is listed for the site and none were recorded during the site visit. No endemic species are listed for either the Soweto Highveld Grassland or the Tsakane Clay Grassland Vegetation Types.

Forty-seven alien plant species were recorded on the three Enertrag sites of which 12 are currently declared alien invasive species and 35 naturalised alien species (Appendix B). Another four naturalised alien species are listed by NewPosa for the region.

Fauna

The site falls within the distribution range of 52 terrestrial mammal species. Three IUCN Threatened and seven Near Threatened mammal species were listed for the environs of the Impumelelo site. Mammals that have been sighted (own observations and landowner reported) include the Near Threatened serval *Leptailurus serval*, Southern African hedgehog *Atelerix frontalis* and the Southern African vlei rat *Otomys auratus.* The steenbok *Raphicerus campestris* and hedgehog *Atelerix frontalis* are Schedule 2 mammal species (MNCA 1998). The serval *Leptailurus serval* and the hedgehog *Atelerix frontalis* are also threatened or protected mammal species (ToPS), while the serval *Leptailurus serval* was the only CITES listed mammal species recorded on the site.

Thirty-two (32) reptile species are listed for the region. *Smaug giganteus*, the giant girdled lizard, has a Vulnerable IUCN status and is classified as Endangered in the NEMBA (2007c) ToPS list, but was not highlighted by the screening tool for the site and not listed on the MTPA database for the participating farms. Provincially protected reptile species include 15 Schedule 2 Protected reptiles and 17 Schedule 5 reptiles. The two CITES listed reptile species that were recorded for the region were the giant girdled lizard (ouvolk), *Smaug giganteus,* and the common girdled lizard, *Cordylus vittifer*.

The only reptile that the landowners reported for the Impumelelo site, is the Rinkhals *Hemachatus haemachatus*.

The Screening Tool listed *Lepidochrysops procera* (Lepidoptera) as a SCC for the site. However, it is not listed in the ADU database or the MTPA database for the participating farms, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops procera* was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was only recorded once in one locality.

Conservation

Wind farms are considered by Mpumalanga to be biodiversity-incompatible and should not be located in Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs). (MBSP 2014). They should be located in ONAs or heavily modified areas, subject to the appropriate authorisations. However, in Table 18 of the MBSP (2014) handbook it is stated that wind farms in CBAs (Terrestrial) and ESAs are permissible under certain conditions and subject to the appropriate authorisations.

The presence of Critical Biodiversity Areas (CBA irreplaceable as well as CBA optimal) is indicated across a large section of the Impumelelo site. These CBAs correspond largely to Habitat 4 (natural grassland) in the current study which represent large natural grassland patches. Thirteen turbines are located in areas demarcated as either CBA irreplaceable (CBA1) or CBA optimal (CBA2). These sites should be relocated or micro-sited prior to approval of final layout to avoid CBA1s and preferably also CBA2s as far as possible.

There are some ESA Local and Landscape corridors demarcated within the Impumelelo site and there is one wind turbines (WTG01) located in the ESA Landscape corridor according to the current layout. This turbine should preferably be relocated or microsited prior to approval of final layout because it also falls in natural grassland (Habitat 4).

Some ONAs were demarcated within the Impumelelo site (MBSP 2014), however turbines are permissible in ONAs subject to the appropriate authorisations.

The Impumelelo site does form part of the 5- and 20-year plan of the Mpumalanga PAES, which corresponds to the NPAES (2018) plan. As in the case of NPAES, a substantial number of turbines are located within the MPAES, i.e. those turbines falling in CBAs and ESAs.

Large portions of the site are demarked as either ‘Heavily modified’ or ‘Moderately modified – old lands’, especially in the east. These MBSP (2014) categories do not have equivalent categories in the SANBI CBA classification system and must be assumed to be degraded to such an extent that they cannot qualify as ESAs or ONAs. Wherever possible, turbines can be placed in these units.

The site does not fall in a Strategic Water Source Area (SWSA). Although the Screening Tool did not mention river of wetland FEPAs, the entire Impumelelo site is contained in an Upstream Management Area river FEPA. In the current assessment, the area mapped as river FEPA did not emerge as being highly sensitive and the sensitivity model that was applied to the vegetation, classified only the drainage lines on site as being of high sensitivity with most of the area classified as low sensitivity and a few spots of medium sensitivity. Several Highveld Wetland categories are present in the Impumelelo site, with most of the seeps and channelled valley-bottom wetlands captured in the CBA delineation.

Sensitivity model applied to the vegetation on site

A sensitivity model was applied to the vegetation data for each of the six habitats (plant communities) on site. Overall, the wetlands were classified as having a high sensitivity (Habitat 7), the shallow soil (rocky sheet) grasslands (Habitat 1) and rocky grasslands (Habitat 3) were of medium sensitivity and the remainder of the habitats were classified as low sensitivity. The current site layout for the turbines avoided the sensitive habitats although Substation 1 (SS1) is located within a habitat of medium sensitivity (Habitat 1). Habitat 1 is home to *Gladiolus robertsoniae* and could potentially be suitable habitat for Sensitive species 691. Along the watercourses, buffers are applicable to the development. A buffer zone of 32 m is usually applied to drainage lines, but the aquatic specialists may apply wider buffer zones along these habitats. **We recommend that the buffer specifications of the aquatic specialist are followed for all drainage lines/channelled valley bottom wetlands and seeps.**

Screening Tool

The Site Sensitivity Verification Report is given in Appendix D.

Plant Species Theme

The Screening Tool rated the sensitivity of the Plant Species Theme as High and four species were highlighted as being of concern. None of the SCC highlighted by the Screening Tool were recorded on site during the vegetation survey. However, Sensitive species 691 is present at one location on site (MTPA data). The succulent *Khadia beswickii* (VU) was not recorded on site and the one location indicated by MTPA was to the south of the Impumelelo site. The geophyte *Gladiolus robertsoniae* (NT) was noted on the Impumelelo site during the survey and three other locations (4 records) on site were also provided by MTPA. One location (2 records) for *Kniphofia typhoides* (NT) is also indicated for the site (MTPA data). The Mpumalanga protected and red list plant species recorded on site include: *Aloe transvaalensis, Boophone disticha, Crinum bulbispermum, Eucomis autumnalis, Gladiolus crassifolius, Gladiolus dalenii, Gladiolus robertsoniae, Haemanthus* sp., *Hypoxis hemerocallidea, Khadia beswickii, Nerine gracilis, Huernia hystrix and Trachyandra erythrorhiza.*

Overall, the sensitivity of the plant species theme is rated as **medium.**

Animal Species Theme (bird and bat components excluded)

The Screening Tool rated the sensitivity of the Animal Species Theme as high. Animal species **(excluding avifauna)** highlighted by the screening tool for the region included *Crocidura maquassiensis, Hydrictis maculicollis*, *Ourebia ourebi ourebi* and *Lepidochrysops procera.* None of these species were listed in the MTPA database for the farms participating in the proposed Impumelelo WEF development. *Crocidura maquassiensis* was also not listed in the ADU mammal species list for the region or the MNCA (1998) lists for the Mpumalanga province. *Lepidochrysops procera* (Lepidoptera) was not listed in the ADU database, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops procera* was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was only recorded once in one localty. The Impumeleo site falls marginally within the distribution range of *Ourebia ourebi ourebi.*

The giant girdled lizard (*Smaug giganteus*), classified as Endangered in the NEMBA (2007c) ToPS list, is listed for the larger region on the ADU database, but was not highlighted by the Screening Tool nor listed in the MTPA database for the farms in the immediate vicinity of the Impumelelo site. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelo site. No individuals were recorded on site.

Overall, the sensitivity of the animal species theme **(bird and bat components excluded)** is rated as **medium.** If the suggested mitigation measures are followed the animal SCC should not be negatively affected by the development.

Relative Terrestrial Biodiversity Theme

The Screening Tool rated the sensitivity of the Relative Terrestrial Biodiversity Theme as Very High based on the presence of an Endangered and a Vulnerable ecosystem; CBAs; ESAs; and Protected Area Expansion Strategy (PAES). Our background study confirmed that the Soweto Highveld Grassland vegetation type on site is listed as Vulnerable and that the Tsakane Clay Grassland is listed as Endangered although the latter vegetation type covers a negligible portion of the site. Our background study confirmed the presence of CBAs on site. Turbines, construction sites and substations should not be located within the areas demarcated as CBA1s and preferably also not in CBA2s.

Environmental Impact Assessment

The direct, indirect and cumulative impacts of the proposed development on the Terrestrial Biodiversity and Species were assessed based on the knowledge gained during the site visit and literature review. Each of the impacts is briefly described in Chapter 13 in terms of the nature; proposed mitigation measures; and the significance of the

impact without and with the mitigation measures applied. The methodology follows the guidelines provided by the CSIR.

The key issues are that the site falls within a "Vulnerable" national vegetation type and that large parts of the site have been delineated as CBAs and ESAs as well as Priority Focus Areas (NPAES 2018). Infrastructure positioning should be modified/amended to avoid the CBA1s and preferably also the CBA2s. These sites must be re-located or micro-sited prior to approval of final layout. Preference should be given to heavily- or moderately modified areas to locate turbines.

Potential impacts identified during construction, operational and decommissioning phases

- The clearing of natural vegetation
- Construction of roads
- The loss of threatened, protected, CITES listed and/or endemic plants/animals
- Loss of faunal habitat
- Direct faunal mortalities due to construction and increased traffic
- Increased dust deposition
- Increased human activity, noise and light levels
- Establishment of alien vegetation
- Increased water run-off and erosion
- Changes in animal behaviour

Cumulative impacts

- Vegetation loss and habitat destruction
- Compromising integrity of CBAs, ESAs and NPAES
- Reduced ability to meet conservation obligations and targets
- Loss of landscape connectivity and disruption of broad-scale ecological processes

The impacts, mitigation measures, management objectives and actions as well as monitoring are discussed in Chapters 12 & 13 and also in the Environmental Management Programme (see Chapter 15).

Legislative and permit requirements

The most important permit requirement is the permit that needs to be obtained for the removal of plant species protected in Mpumalanga (MTPA). Legislative requirements also relate to the combatting of alien invasive species. Other aspects are summarised in Chapter 14, e.g. NEMBA (ToPS listed species) and CITES listed species.

Final specialist statement and authorisation recommendation

Our findings related to the Terrestrial Ecology and Species are the following:

Provided all mitigation measures and management actions, proposed to conserve protected fauna and flora on the site, are taken into consideration, and the positioning of infrastructure is amended to avoid CBAs and sensitive habitats, the low vegetation sensitivity rating for many of the habitats and low impact significance mean the project could go ahead provided all mitigation measures are implemented.

A brief summary of the most important considerations is provided below:

Vegetation and flora:

- **Screening Tool:** Vulnerable Sensitive species 691 was recorded at one location on site (MTPA data). The succulent *Khadia beswickii* (VU) was not recorded on site and the one location indicated by MTPA was to the south of the Impumelelo site.
- **Vegetation types:** The Soweto Highveld Grassland vegetation type is listed as "Vulnerable" and

consequently the layout of the wind infrastructure should give preference to the habitats on site where past disturbance has occurred e.g. disturbed areas, cultivated cropland or abandoned cropland. The Endangered Tsakane Clay Grassland covers a very small area on the western boundary of the site and although it falls within the Hartbeesfontein farm boundary, no WEF infrastructure has been planned for this small section.

- **Threatened plant species:** Vulnerable Sensitive species 691 was recorded at one location on site (MTPA data). *Khadia beswickii* occurs to the south of the site (MTPA data).
- **Near Threatened Species:** *Gladiolus robertsoniae* and *Kniphofia typhoides* occur on site.
- **Protected plant species:** No ToPS species or protected tree species were recorded on site. A number of other Mpumalanga protected species without a threatened IUCN status were recorded on site, many of these species are used medicinally and their populations are declining.
- **CITES:** Two CITES listed species occur on site, i.e. *Aloe transvaalensis* and *Euphorbia clavarioides.*
- **Habitats:** Four of the seven habitats on site had a low sensitivity rating with two habitats rated as of medium sensitivity (Habitat 1: grassland on shallow soil (rocky sheets) and Habitat 3: rocky grassland). The wetland habitat (Habitat 7) had a high sensitivity.
- **Overall sensitivity of plant species theme based on the assessment** was rated as **medium.** Nevertheless, infrastructure should avoid highly sensitive habitats and all CBA1s and preferably also CBA2s.

Fauna (avifaunal and bat component excluded):

- **Screening Tool:** The species that were highlighted by the Screening tool, included *Crocidura maquassiensis, Hydrictis maculicollis*, *Ourebia ourebi ourebi* and *Lepidochrysops procera.* None of these species were listed in the MTPA database for the farms participating in the proposed Impumelelo WEF development and none were encountered during the site visit. The spotted-necked otter (*Hydrictis maculicollis*), Maquassie musk shrew (*Crocidura maquassiensis*) and *Lepidochrysops procera* are also not listed on the ADU database for the region. The Impumelelo site falls marginally within the distribution range of *Ourebia ourebi ourebi.*
- **Threatened animal species:** The giant girdled lizard (*Smaug giganteus*), a reptile with a Vulnerable IUCN status occurs in the broader region. This species was however not highlighted by the Screening Tool and is not listed in the MTPA database for the region. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelelo site.
- **Near Threatened species:** Three Near Threatened mammal species are reported for the site according to the land owners, i.e. the serval *Leptailurus serval*; Southern African hedgehog *Atelerix frontalis* and the Southern African vlei rat *Otomys auratus*). None of these species were however highlighted by the Screening Tool as SCC.
- **Overall sensitivity of animal theme (avifaunal and bat component excluded):** This is rated as **medium.** If the suggested mitigation measures are followed the animal SCC should not be negatively affected.

Conservation:

- **Protected Areas:** The study area is not located in a protected area.
- **National Protected Areas Expansion Strategy (NPAES):** A large portion of the site is marked as 'Priority Focus Areas' in the NPAES (2018).
- **Mpumalanga Protected Areas Expansion Strategy (MPAES):** The site is earmarked in the 5- and 20-year plan of the Mpumalanga PAES.
- **Critical Biodiversity Areas (CBAs):** Thirteen of the 28 turbines, four of the five constructions sites and the two substations fall partly or entirely in CBA1s or CBA2s. These sites must be micro-sited prior to approval of final layout.
- **Ecological Support Areas (ESAs):** ESA Landscape corridors and ESA Local corridors occur within the boundary of the Impumelelo site and were mostly avoided in the current layout. Turbines are permissible in ESAs under certain conditions (MBSP 2014).

- **Other Natural Areas (ONAs):** Some ONAs were demarcated within the Impumelelo site, however turbines are permissible in ONAs under certain conditions subject to the appropriate authorisations (MBSP 2014).
- **Mpumalanga Highveld wetlands:** These wetlands were largely incorporated into the delineation of the CBAs (refer to aquatic specialist report for wetlands).

Ecological processes, function and drivers:

- Overall, it is unlikely that the development will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.
- The disturbance caused by the construction of the WEF will create conditions favourable for invasion by alien species.
- Fire is an important driver of vegetation dynamics in the Grassland Biome and can occur when the fuel load is high. To avoid damage to the infrastructure, fire will have to be suppressed. If the grass layer is regularly mowed/brush cut, it should prevent grasses from becoming moribund in the absence of fire although mowing or brushcutting would reduce seed set.
- Grasslands have evolved under the grazing pressure from large ungulates. Mesic Highveld Grasslands are reasonably well adapted to grazing pressure under low to moderate stocking rates with adequate rest periods. The WEF development will still allow livestock grazing.

Significance of environmental impacts:

Overall the significance of the environmental impacts was rated as low to medium. In summary:

- Since the development footprint is relatively small and spread across the site, the loss of prime habitat within the Soweto Highveld Grassland vegetation type can be constrained by well-planned positioning of the turbines.
- **From an ecological point of view**, large portions of the site have been heavily modified (compare CBA map) and are not prime examples of the Soweto Highveld Grassland. If the development is thus contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered in the allocation of a vulnerable status.
- The vegetation in the wetland habitat (Habitat 7) was rated as highly sensitive and Habitats 1 and 3 were rated as medium sensitive in the current assessment. Substation 1 (SS1, Figure 15) is located in a medium sensitive habitat and also in a CBA1 and should be relocated or microsited.
- Most of the habitats covered by the proposed infrastructure were rated as having a low vegetation sensitivity in the current assessment.
- Except for Sensitive species 691 no other SCC highlighted by the Screening Tool were encountered on site, thus if the potential habitat of Sensitive species 691 is avoided and all mitigation measures are applied, the impact on populations of Screening Tool species could be minimised.
- Depending on the type of fencing to be erected at some of the infrastructure, the WEF will contribute minimally to obstruction of animal movement.

Key environmental mitigation and management actions proposed

- Avoid all CBA1s and preferably also CBA2s.
- Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on species and habitats of conservation concern.
- Demarcate all infrastructure sites clearly to avoid unnecessary clearance of the vegetation.
- Avoid or minimise impacts that could potentially affect animal behaviour.
- Trenches should not be left open for long periods of time. Trenches should be inspected regularly for the presence of trapped animals.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns.

- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.
- Speed limits should be strictly adhered to.
- Dust control measures should be implemented.
- Permits have to be obtained for the removal of Mpumalanga protected species.
- Implement a monitoring program for the early detection of alien invasive plant species.
- Employ a control program to combat declared alien invasive plant species.

Preferred infrastructure locations

Access route:
The site can be accessed by the R547 and R23 roads and Boschmansfontein Rd. in the east.

Wind turbines:

- Nine of the 28 turbines are located in CBA1s (Figure 18). These sites must be re-located or micro-sited prior to approval of final layout.
- A further 4 turbines are located in CBA2s and one turbine in an ESA. The turbines in CBA2s should preferably be relocated or micro-sited. However, turbines in CBA2s and ESAs are permissible under certain conditions (MBSP 2014).
- No turbines were located in Mpumalanga Highveld Wetlands (Figure 19).
- The current layout of the wind turbines avoided the medium and high habitat sensitive areas on site (Figure 20).

On-site substations (SS1 & SS2):

- The two optional on-site substations fall within (or partly within) CBAs (Figure 18).
- The two optional on-site substations avoid wetlands (Figure 19).
- Substation 1 (SS1) falls within a habitat (Habitat 1) of medium sensitivity and is potential habitat for Sensitive species 691 and is habitat for *Gladiolus robertsoniae* (Figure 20).

Construction sites:

- Construction site 1 falls in a CBA1 (Figure 18).
- Construction site 2 falls in a CBA2 (Figure 18).
- Construction site 3 falls in a CBA2 (Figure 18).
- Construction site 4 falls in an ONA and partly in a CBA1 (Figure 18).
- Construction site 5 falls in a moderately modified area (Figure 18).
- All construction sites avoid wetlands (Figure 19).

Internal roads on site:

- The road network within CBA1s should be minimised.

SPECIALIST DECLARATION

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Appointment of specialist

Ekotrust cc was originally commissioned by CSIR (EMS) Stellenbosch to provide an assessment on the terrestrial biodiversity and species of the Impumelelo Wind Energy Facility, located to the south of Secunda in the Mpumalanga province. During 2022, WSP was appointed as the new EAP for the project.

Company profile:

Name of Company: Ekotrust cc
(Registration number: CK90/05465/23)
Sole Member: Dr Noel van Rooyen
Founding date: 1990

Ekotrust cc specialises in habitat evaluation, vegetation classification and mapping, veld condition assessment, carrying capacity, bush encroachment, fire management, floristic diversity assessments, rare species assessments, alien plant assessments, environmental impact assessments, wildlife management, wildlife production, wildlife numbers and ratios.

Specialist declaration

We, Noel van Rooyen and Gretel van Rooyen, as the appointed independent specialists, hereby declare that we:

- act as independent specialists in this application;
- 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;
- regard the information contained in this report, as it relates to our specialist input/study, to be objective, true and correct within the framework of assumptions and limitations;

- do not have and will not have any business, financial, personal or other interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations 2014, and amendments 2017; *Procedures for the assessment and minimum requirements 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, and any specific environmental management act (NEMA 2020);
- declare that there are no circumstances that may compromise our objectivity in performing such work;
- 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;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- undertake to disclose to the applicant and the competent authority all material information in our possession that reasonably has or may have the potential to influence any decision to be taken with respect to the application by the competent authority; or the objectivity of any report, plan or document to be prepared by us for submission to the competent authority;
- all the particulars furnished by us in this form are true and correct; and
- realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Indemnity and conditions relating to this report:

The observations, findings, recommendations and conclusions provided in the current report are based on the compilers' best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

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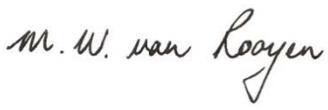
Signature of specialists:		
Name of specialists:	Dr N van Rooyen	Prof. MW van Rooyen
Date:	24 May 2023	24 May 2023

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ACRONYMS

AIS	Alien Invasive species
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CBD	Convention on Biodiversity
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and the Environment
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAr	Environmental Impact Assessment Report
EMPr	Environmental Management Plan Report
ESA	Ecological Support Area
IUCN	International Union for the Conservation of Nature
I&APs	Interested and Affected Parties
GIS	Geographical Information System
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act
MPHG	Mpumalanga Highveld Grassland
MTPA	Mpumalanga Tourism & Parks Agency
GIS	Geographical Information System
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NPAES	National Protected Area Expansion Strategy
ONA	Other Natural Areas
PA	Protected Area
PAES	Protected Area Expansion Strategy
SEA	Strategic Environmental Assessment
SANBI	South African National Biodiversity Institute
ToPS	Threatened and Protected Species
ToR	Terms of Reference
SEF	Solar Energy Facility
WEF	Wind Energy Facility

GLOSSARY

Alien invasive species	Any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health.
Alternative	A possible course of action, in place of another, that would meet the same purpose and need (of the proposal). Alternatives can refer to any of the following, but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.
Alluvium	Unconsolidated material deposited by flowing water
Biodiversity	The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. It includes diversity within species, between species and of ecosystems.
Category 1a Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as a species that must be combatted or eradicated. Landowners are obliged to take immediate steps to control Category 1a species in compliance with sections 75(1), (2) and (3) of the Act. If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must combat or eradicate the listed invasive species in accordance with such a programme.
Category 1b Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as species that must be controlled. If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such a programme.
Category 2 Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the Act as species that require a permit to carry out a restricted activity specified in the Notice or an area specified in the permit, as the case may be. Permit-holders must ensure that specimens of the species do not spread outside the area specified in the Notice or permit.
Category 3 Listed Invasive Species	A species listed by notice in terms of section 70(1)(a) of the act, as species that are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the Act, as specified in the Notice. However, a Category 3 Listed Invasive Species that occurs in riparian areas must be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.
Critical Biodiversity Areas	Areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species.
Critically Endangered species	Indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
Development	The building, erection, construction or establishment of a facility, structure or infrastructure, including associated earthworks or borrow pits, that is necessary for the undertaking of a listed or specified activity.
Development footprint	Any evidence of physical alteration as a result of the undertaking of any activity.
Ecological Support Areas	These are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of Protected Areas or CBAs and are often vital for delivering ecosystem services. ESAs must be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable.
Endangered species	Indigenous species facing a high risk of extinction in the wild in the near future, although they are not yet Critically Endangered species.
Habitat	A place where a species or ecological community occurs naturally.
Indigenous vegetation	Vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Indigenous	A species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic, but excludes a species that has been introduced in the Republic as a result of human activity.
Introduced	In relation to a species, means the introduction by humans, whether deliberately or accidentally, of a species to a place outside the natural range or natural dispersal potential of that species;
Linear activity	An activity that is arranged in or extending along one or more properties and which affects the environment or any aspect of the environment along the course of the activity, and includes railways, roads, canals, channels, funiculars, pipelines, conveyor belts, cableways, power lines, fences, runways, aircraft landing strips, firebreaks and telecommunication lines.
Mitigate	The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.
"No-Go" option	The “no-go” development alternative option assumes the site remains in its current state, i.e. there is no development in the proposed project area.
Schedules 1 – 4: Specially protected game, Protected game, Ordinary game and protected wild animals	Any species of wild animal specified in Schedule 1, 2, 3 & 4 of the Act (MNCA 1998).
Schedule 5: Wild animals	Provisions of Section 33 apply (MNCA 1998): No person shall import into the province, keep, possess, sell, purchase, donate or receive as a donation or convey a Schedule 5 live wild animal without a permit.
Schedule 6: Exotic animals	Provisions of Section 34 apply (MNCA 1998): No person shall keep, possess, sell, donate or receive as a donation or convey a Schedule 6 live exotic animal without a permit.
Schedule 7:Invertebrates	Provisions of Section 35(1) apply (MNCA 1998): No person shall collect, catch, kill, keep, purchase, sell, donate or receive as a donation, convey, import or export a Schedule 7 invertebrate without a permit.
Schedule 8: Problem Animal	An animal declared to be a problem animal listed in Schedule 8 of the Act (MNCA 1998).

Schedules 11 & 12: Protected plants and specially protected plants	Any species of flora specified in Schedules 11 and 12 of the Act (MNCA 1998).
Schedule 13: Invader weeds and plants	Any species of flora specified in Schedule 13 of the Act (MNCA 1998). No person shall possess, sell, purchase, donate or receive as a donation, convey, import or cultivate a Schedule 13 declared invader weed or plant without a permit.
Vulnerable species	Indigenous species facing a high risk of extinction in the wild in the medium-term future, although they are not Critically Endangered species or an Endangered species.
Watercourse	Includes (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, pan, lake or dam into which, or from which, water flows; and a reference to a watercourse includes, where relevant, its bed and banks.
Wetland	Land that 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 typically adapted to life in saturated soil.

GENERAL INFORMATION

Study site: Impumelelo Wind Energy Facility: Farms (or portions) of the farms Platkop 543 IR, Hartbeesfontein 522 IR and Mahemsfontein 544 IR.

Client: ENERTRAG South Africa (Pty) Ltd

Approximate size of property: 2840 ha

Environmental Assessment Practitioner (EAP):

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Terrestrial Biodiversity and Species Assessment by:

This specialist assessment was undertaken by Dr Noel van Rooyen and Prof. Gretel van Rooyen of Ekotrust cc. The *curriculum vitae* of the specialists are included in Appendix F of this assessment.

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TERMS OF REFERENCE

The Scope of Work for the terrestrial biodiversity and ecology specialist study includes the following tasks:

- Compilation of a specialist study in adherence to:
  - the gazetted '*Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Terrestrial Biodiversity' (GG 43110 / GN R320, 20 March 2020)* (NEMA 2020a). Note that this protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations, as amended.
  - any additional relevant legislation and guidelines that may be deemed necessary.
- The assessment should be based on existing information, national and provincial databases, SANBI mapping, professional experience and field work conducted.
- Undertake a site inspection to identify the site sensitivities, and verify them in terms of the DFFE Screening Tool (https://screening.environment.gov.za/).
- If needed, liaise with the South African National Biodiversity Institute (SANBI) to obtain information on sensitive species flagged in the DFFE Screening Tool (where species names are obscured / only numbered).
- Describe the terrestrial ecological features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora and fauna), Species of Conservation Concern (SCC) or Protected Species.
- If applicable, specify development set-backs/buffers, and provide clear reasons for these recommendations.
- Map the sensitive ecological features within the proposed project area, showing any "no-go" areas (i.e. "very high" sensitivity).
- Provide input on the preferred infrastructure locations following the sensitivity analysis.
- Provide sensitive features spatial data in a useable GIS format (.kmz /.shp).
- Provide an assessment of direct, indirect and cumulative impacts associated with the proposed WEF, with and without mitigation.
- Address relevant concerns/comments raised by Interested and Affected Parties and Stakeholders, including the Competent Authority, during Public Participation Processes.
- Identify relevant legislative requirements and permits that may be required.
- Recommend mitigation measures, best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts to be included in the Environmental Management Programme (EMPr).
- Update the draft specialist study report after Environmental Assessment Practitioner (EAP) and client review (before public release) and after public review for submission to the Competent Authority for decision-making.
- Address any queries from the Competent Authority during the decision-making phase.

STATEMENTS, LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

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

- The area has been moderately collected in the past and the list of plant species that could potentially occur on site as obtained from the NewPosa database, is thus considered to provide a fair representation of the flora on site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species. Information on rare and threatened plant and animal species was supplemented by data provided by MTPA on localities of such species at farm level.
- Rare plant species usually occur in specialised and localised habitats, thus special attention was given to these habitats.
- The site visit was undertaken in December 2021 after the region had received good rains, thus the botanical assessment was conducted under favourable conditions. Fieldwork therefore fell within the recommended ideal survey time for the Grassland biome (October to March) as described in the 'Species Environmental Assessment Guideline (SANBI, 2020). However, the timing was not ideal for spotting sensitive species 691 (VU), nor *Kniphofia typhoides* (NT) both of which flower from February onwards.
- No aerial census, road census or trapping (either camera trapping or by way of Sherman traps) was conducted for fauna, since these methods generally provide an underrepresentation of the full faunal diversity within the limited timeframe available. Faunal lists were sourced from literature and the website of the Animal Demography Unit of the University of Cape Town.

1. INTRODUCTION

Impumelelo Wind (Pty) Ltd (Registration number 2022/601923/07) proposes to develop the Impumelelo Wind Energy Facility (up to 200 MW) and its associated infrastructure near Secunda in Mpumalanga. Site access will be from the east via the R547 (R23) Road and Boschmansfontein Road.

The proposed Impumelelo Wind Energy Facility (WEF) and associated infrastructure include the following components:

- Twenty-eight wind turbine generators (WTGs) with a maximum capacity of up to 200 MW.
- Turbines with a hub height of up to 200 m and a rotor diameter of up to 200 m.
- Excavation areas of approximately 1 000 m^2 per turbine with foundation of approximately 500 – 650 m^3 concrete.
- Temporary laydown area of approximately 2.2 to 3 ha.
- Construction camp laydown area of about 0.5 ha.
- Operations and Maintenance (O&M) buildings footprint covering 500 m^2 . Septic tanks with portable toilets.
- Medium voltage cabling up to 33 kV connecting the turbines will be laid underground except where overhead lines are required.
- Sixty kilometers of internal roads with a width of up to 6 m providing access to each turbine, the BESS, on-site substation, step-down substation and laydown area. The roads will include turning circles/bypass areas of up to 20 m at some sections during the construction phase.
- A Lithium-ion Battery Energy Storage System (BESS) covering 5 ha with a capacity of up to 200MW/800 MWh.
- An Independent Power Producer site substation (IPP) covering 1.5 ha will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads and other substation components as required.

Scoping and Environmental Impact Assessment processes are required for the proposed development of the Impumelelo WEF. As required in Part A of the Government Gazette 43110, GN 320 (20 March 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area.

This report presents the Specialist Terrestrial Biodiversity and Species Impact Assessment Report of the proposed Impumelelo project. The scope, purpose and objectives of the report have been summarised in the ToR.

2. APPROACH AND METHODOLOGY

2.1 Approach

The study commenced as a desktop study, followed by field-based surveys in December 2021. October to March is the main rainy season when about 86% of the annual rainfall occurs, thus the site visit was conducted under favourable conditions. However, the timing was not ideal for spotting Sensitive species 691 (VU), nor *Kniphofia typhoides* (NT) both of which flower from February onwards.

The focus of the site visit was:

- to undertake a site sensitivity verification in order to confirm the current land use and environmental sensitivity as identified in the screening tool; and
- to conduct surveys (fauna and flora) of the Impumelelo site to identify sensitive habitats, to classify the vegetation into habitats (or plant communities), compile species lists and to search for Species of Conservation Concern (SCC). According to SANBI's (SANBI 2022) definition of SCC, these are species that have a high conservation importance in terms of preserving South Africa's high floristic and faunal diversity and include not only threatened species, but also those classified as Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining, Data Deficient - Insufficient Information (DDD) and Data Deficient – Taxonomic (DDT) (www.redlist.SANBI.org).

Hard copy and digital information from spatial databases, such as BGIS of the South African Biodiversity Institute (SANBI) for maps of Critical Biodiversity Areas, Protected Areas, Mpumalanga Highveld Wetlands, Nationally Protected Area Expansion Strategy (NPAES), MBSP Terrestrial assessment (MTPA 2022); Freshwater Ecosystem Priority Areas (FEPA); the geological survey maps (2628 East Rand); land type maps (2628 East Rand); topocadastral maps (2629CA SECUNDA, 2629CB BAANBREKER, 2628DB WILLEMSDAL 1:50 000 maps); vegetation types of SANBI (2006 – 2018); NewPosa database of SANBI; and databases of the Animal Demography Unit, University of Cape Town, as well as literature were sourced to provide information on the environment and biodiversity of the study area.

Satellite images (Google Earth) were used to stratify the area into relatively homogeneous terrain/vegetation units. The vegetation survey consisted of visiting the mapped units and systematically recording plant species on site, and estimating their canopy cover. A total of 20 sample plots were surveyed on the Impumelelo site. However, a further 60 sample plots were surveyed on the Vhuvhili and Mukondeleli sites in the nearby region and the total of 80 sample plots were used to compile a differential table (Appendix A) to identify the habitats (or plant communities) in the region. Physical habitat features were also noted. During the site visit, digital photographs were taken and representative photographs of the different habitats are included in the report. The site was also surveyed for rare, threatened, protected and/or endemic plant species during the site visit.

The animal site survey was limited to day-time visual assessments on site. Animal species presence on site was mainly attained by means of direct or indirect sighting methods (animals, spoor, burrows, scats, sounds), whilst traversing the site by vehicle or on foot. Red-listed species are generally uncommon and/or localised and the survey may have been insufficient to record their presence at or near the proposed development. Furthermore, the owners of the participating farms were consulted regarding sightings of especially mammal species on the properties. **Please note the avifauna and bats were assessed in the avifaunal and bat specialist assessments and are not part of the current report.**

2.2 Vegetation and flora

The plant species data were summarised in a phytosociological table (Appendix A) and seven habitats (or plant communities) and a further four habitats were identified, described and mapped.

The term species is used here in a general sense to denote species, subspecies and varieties. The checklist of plant species in Appendix B was compiled from the NewPosa database of the South African National Biodiversity Institute (newposa.sanbi.org) and supplemented by lists of rare species of the Mpumalanga Tourism & Parks Agency and own observations during the vegetation surveys. The IUCN status, conservation and protected status of all plant species provided in Appendix B were determined from available literature and Acts, e.g. NewPosa database (newposa.sanbi.org), and Red list database (redlist.sanbi.org) of the South African National Biodiversity Institute; NEM:BA (2007c) (ToPS list); NFA (2023), CITES (2023) and the MNCA (1998).

2.3 Fauna

Species lists (the term species is used here in a general sense to denote species, subspecies and varieties) of the faunal component were sourced from the Animal Demography Unit, University of Cape Town website (www.adu.uct.ac.za) and consulting of other available databases and/or relevant literature, e.g. Leeming (2003), Skinner and Chimimba (2005), Alexander and Marais (2007), Mecenero *et al.* (2013), Bates *et al.* (2014), Child *et al.* (2016), MNCA (1998) lists and DEA (2016a) to determine the diversity, conservation status and distribution of relevant faunal species (Appendix C). These species lists were supplemented by own observations and observations by the landowners.

2.4 Sensitivity assessment

Based on the environmental features and the species encountered in the on-site survey, a sensitivity assessment of each plant community (habitat) was done (Chapter 10). Sensitive features are presented spatially in GIS format (provided as a separate .kmz file).

2.5 Sources of information

Vegetation:

- Vegetation types occurring in the area were obtained from Mucina & Rutherford (2006) and the revised national vegetation map produced by SANBI in 2018 (SANBI 2006-2018).
- Conservation status of the vegetation types was obtained from Mucina & Rutherford (2006) and the National List of Threatened Ecosystems (NEMA 2011, SANBI 2019).
- Information on species endemic to a national vegetation type was obtained from Mucina & Rutherford (2006);
- The Impumelelo WEF does not occur in any Centre of Plant Endemism (Van Wyk & Smith 2001).
- A plant species checklist of the immediate region around the site (2628DB, 2629CA & 2629CB grids) was obtained from the NewPosa database of the South African National Biodiversity Institute (SANBI) (Appendix B).
- The IUCN Red List Categories of the plant species were extracted from the Threatened Species Programme (Red List of South African plants) as well as the NewPosa database of the South African National Biodiversity Institute (SANBI).
- The MNCA (1998) and Mpumalanga Biodiversity Sector Plan (MBSP 2014) were consulted to establish

provincially specially protected and protected status of plant species including the rare plant species at the Impumelelo site. The exact locations of certain SCC were provided by MTPA in 2023.
- The National Protected tree list (NFA 2023) was consulted.
- **The wetland component is reported on separately (see aquatic specialist report).**

Fauna

- Lists of mammals, reptiles, frogs, butterflies (Lepidoptera), spiders and scorpions were extracted from the Animal Demography Unit, University of Cape Town website (http://vmus.adu.org.za) and supplemented by information gathered in Skinner & Chimimba (2005) for mammals; Bates *et al*. (2014) for reptiles; and Mecenero *et al.* (2013) for butterflies (Appendix C).
- Lists extracted from the MTPA database for the farms participating in the proposed Impumelelo WEF development (MTPA) were consulted.
- The IUCN Red List Categories for the animal species were extracted from Child *et al.* (2016) for mammals; Bates *et al*. (2014) for reptiles; and Mecenero *et al.* (2013) for butterflies. No IUCN Categories are however available for spiders and scorpions.
- Data provided by MTPA were consulted to establish the provincially specially protected and protected status of animal species.
- **The avifauna and bat component is reported on separately (see avifaunal and bat specialist reports).**

Other

- The Mpumalanga Biodiversity Sector Plan (MBSP 2014) was consulted for maps indicating CBAs and ESAs in the region of the Impumelelo site (updated MBSPTerrestrial 2022 map provided by MTPA).
- The National Protected Areas Expansion Strategy (NPAES 2018) was consulted for possible inclusion of the site into a protected area in future (DFFE, EGIS).
- The 5-year and 20 year plan of the Mpumalanga PAES was consulted (data supplied by MTPA).
- NFEPA database (2011) was consulted for inclusion of the site in a Freshwater Ecosystem Priority Area and MPHG Wetlands database (2014) was consulted for Mpumalanga Highveld Wetlands on site (biodiversityadvisor.sanbi.org).

Regulatory framework

This report has been prepared in terms of the Environmental Impact Assessment (EIA) Regulations under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017) and the gazetted '*Procedures for the assessment and minimum criteria for reporting on identified environmental themes* (Government Gazette 43110, No. 320, 20 March 2020 (NEMA 2020a).

3. REGULATORY FRAMEWORK

3.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the National Environmental Management Act (Act No. 107 of 1998) specifies that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development.

3.2 Natural resources

Terrestrial and other ecosystems and their associated species are widely used for commercial, semi-commercial and subsistence purposes through both formal and informal markets. While some of this use is well managed and/or sustainable, much is thought to be unsustainable. "Use" in this case refers to direct use, such as collecting, harvesting, hunting and fishing for human consumption and production, as well as more indirect use such as ecotourism and wildlife ranching.

3.3 Convention on Biodiversity (CBD)

South Africa is a signatory to the United Nations Convention on Biological Diversity (CBD), which was ratified in 1995. The CBD requires signatory states to implement the objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources; and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

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

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or well-being. It is administered by the Department of Forestry, Fisheries and the Environment (DFFE), but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

The EIA Regulations Listing Notices of 2010 were repealed in 2014 and amended regulations and listings were published in 2014 and 2017 under the National Environmental Management Act (NEMA 2014, 2017). Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324) of the 2017 Regulations list activities that may require Environmental Authorisation prior to commencement of an activity and identify competent authorities in terms of sections 24(2) and 24D of the Act.

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 NEMA 1998, when applying for Environmental Authorisation were published in the Government Gazette 43110, No. 320, 20 March 2020 and Government Gazette 43855, No. 1150, 30 October 2020).

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

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DFFE, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term 'biodiversity', according to the Convention on Biodiversity (CBD), refers to 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 part; this includes diversity in genes, species and ecosystems.

Threatened ecosystems
Section 53 of NEM:BA lists the threatened status of ecosystems, i.e. Critically Endangered ecosystems, Endangered ecosystems, and Vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA 2011). The 2018 National Biodiversity Assessment (SANBI 2019) includes the updated extent and status of threatened ecosystems, although not yet formally adopted under the NEM:BA.

Threatened or Protected Species (ToPS) Regulations
Section 56 of NEM:BA makes provision for the declaration of species which are of such high conservation value, national importance or are considered threatened that they need protection, i.e. Critically Endangered species, Endangered species and Vulnerable species. Lists of species that are threatened or protected, and associated activities that are prohibited and/or exempted from restriction were published in 2007 (NEMBA 2007c). Any proposed development involving one or more threatened or protected species and/or prohibited/restricted activities will require a permit in term of these Threatened or Protected Species (ToPS) Regulations.

Alien and Invasive Species (AIS) Regulations
Chapter 5 of NEM:BA provides for the protection of biodiversity from alien and invasive species. The act defines alien species and provides lists of invasive species in regulations. The Alien and Invasive Species (AIS) lists were published in Government Gazette No. 43726 of 18 September 2020 (NEM:BA 2020a). The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was subsequently published in Government Gazette No. 43735 of 25 September 2020 (NEM:BA 2020b).

In terms of the aforementioned legislation, the following categories of declared alien and invasive plants are recognised in South Africa (see Glossary for explanations):

1. Category 1a Listed Invasive Species
2. Category 1b Listed Invasive Species
3. Category 2 Listed Invasive Species
4. Category 3 Listed Invasive Species

3.6 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA)

NEM:PAA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

3.7 National Forests Act (Act No. 84 of 1998) (NFA)

The National Forest Act makes provision for the declaration of for example specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. The latest list of declared protected tree species in terms of the NFA was published in 2023 (NFA 2023). In terms of section 15(1) of this act, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. The competent authority responsible for considering and issuing the license will be the national Department of Forestry, Fisheries and the Environment (DFFE).

3.8 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

The objectives of the Conservation of Agricultural Resources Act are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land; by combating and preventing erosion and weakening or destruction of the water resources; and by protecting natural vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed to which land users must comply. The activities mentioned relate to:

- the cultivation of virgin soil;
- the irrigation of land;
- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes and watercourses;
- the regulation of the flow pattern of run-off water;
- the utilisation and protection of vegetation; and
- the restoration or reclamation of eroded land.

3.9 Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international agreement to which countries adhere voluntarily. The aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed in three appendices reflecting the degree of protection that the species needs. Appendix I includes species that are threatened with extinction and trade in these species is permitted only in exceptional circumstances. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III lists species that are protected in at least one country that has asked other CITES parties for assistance in controlling the trade (Website: www.cites.org).

4. STUDY AREA

4.1 Location

The Impumelelo site covers an area of approximately 2840 ha and is located northeast of Greylingstad on the farms (or portions of) Platkop 543 IR, Hartbeesfontein 522 IR and Mahemsfontein 544 IR (Figures 1 & 2). The area falls within the Gert Sibande District Municipality and Dipaleseng Local Municipality in the Mpumalanga province. The central part of the site is located at 26° 39' 52.8" S; 28° 50' 57.0" E.

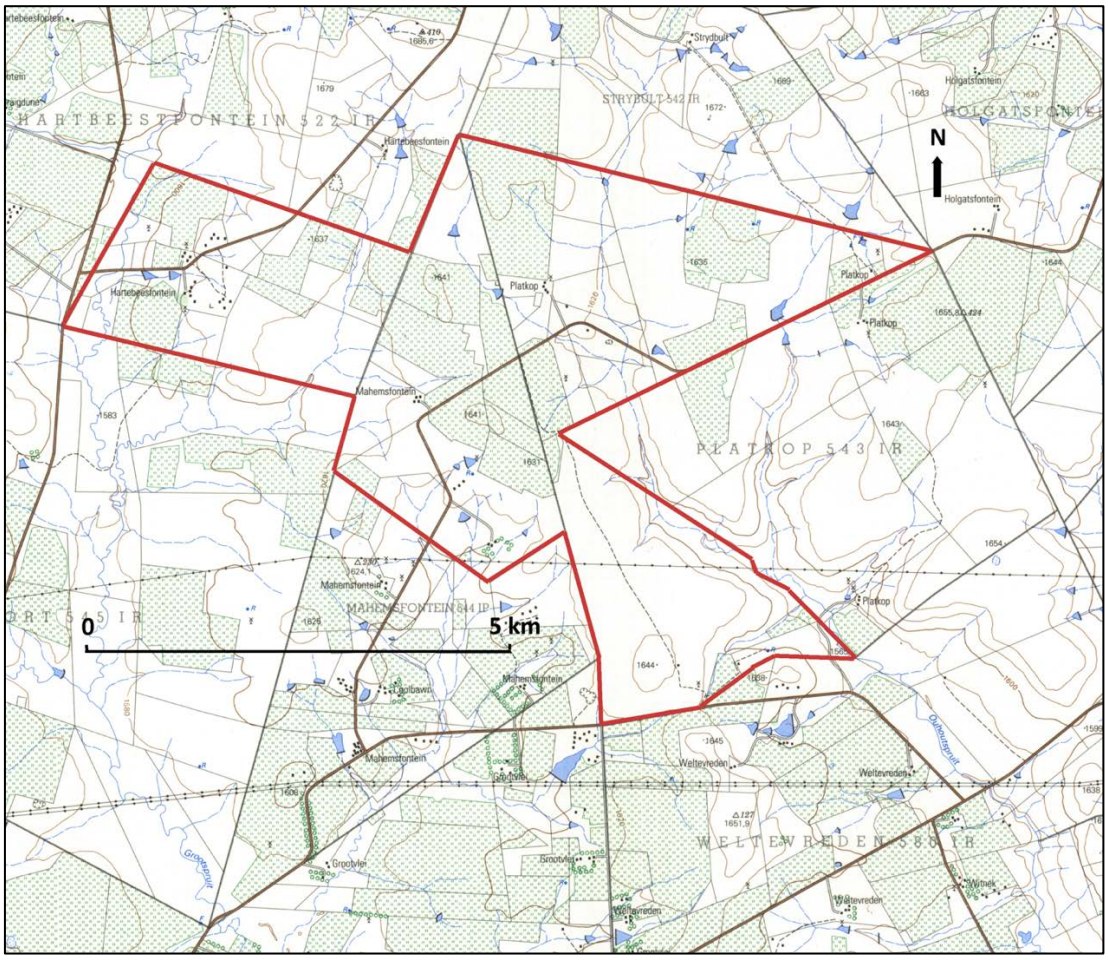


Figure 1: Topocadastral map of the Impumelelo site (2628DB Willemsdal 1996).

4.2 Terrain morphology and drainage

The site is characterised by grassland on gently undulating plains. Altitude ranges from about 1600 m in the west along the Grootspruit to approximately 1640 m in the northeast of the site (Figure 1). The site is drained from north to south by the Grootspruit and its tributaries in the west and the Ouhoutspruit and its tributaries in the east.

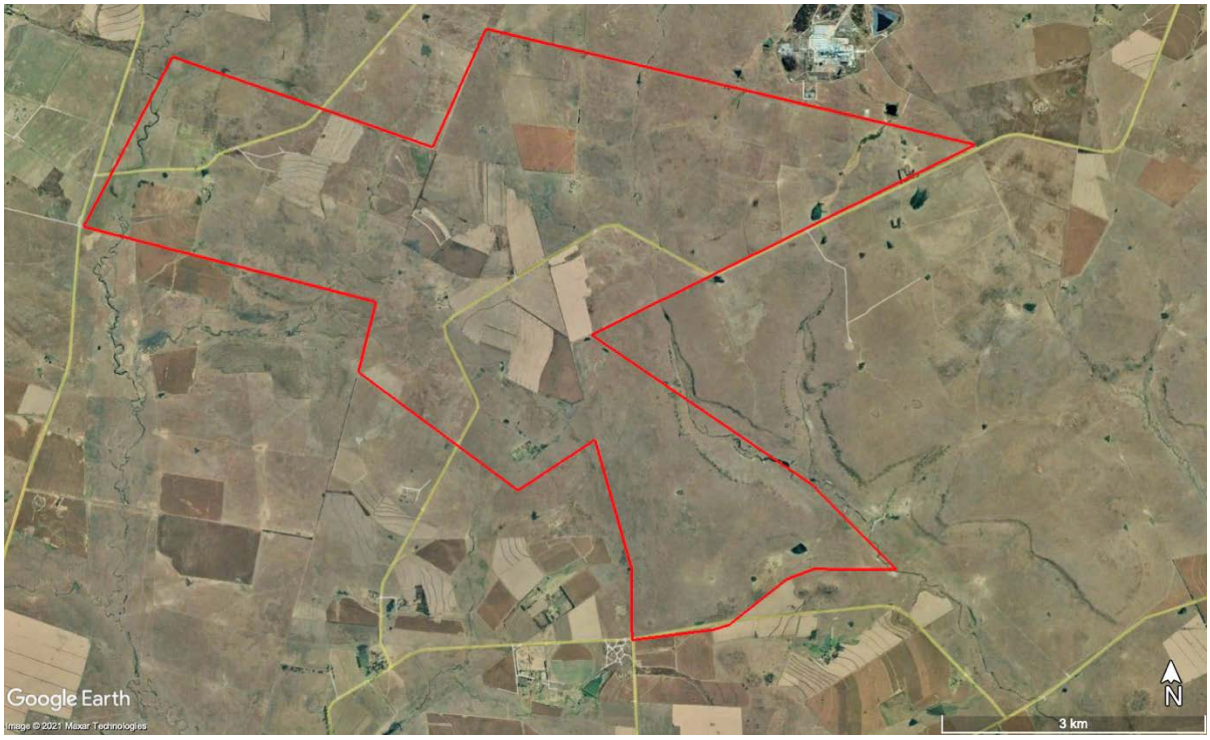


Figure 2: Google image of the Impumelelo site.

4.3 Climate

4.3.1 Regional climate (Mucina & Rutherford 2006)

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

4.3.2 Rainfall

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

Table 1: Rainfall at some weather stations in the general environs of the Impumelelo site (Weather Bureau 1998)

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

Table 2: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Secunda: 26° 30’ S; 29° 11’ E; 1628 m (Weather Bureau 1998)

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

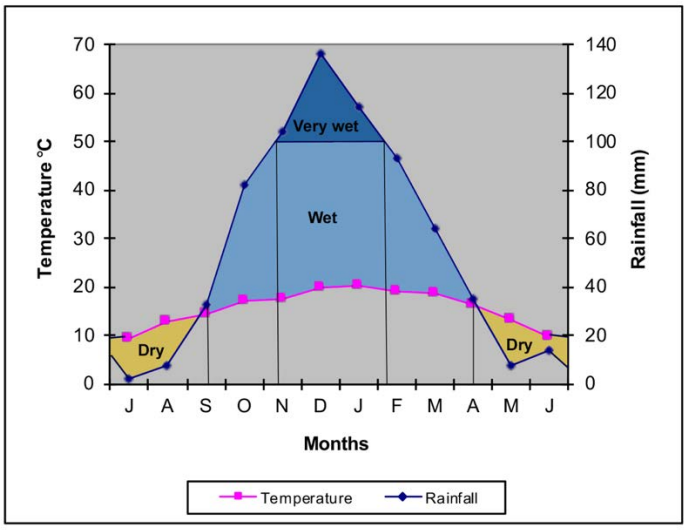


Figure 3: Climate diagram for the Secunda region. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve, it indicates a dry period and when the monthly rainfall is higher than 100 mm, it indicates a very wet period.

4.3.3 Temperature

The mean annual temperature for Secunda is 15.8°C (Table 3) with the extreme maximum and minimum temperatures 33.0°C and -4.3°C respectively. The mean daily maximum for January is 27.2°C and for July it is 18.1°C, whereas the mean daily minimum for January is 13.5°C and for July it is 0.9°C. Frost may occur anytime from April to October.

Table 3: Temperature data (°C) for the Secunda region: 26° 30' S; 29° 11' E; 1628 m (Weather Bureau 1998)

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

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

4.3.4 Cloudiness and relative air humidity

At Bethal weather station, located about 25 km east of Secunda, the cloud cover at 14:00 is the highest from November to January (5.1 – 5.3 eights) and the lowest in June, July and August (1.5 – 1.9 eights) (Table 4). The highest mean relative air humidity (%) at 08:00 occurs during the late summer and autumn months (February to April; 83 – 84%) and the lowest relative air humidity at 14:00 (31%) occurs in early spring (August) (Weather Bureau 1998).

Table 4: Cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Bethal: 26° 27' S; 29° 29' E; 1663 m (Weather Bureau 1998)

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

4.4 Geology

The geology of the site is depicted in the 1:250 000 geological map 2626 East Rand (1986) (Figure 4). Most of the site is underlain by dolerite with some areas in the west and southeast covered by sandstone, shale and coal beds

of the Vryheid Formation, Ecca Group. Alluvium occurs along the drainage lines.

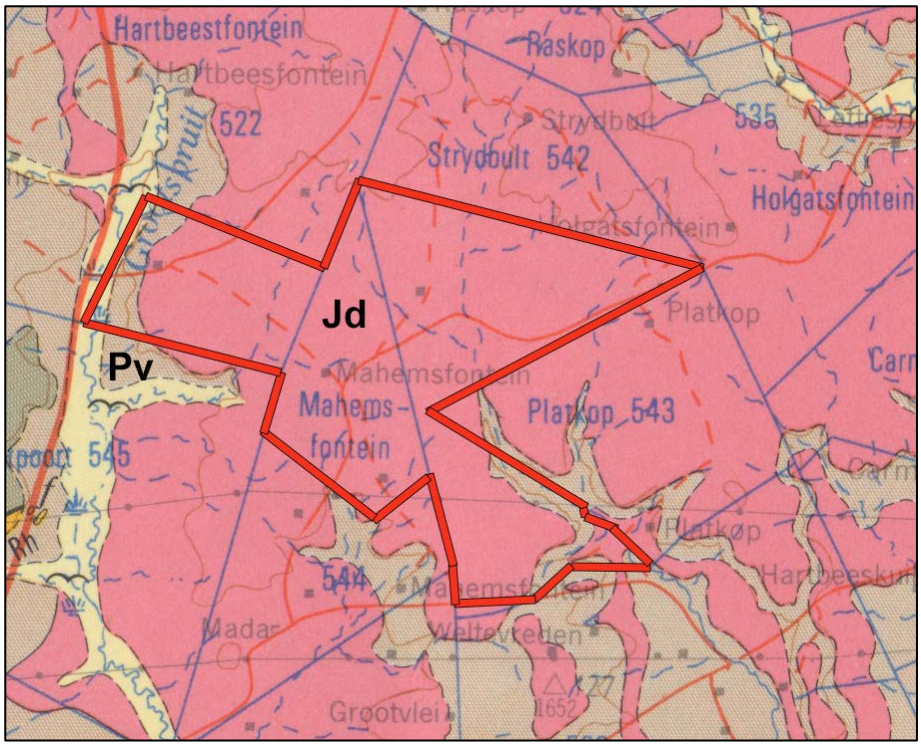


Figure 4. Geology of the Impumelelo site (2628 East Rand Geological Survey 1986).

Legend:
Jd = Dolerite
Pv = Sandstone, shale and coal beds (Vryheid Formation, Ecca Group)
Yellow = Alluvium

4.5 Land types

Land types denote areas that display a marked degree of uniformity with respect to terrain form, soil pattern and climate. A terrain unit within a land type is any part of the land surface with homogeneous form and slope. The site is covered by the Ea 20b Land Type (2628 East Rand Land Type Series 1979) which occurs on undifferentiated soil and consists of one or more vertic, melanic or red structured diagnostic horizons.

5. VEGETATION

5.1 Introduction

The site falls in the Grassland Biome and more specifically in the Mesic Highveld Grassland Bioregion. The site does not fall within any Centre of Plant Endemism according to Van Wyk and Smith (2001).

5.2 Broad-scale vegetation types

Soweto Highveld Grassland (Gm 8)

The Impumelelo site is located predominantly within the Soweto Highveld Grassland (Gm8) vegetation type (SANBI 2006-2018) (Figure 5). This vegetation type covers 14 513 km^2 of Mpumalanga and Gauteng (and to a very small extent also in the neighbouring Free State and North-West provinces) and occurs at an altitude ranging from 1420 m to 1760 m above sea level (Mucina & Rutherford 2006).

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

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

Although the conservation status of this vegetation type was listed as “Endangered” by Mucina & Rutherford (2006) it is listed as “Vulnerable” by NEMA (2011) and the National Biodiversity Assessment (SANBI 2019). Very few statutorily conserved areas occur in this vegetation type and almost half of it has been transformed mostly by cultivation, plantations, mining and urbanisation.

Tsakane Clay Grassland (Gm9)

This vegetation type covers a very small section of the Impumelelo site in the west (Figure 5). The vegetation type covers 1284 km^2 of Gauteng and Mpumalanga provinces in a landscape that is flat to slightly undulating with low hills. The short dense grassland is dominated by a mixture of common highveld grasses such as *Themeda triandra, Heteropogon contortus, Elionurus muticus* and a number of *Eragrostis* species. Other prominent grass species include *Brachiaria serrata, Cynodon dactylon, Hyparrhenia hirta, Microchloa caffra, Setaria sphacelata* and *Trachypogon spicatus*. The forb layer is characterised by *Ajuga ophrydis, Abildgaardia ovata, Helichrysum nudifolium, Helichrysum rugulosum, Hermannia depressa, Senecio coronatus* and *Nidorella hottentotica*.

The conservation status is listed as “Endangered” because more than 60% of the vegetation type has been transformed by cultivation, roads, plantations, mining, dam-building and urbanisation. The vegetation type is poorly protected with 4.7% conserved in statutory nature reserves (SANBI 2019).

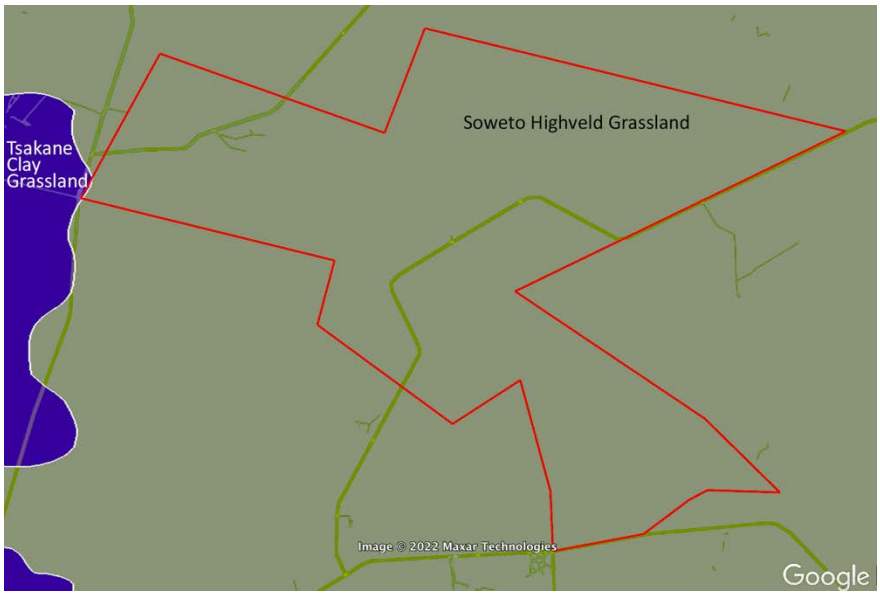


Figure 5. The site (red boundary line) is located mainly in the Soweto Highveld Grassland vegetation type.

5.3 Description of habitats (plant communities)

During the field survey, 20 sampling sites were surveyed at the proposed Impumelelo WEF. However, a further 60 sample plots were surveyed on the Vhuvhili and Mukondeleli sites in close proximity and the total of 80 sample plots were used to improve the identification and description of habitat types in the area. Based on species composition, seven habitats (plant communities) were distinguished, described and mapped on the Impumelelo site (Figure 6). A further four units were also distinguished, i.e. croplands, infrastructure, disturbed areas and dams.

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

1. *Euryops laxus - Microchloa caffra* grassland on shallow soils
2. *Elionurus muticus - Aristida diffusa* rocky grassland
3. *Diospyros lycioides - Tristachya biseriata - Ajuga ophrydis* rocky grassland
4. *Themeda triandra - Eragrostis chloromelas - Helichrysum pilosellum* natural grassland
5. *Eragrostis curvula - Hyparrhenia hirta* disturbed grassland
6. *Digitaria eriantha/Eragrostis curvula* planted pasture
7. *Trisetopsis imberbis - Crinum bulbispermum* wetlands
    - 7a. *Trisetopsis imberbis - Leersia hexandra* wetlands
    - 7b. *Andropogon appendiculatus - Cyperus longus* wetlands
    - 7c. *Typha capensis - Phragmites australis* wetlands
8. Cropland
9. Infrastructure
10. Disturbed areas
11. Dams

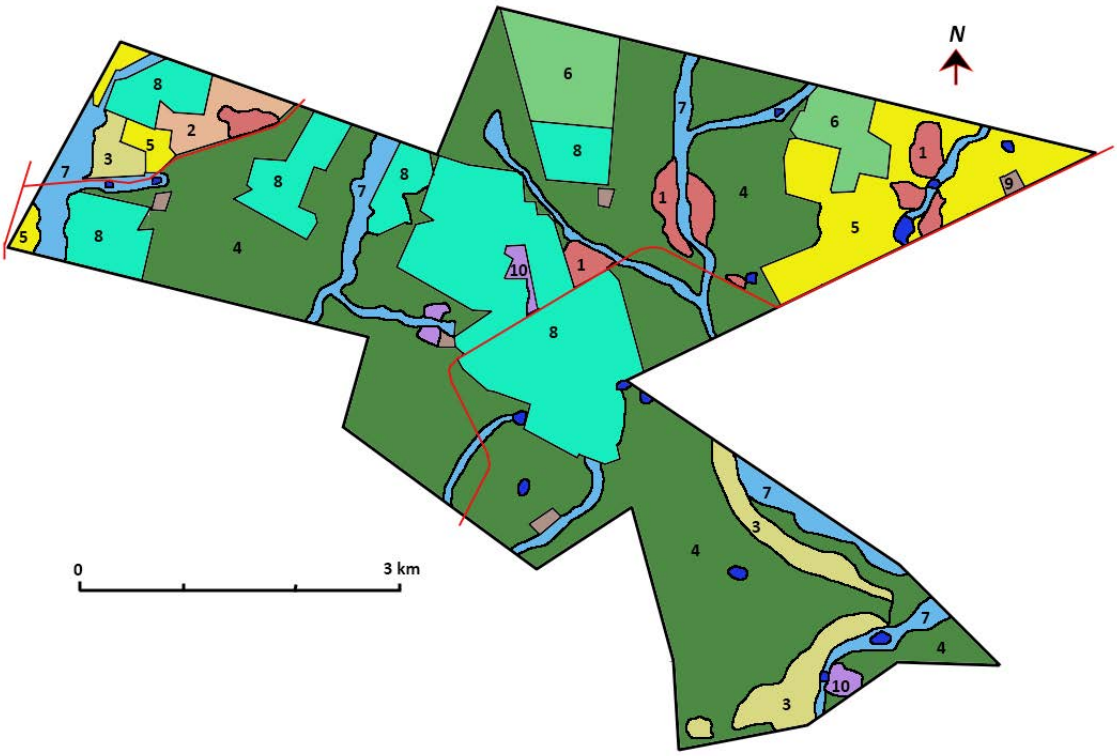
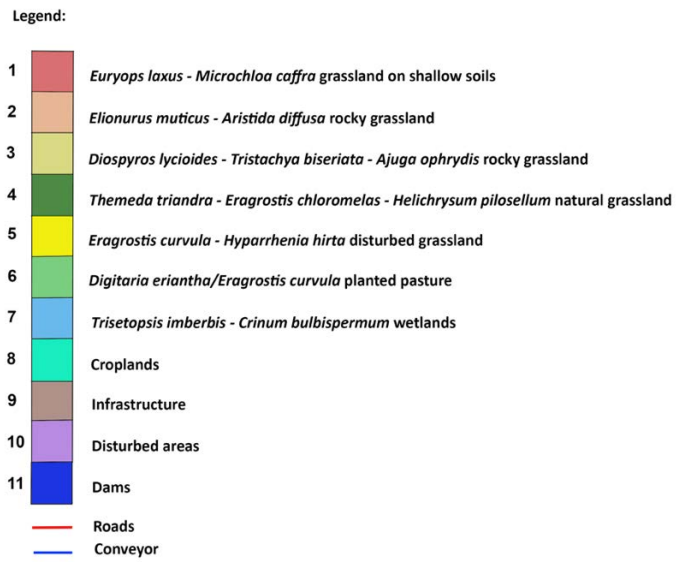


Figure 6. Vegetation map of the Impumelelo site.



Habitat 1. *Euryops laxus - Microchloa caffra* grassland on shallow soils

This rocky grassland occurs on the plains in the central, northwestern and northeastern parts of the Impumelelo site (Figures 6 & 7). It occurs on shallow soils on rocky sheets. Surface rocks and gravel cover up to 50% of the area. The shallow, dark-brown to black, clayey soils are derived from dolerite.

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

The diagnostic species of this habitat (community) include *Euryops laxus, Microchloa caffra, Dipcadi ciliare, Panicum repens, Jamesbrittenia stricta, Colchicum striatum, Huernia hystrix* and *Oropetium capense* (species group 1, Appendix A).

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

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

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

Habitat 2. *Elionurus muticus - Aristida diffusa* rocky grassland

This rocky grassland covers a small area in the western part of the Impumelelo site (Figures 6 & 8). Surface rocks and gravel cover up to 30% of the area. The shallow to intermediate deep, dark-brown, clayey soils are derived from dolerite.

Figure 8: Community 2: *Elionurus muticus - Aristida diffusa* rocky grassland.

The diagnostic species of this habitat (community) include *Melinis repens* and *Kohautia amatymbica* (species group 2, Appendix A).

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

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

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

Habitat 3. *Diospyros lycioides - Tristachya biseriata - Ajuga ophrydis* rocky grassland

This rocky grassland occurs on the slopes and ridges in the southern part of the site and in the western part of the Impumelelo site (Figures 6 & 9). Surface rocks and gravel cover up to 50% of the area. The shallow to intermediate deep, dark-brown, clayey soils are derived from dolerite.

Figure 9: Community 3: *Diospyros lycioides - Tristachya biseriata - Ajuga ophrydis* rocky grassland.

The diagnostic species of this habitat (community) include *Diospyros lycioides, Ajuga ophrydis, Tephrosia capensis, Acalypha angustata, Tristachya biseriata* and *Erythrina zeyheri* (species group 4, Appendix A).

- Shrubs cover on average 3% of the area and the most prominent species are *Diospyros lycioides, Searsia magalismontana* and *Searsia rigida*.
- Dwarf shrubs cover 2% of the habitat and include *Artemisia afra, Erythrina zeyheri, Ziziphus zeyheriana, Asparagus cooperi* and *Athrixia elata.*
- The grass layer is well developed and covers approximately 81% of the area. The dominant grass species are *Eragrostis chloromelas, Themeda triandra, Setaria incrassata, Setaria nigrirostris, Brachiaria serrata* and *Setaria sphacelata*. Other common grass species include *Tristachya biseriata, Hyparrhenia hirta, Eragrostis curvula* and *Cynodon dactylon.*
- Herbaceous species have a mean canopy cover of approximately 11%. The most common species include *Ajuga ophrydis, Tephrosia capensis, Acalypha angustata, Senecio othonniflorus, Dianthus mooiensis, Scabiosa columbaria, Helichrysum rugulosum, Berkheya setifera, Berkheya radula, Haplocarpha scaposa, Ipomoea crassipes, Commelina africana, Cyanotis speciosa, Asclepias stellifera* and *Hermannia erodioides.*
- The only succulent species recorded in this habitat was *Aloe ecklonis*, although it was not encountered on Impumelelo.
- The most common geophytes include *Eucomis autumnalis, Ledebouria graminifolia, Ledebouria cooperi, Gladiolus crassifolius, Gladiolus dalenii, Pelargonium alchemilloides* and *Hypoxis rigidula*.
- The following alien invasive species were recorded: *Opuntia ficus-indica* and *Solanum elaeagnifolium.*

Threatened (red listed) and/or protected species recorded in plant community 3:

IUCN list:	None
NEM:BA (ToPS):	None
NFA:	None
MNCA:	*Aloe ecklonis, Eucomis autumnalis, Gladiolus crassifolius, Gladiolus dalenii*
Mpumalanga Rare spesies list:	*Hypoxis hemerocallidea*
CITES:	*Aloe ecklonis*
Endemic species:	None

Habitat 4. *Themeda triandra - Eragrostis chloromelas - Helichrysum pilosellum* natural grassland

This natural grassland occurs on plains and gentle footslopes and covers most of the Impumelelo site (Figures 6 & 10). Surface rocks and gravel are mostly absent but may cover more than 10% of the area in places. The deep, dark-brown to black, clayey soils are derived from dolerite.

Figure 10: Community 4 – *Themeda triandra - Eragrostis chloromelas - Helichrysum pilosellum* natural grassland.

There is no diagnostic species group that differentiates this community. However, the presence of species groups 6, 7 & 8 and the absence of species groups 1 – 5 distinguish this community (Appendix A).

- The grass layer is well developed and covers approximately 88% of the area. The dominant grass species include *Themeda triandra, Eragrostis chloromelas, Setaria incrassata, Elionurus muticus* and *Brachiaria serrata.* Other common grass species include *Eragrostis curvula, Eragrostis planiculmis, Hyparrhenia hirta, Setaria nigrirostris, Eragrostis plana, Lolium perenne* and *Cynodon dactylon.*
- Herbaceous species have a mean canopy cover of approximately 8%. The most common species include *Helichrysum pilosellum, Gazania krebsiana, Scabiosa columbaria, Indigofera hedyantha, Berkheya radula, Berkheya setifera, Helichrysum rugulosum, Ipomoea crassipes, Asclepias stellifera, Jamesbrittenia aurantiaca, Oenothera rosea, Oenothera tetraptera, Senecio inaequidens, Conyza podocephala, Senecio erubescens, Hermannia erodioides, Pseudognaphalium luteo-album* and *Convolvulus saggitatus.*
- The succulent species recorded in this habitat were *Aloe ecklonis*, *Aloe transvaalensis* and *Euphorbia clavarioides*, although not all were encountered on Impumelelo.
- The most common geophytes include *Hypoxis rigidula, Hypoxis acuminata, Hypoxis hemerocallidea, Gladiolus dalenii, Pelargonium minimum* and *Ledebouria* cf. *revoluta.*
- Sedges include *Bulbostylis humilis, Cyperus esculentus, Kyllinga erecta* and *Abildgaardia ovata*.
- The following alien invasive plant species were recorded in this community: *Cirsium vulgare, Verbena bonariensis, Verbena brasiliensis, Solanum elaeagnifolium, Cuscuta campestris* and *Datura ferox*.

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

IUCN list:	None
NEM:BA (ToPS):	None
NFA:	None
MNCA:	*Aloe ecklonis, Aloe transvaalensis, Gladiolus dalenii, Boophone disticha*

Mpumalanga Rare spesies list: *Hypoxis hemerocallidea*
CITES: *Euphorbia clavarioides, Aloe transvaalensis, Aloe ecklonis*
Endemic species: None

Habitat 5. *Eragrostis curvula - Hyparrhenia hirta* disturbed grassland

This mixture of degraded natural grassland and old abandoned croplands occurs in the northeastern and the western parts of the Impumelelo site. It is found on the plains of the undulating countryside (Figures 6 & 11). Surface rocks and gravel are absent and the deep, dark-brown, clayey soils are derived from dolerite.

Figure 11: Community 5 – *Eragrostis curvula - Hyparrhenia hirta* disturbed grassland.

There is no diagnostic species group that differentiates this community. However, the presence of species groups 9, 10 & 11 and the absence of species groups 1 – 8 distinguish this community (Appendix A).

- Dwarf shrubs cover less than 1% of the habitat and include *Seriphium plumosum*.
- The grass layer is well developed and covers approximately 83% of the area. The dominant grass species include *Eragrostis curvula, Hyparrhenia hirta, Themeda triandra, Setaria incrassata, Eragrostis plana, Eragrostis chloromelas* and *Paspalum dilatatum*. Other common grass species include *Setaria nigrirostris, Setaria sphacelata, Cynodon dactylon, Hyparrhenia tamba, Elionurus muticus, Brachiaria serrata, Aristida bipartita* and *Eragrostis planiculmis.*
- Herbaceous species have a mean canopy cover of approximately 14%. The most common species are *Senecio erubescens, Oenothera tetraptera, Hermannia erodioides, Solanum elaeagnifolium, Pseudognaphalium luteo-album, Schkuhria pinnata, Ranunculus multifidus, Senecio inaequidens, Oenothera rosea, Asclepias stellifera, Asclepias* cf. *gibba, Berkheya setifera, Berkheya radula, Helichrysum rugulosum, Helichrysum aureo-nitens, Leobordea divaricata* and *Scabiosa columbaria*.
- The only succulent species recorded in Habitat 5 was *Aloe transvaalensis*, although it was not encountered on Impumelelo.
- Geophytes include *Crinum bulbispermum*, *Gladiolus crassifolius, Cyrtanthus stenanthus, Hypoxis rigidula, Hypoxis argentea, Ledebouria* cf. *revoluta, Haemanthus humilis, Pelargonium luridum* and *Boophone disticha.*
- Sedges include *Abildgaardia ovata, Kyllinga erecta* and *Cyperus esculentus*.
- The following alien invasive plant species were recorded in this community: *Cirsium vulgare, Verbena*

bonariensis, Verbena brasiliensis, Solanum elaeagnifolium and *Cuscuta campestris.*

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

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

Habitat 6. *Digitaria eriantha*/*Eragrostis curvula* planted pasture

These planted pastures are found in the northern parts the site and consist mostly of *Digitaria eriantha* pasture (Figures 6 & 12). Surface rocks and gravel are absent and the deep, dark-brown, clayey soils are derived from dolerite.

Figure 12: Community 6 – *Digitaria eriantha*/*Eragrostis curvula* planted pasture.

There is no diagnostic species group that differentiates this community. However, the presence of species groups 11 and the absence of species groups 1 – 10 distinguish this community (Appendix A).

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

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

IUCN list:	None

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

Habitat 7. *Trisetopsis imberbis - Crinum bulbispermum* wetlands

These streams, wetlands, vleis and floodplains are associated mostly with the Ouhoutspruit and Grootspruit and their tributaries and traverse most of the Impumelelo site (Figures 6 & 13). Surface rocks are present in some places along the streams. The alluvial soils are mostly deep, dark-brown to black clayey soils.

Figure 13: Community 7 – *Trisetopsis imberbis - Crinum bulbispermum* wetlands.

The diagnostic species of this habitat (community) include *Ischaemum fasciculatum, Andropogon appendiculatus, Fingerhuthia sesleriiformis* and *Galium capense* (species group 12, Appendix A).

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

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

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

Two subcommunities are distinguished on the Impumelelo site (Appendix A). Subcommunity 7b does not occur on Impumelelo.

7a. *Trisetopsis imberbis - Leersia hexandra* wetlands

The species that characterise this subcommunity include *Trisetopsis imberbis, Paspalum dilatatum, Bromus catharticus, Eragrostis curvula, Leersia hexandra* and *Ischaemum fasciculatum.*

7c. *Typha capensis – Phragmites australis* wetlands

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

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

Mapping unit 8. Cropland

These croplands are currently utilised mainly for maize production, but crops could be rotated.

Mapping unit 9. Infrastructure

This unit includes farm houses and associated infrastructure.

Mapping unit 10. Disturbed areas

These sites include areas that are used for diggings and areas disturbed by farming activities.

Mapping unit 11. Dams

6. ALIEN INVASIVE PLANT SPECIES

6.1 Introduction

An "invasive species" is any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health. Invasive alien plant species are globally considered as one of the greatest threats to biodiversity and ecosystems integrity.

The Alien and Invasive Species (AIS) Regulations and the Alien and Invasive Species (AIS) list were published in 2020 (NEM:BA 2020a & b).

Forty-seven alien plant species were recorded on the three Enertrag sites of which 12 are currently declared alien invasive species and 35 naturalised alien species (Appendix B). Another four naturalised alien species were listed by NewPosa for the region.

The following categories of declared weeds and invader plants are recognised in South Africa:

Category 1a Listed Invasive Species refers to species that must be combatted or eradicated. Landowners are obliged to take immediate steps to combat or eradicate Category 1a species.

Category 1b Listed Invasive Species refer to species that must be controlled. If an Invasive Species Management Programme has been developed, landowners are obliged to control the species in accordance with such programme. The following species were recorded in the area:

Arundo donax
Cereus jamacaru
Cirsium vulgare
Cuscuta campestris
Datura ferox
Opuntia ficus-indica
Solanum elaeagnifolium
Verbena bonariensis
Verbena brasiliensis
Xanthium spinosum

Category 2 Listed Invasive Species refer to species that require a permit to carry out a restricted activity e.g. cultivation, within an area specified in the Notice or an area specified in the permit, as the case may be. Category 2 includes plant species that have economic, recreational, aesthetic or other valued properties, notwithstanding their invasiveness. It is important to note that a Category 2 species that falls outside the demarcated area specified in the permit, becomes a Category 1b invasive species. Permit-holders must take all the necessary steps to prevent the escape and spread of the species outside of the land or the area specified in the Notice or permit.

Acacia mearnsii
Eucalyptus camaldulensis

These species are exempted for existing plantations.

Category 3 Listed Invasive Species refer to species that are subject to exemptions and prohibitions as specified in the Notice. Category 3 species are less-transforming invasive species that are regulated by activity. The principal focus with these species is to ensure that they are not introduced, sold or transported. However, a Category 3 plant species becomes a Category 1b species within riparian areas.

6.2 Prevention and control of alien invasive plant species

There are a number of strategies that can be employed to prevent the introduction of new invasive plant species:

- Limiting their introductions by humans;
- Creating a buffer zone of alien-free vegetation around the site;
- Integrated catchment management with the surrounding neighbours because areas around and upstream of the site provide an unlimited source of seed which invade downstream areas; and
- Maintening a healthy grass cover by sound veld management and judicious burning of the grass sward.

Alien invaders should be controlled by mechanical and/or chemical means. Mechanical means include ringbarking (girdling), uprooting, chopping, slashing and felling. An axe, chain saw or brush cutter can be used. Stumps or ringbarked stems should be treated immediately with a chemical weed killer. Follow-up treatment is usually needed.

7. FLORA: CHECKLISTS AND RED-LISTED AND/OR PROTECTED SPECIES

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

The South African Threatened Species Programme website (redlist.sanbi.org) of SANBI; the National Forests Act (Act No. 84 of 1998) (NFA 2023); the National Environmental Management: Biodiversity Act (NEMBA 2007c) (ToPS list); CITES (2023) appendices and the lists of red-listed or protected plant species of MNCA (1998) were consulted to classify the species in the study area into the relevant IUCN or protected categories (Appendix B).

7.1 Species listed by the Screening Tool

None of the four plant species listed by the Screening Tool were encountered on site during the habitat survey, however the MTPA database indicates one record of Sensitive species 691 on site as well as one on the boundary of the site (for more information on the other plant species see Chapter 7).

Sensitivity	Feature(s)
High and medium	Sensitive species 691
Medium	Sensitive species 1252
Medium	*Khadia beswickii*
Medium	Sensitive species 1248
Low	Low Sensitivity

7.2 IUCN Red-listed species

For the IUCN Categories, the following definitions were applied (see Figure 14). **The colours in Figure 14 were applied to the checklist of plants and animals in this section as well as in Appendices B and C.**

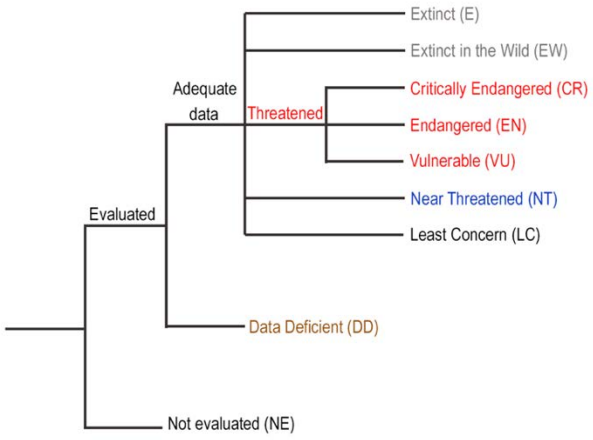


Figure 14: Schematic representation of the relationship between the various IUCN Red List Categories.

Extinct Categories:

- **Extinct (E):** A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW):** A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalised population (or populations) well outside the past range.

Threatened Categories:

- **Critically Endangered (CR):** A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
- **Endangered (EN):** A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that it is facing a very high risk of extinction.
- **Vulnerable (VU):** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that it is facing a high risk of extinction.

Not Threatened Categories but regarded as SCC by SANBI:

- **Near Threatened (NT):** A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
- **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. In this case the species would be classified as DDD. If however, taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible, the species is classified as DDT. The latter category cannot be considered as SCC.
- **Additional categories recognised by SANBI:** Although not threatened categories, SANBI have added the species classified as Critically Rare, Rare and Declining to their SCC.

Not Threatened Categories and not considered as SCC by SANBI

- **Least Concern (LC):** A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
- **Not Evaluated (NE):** A taxon is Not Evaluated when it is has not yet been evaluated against the five IUCN criteria. This category often applies to alien species.

Khadia beswickii and *Nerine gracilis* are the only IUCN threatened species occurring in the region according to the NewPosa database (Appendix B). *Nerine gracilis* was recorded at one location on site (MBSP 2022). Near Threatened (NT), Data Deficient (DDD) and Data Deficient (Taxononically) (DDT) species are not classified as threatened according to the IUCN classification.

7.3 SANBI: Species of Conservation Concern

According to the South African National Biodiversity Institute (SANBI 2022), SCC include all species that have been assessed according the IUCN Threatened or Red-List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD), as well as range-restricted species which are not declining and are nationally listed as Rare or Critically Rare. The DD category is split into those that are taxonomically unresolved (DDT) and those where insufficient data (DDD) are available to make a judgement on endangered status. The Taxonomically Data Deficient (DDT) species were excluded as SCC since taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of extinction risk is not possible.

The SCC listed for the region are (NewPosa; data supplied by MTPA):

Argyrolobium campicola	NT
Gladiolus robertsoniae	NT
Habenaria barbertoni	NT
Khadia beswickii	VU
Kniphofia typhoides	NT
Nerine gracilis	VU
Stenostelma umbelluliferum	NT

The succulent *Khadia beswickii* (VU) was not recorded on site and the one location indicated by MTPA was to the south of the Impumelelo WEF site. It is usually found on open shallow soil over rocks on ridges.

The geophyte *Nerine gracilis* (VU) occurs in damp depressions in shallow soil over rock sheets (e.g. Habitat 1, Figure 6). This habitat had a medium sensitivity and should be avoided by the development. The species was recorded at one location on site (MBSP 2022) but not within 200 m of any of the current proposed turbine locations.

The geophyte *Gladiolus robertsoniae* (NT) was noted on the Impumelelo site (in Habitat 1, Figure 6) and falls in areas designated as CBA1, CBA2 and ONA (MBSP 2022). It is found wedged in rock crevices in wet, rocky sites, mostly on dolerite outcrops. Three locations on site were also provided by MTPA but these were not closer than 200 m from any of the turbine locations. Although this rocky habitat had a medium sensitivity it should be avoided by the development because it is habitat to Sensitive species 691 as well as *Gladiolus robertsoniae*.

One location (2 records) for *Kniphofia typhoides* (NT) occurs on site but it was further than 200 m from any of the turbine locations. It is almost invariably found in *Themeda triandra* natural grasslands on black clay soil and shows a preference for low-lying wetlands (pans or vleis) (Habitat 4, Figure 6).

7.4 Protected species

7.4.1 Mpumalanga Nature Conservation Act (No. 10 of 1998) (MNCA 1998) and Mpumalanga Red list (Lötter 2015)

A total of thirty (30) plant species are listed as Schedule 11 Protected plant species in the region according to the MNCA (1998) (Appendix B). Most of these species are members of the Amaryllidaceae and Orchidaceae. Twelve Protected plant species (Schedule 11) were recorded during the survey of the three Enertrag sites in December 2021 of which nine species were recorded on Impumelelo.

The 12 species recorded on all three Enertrag sites:

*Aloe ecklonis**	*Gladiolus crassifolius*
Aloe transvaalensis	*Gladiolus dalenii*
Boophone disticha	*Gladiolus robertsoniae*
Crinum bulbispermum	*Haemanthus humilis**
*Cyrtanthus stenanthus**	*Haemanthus* sp.
Eucomis autumnalis	*Huernia hystrix*

*species not recorded on the Impumelelo site

Additional species on the Mpumalanga Red list (Lötter 2015) but not included in the MNCA (1998) list are:

Hypoxis hemerocallidea	LC
Khadia beswickii	VU*
Nerine gracilis	VU
Trachyandra erythrorrhiza	NT*

*species not recorded on the Impumelelo WEF site

- *Aloe transvaalensis* (LC) was recorded on site. It is an abundant species, but is in Appendix II of CITES.
- *Boophone disticha* (LC) was observed on site. It is a widespread species with extensive use in the medicinal trade.

- *Crinum bulbispermum* (LC) was encountered on site. It is a fairly widespread species associated with rivers, streams, seasonal pans and damp depressions. It is harvested for medicinal purposes and localized declines in subpopulations have been observed for this species.
- *Eucomis autumnalis* (LC) was recorded on site. It is a widespread species often found in damp, open grassland and sheltered places. The species has experienced large population declines because it is a very popular medicinal plant.
- *Gladiolus crassifolius* (LC) was observed on site. All species in the genus *Gladiolus* are protected, but *Gladiolus crasssifolius* is a widespread and common species.
- *Gladiolus dalenii* (LC) was observed on site. All species in the genus *Gladiolus* are protected, but *Gladiolus dalenii* is a widespread and common species.
- *Gladiolus robertsoniae* (NT), see section 7.3 on SCC.
- *Hypoxis hemerocallidea* (LC) was observed on site and also recorded in the MTPA database for the participating farms. It occurs in a wide range of habitats, including open, rocky grassland, dry, stony, grassy slopes, mountain slopes and plateaus. Corms are valued in the medicinal trade and extensive commercial exploitation has caused declines in some subpopulations, and it is additionally threatened by habitat loss and degradation.
- *Huernia hystrix* (LC) was recorded on site. It is a widespread species, but is in Appendix II of CITES.
- *Kniphofia typhoides* (NT), see section 7.3 on SCC.

Some provisions are given in terms of Schedule 11 Protected plants and Schedule 12 Specially Protected plants (Chapter 6, MNCA 1998):

- No person shall pick a Protected plant without a permit.
- No person shall pick an indigenous plant in a nature reserve without a permit.
- No person shall pick an indigenous plant on a public road, land next to a public road within a distance of 100 meters from the centre of the road without a permit.
- No person shall pick an indigenous plant which is not a Protected plant or Specially Protected plant on land which he or she is not the owner or occupier.
- No person shall donate, sell or export or remove from the province a Protected plant without a permit.
- No person shall possess, pick, sell, purchase, donate or receive as a donation, import or export or remove from the Province a Specially Protected plant without a permit.

7.5 ToPS list (NEM:BA 2007c)

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

7.6 CITES appendices

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

7.7 Protected Tree Species - National Forests Act (Act No. 84 of 1998)

No nationally protected tree species is listed for the site (NFA 2023) and none were recorded during the site visit.

7.8 Endemic species

No endemic species are listed for either the Soweto Highveld Grassland or the Tsakane Clay Grassland Vegetation Types (Mucina & Rutherford 2006).

8. FAUNA: CHECKLISTS AND RED-LISTED AND/OR PROTECTED SPECIES

Species lists (the term species is used here in a general sense to denote species, subspecies and varieties) of the faunal component were sourced for the study area from the Animal Demography Unit, University of Cape Town website (http://vmus.adu.org.za), and species listed for the farms in close proximity to the site (data supplied by MTPA) and supplemented by relevant literature to determine the conservation status.

8.1 Mammals

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

8.1.1 Screening Tool

The screening tool rated the sensitivity of the Animal Species Theme as High. The following species were highlighted by the Screening Tool:

Sensitivity	Feature(s)
High	Aves-*Circus ranivorus*
High	Aves-*Eupodotis senegalensis*
High	Aves-*Hydroprogne caspia*
High	Aves-*Polemaetus bellicosus*
High	Aves-*Sagittarius serpentarius*
High	Aves-*Mycteria ibis*
Medium	Aves-*Tyto capensis*
Medium	Aves-*Circus ranivorus*
Medium	Aves-*Hydroprogne caspia*
Medium	Aves-*Eupodotis senegalensis*
Medium	Insecta-*Lepidochrysops procera*
Medium	Mammalia-*Crocidura maquassiensis*
Medium	Mammalia-*Hydrictis maculicollis*
Medium	Mammalia-*Ourebia ourebi ourebi*

The avifaunal and bat component will be addressed by the avifaunal and bat specialists and are therefor excluded from the following discussion. The species that were highlighted by the Screening tool, included the mammals *Crocidura maquassiensis, Hydrictis maculicollis*, *Ourebia ourebi ourebi* and the insect *Lepidochrysops procera.* None of these species were listed in the MTPA database for the farms participating in the proposed Impumelelo WEF development and none were encountered during the site visit. The spotted-necked otter (*Hydrictis maculicollis*) is not listed on the ADU database for the region while the Maquassie musk shrew (*Crocidura maquassiensis*) and *Lepidochrysops procera* are not listed on the ADU database for the region or the MNCA (1998) lists for the Mpumalanga province. The Impumeleo site falls marginally within the distribution range of *Ourebia ourebi ourebi.* None of the animal species listed by the Screening Tool were recorded on site during the survey.

The Maquassie Musk Shrew *Crocidura maquassiensis:* is classified as Vulnerable (Taylor *et al*. 2016). It depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. *Crocidura maquassiensis* has not been reported from Gauteng, North West Province or Mpumalanga post-1999 and thus there is a very low probability for it to occur on site.

Marginally suitable habitat for the spotted-necked otter (Vulnerable IUCN status) is available on site. It occurs widespread, but it is restricted to areas of permanent fresh water offering good shoreline cover and an abundant prey base.

According to the distribution map of *Ourebia ourebi ourebi* provided in Child *et al*. (2016) the Impumelelo site falls within a gap in its distribution although it does occur in the broader region.

8.1.2 IUCN threatened mammal species

Three IUCN threatened mammal species were listed for the environs of the Impumelelo site on the website of the Animal Demography Unit, University of Cape Town:

Ourebia ourebi	Oribi	EN
Panthera pardus	Leopard	VU
Felis nigripes	Black-footed cat	VU

Seven mammal species were listed for the environs of the Impumelelo site as Near Threatened (a category that is not a threatened category in the IUCN classification, but qualifies as SCC):

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

*****Mammals that were either sighted or confirmed by the landowners (Appendix C)

8.1.3 Mpumalanga: provincially protected mammal species (MNCA 1998)

Six of the 52 mammal species listed in Appendix C are Schedule 2: Protected Game in Mpumalanga. The following protected mammal species were recorded on the Impumelelo site:

Raphicerus campestris	Steenbok
Atelerix frontalis	Southern African hedgehog

8.1.4 Nationally Threatened or Protected Species: ToPS (NEMBA 2007c)

According to ToPS legislation (NEMBA 2007c), one mammal species is listed as Endangered, one mammal species is listed as Vulnerable and six species are Protected (Appendix C). *Atelerix frontalis* and *Leptailurus serval* were noted by the land owners on site.

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

Ourebia ourebi	Oribi	(see note above)

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

Panthera pardus	Leopard

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

Aonyx capensis	African clawless otter
Atelerix frontalis	Southern African hedgehog*
Felis nigripes	Black-footed cat
Leptailurus serval	Serval*
Vulpes chama	Cape fox

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

8.1.5 CITES

The following mammal species occurring in the region are CITES listed with the serval *Leptailurus serval* recorded on the Impumelelo site:

Aonyx capensis	African Clawless Otter	Appendix II
Caracal caracal	Caracal	Appendix II
Leptailurus serval	Serval*	Appendix II
Panthera pardus	Leopard	Appendix I

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

8.2 Reptiles

Thirty-two (32) reptile species are listed for the region (Appendix C). The list includes one IUCN threatened (Vulnerable) species, i.e. the giant girdled lizard (*Smaug giganteus)* and one Near-threatened species*, i.e. Chamaesaura aenea* (coppery grass lizard).

Provincially protected reptile species include 15 Schedule 2 Protected reptiles and 17 Schedule 5 reptiles. The giant girdled lizard (*Smaug giganteus)* is listed as Endangered according to the ToPS list (NEMBA 2007c). Only the rinkhals *Hemachatus haemachatus* has been recorded on the Impumelelo site.

Two CITES listed species were recorded for the region surveyed:

Giant girdled lizard (ouvolk)	*Smaug giganteus*
Common girdled lizard	*Cordylus vittifer*

8.3 Frogs

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

8.4 Lepidoptera

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

The Screening Tool listed *Lepidochrysops procera* as a sensitive species for the site. However, it was not listed in the ADU website (http://vmus.adu.org.za), the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. It has a IUCN status of Least Concern, but is a habitat specialist and rated as Rare. It is not regarded as sensitive in the National Sensitive Species List of SANBI and is not exploited, collected, traded or utilised in a targeted manner (http://nssl.sanbi.org.za/species/lepidochrysops-procera). *Lepidochrysops procera* is unlikely to occur on site because its host plant was only recorded once in one locality.

8.5 Scorpions

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

8.6 Spiders

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

9. CONSERVATION

9.1 National Environmental Management: Protected Areas Act (Act No. 10 of 2003)

The study site is not located in a protected area. The nearest protected area is the Devon Protected Environment, about 45 km to the northwest of the site (SAPAD database, Dec 2022).

9.2 National Protected Areas Expansion Strategy (NPAES)

Parts of the study site fall in the NPAES (NPAES 2018) (Figure 15). The mapped units include CBA1 (or CBA irreplaceable), CBA2 (or CBA optimal) and ESAs (Landscape and Local corridors). A substantial number of turbines (16) are located within the 'Priority Focus Areas', thus those turbines falling in CBAs and ESAs.

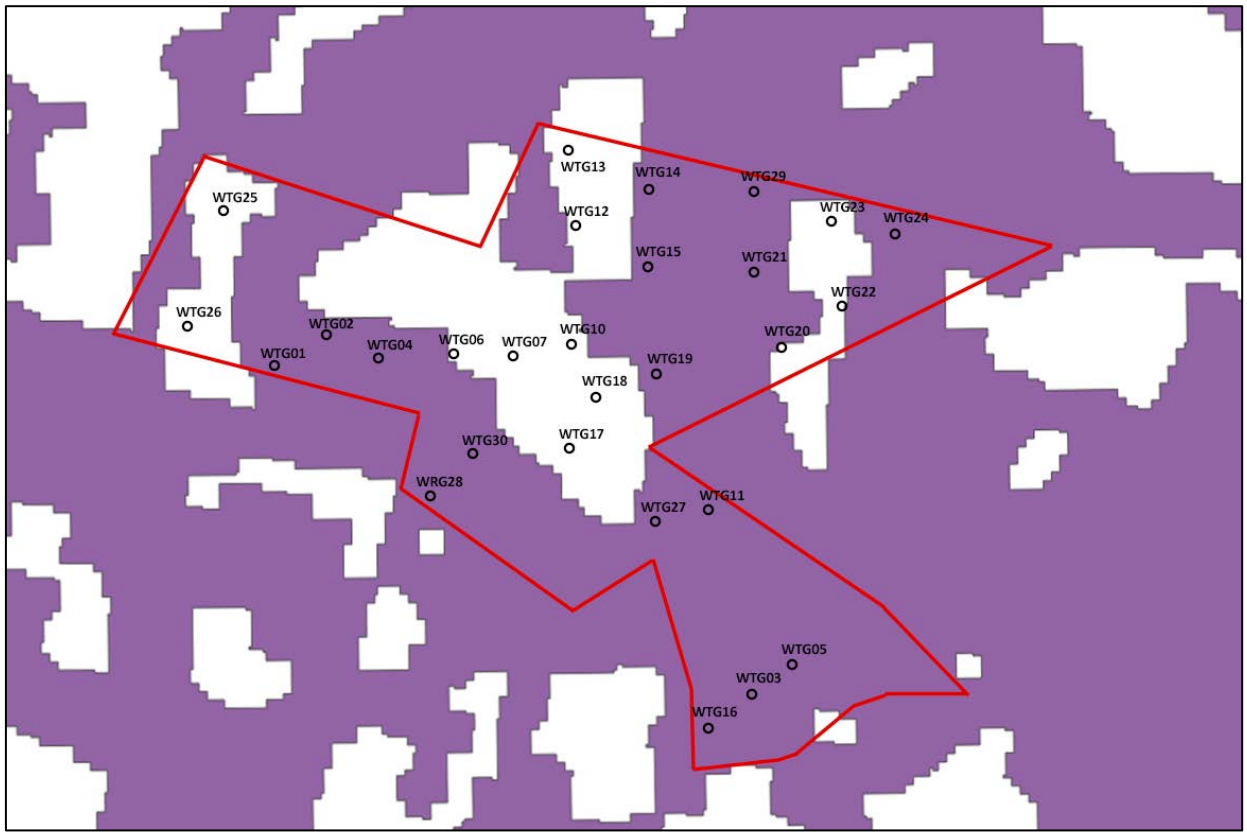


Figure 15. National Protected Areas Expansion Strategy (NPAES) map of the Impumelelo site (NPAES 2018). The mapped units include CBA1 (or CBA irreplaceable), CBA2 (or CBA optimal) and ESAs (Landscape and Local corridors).

9.3 Mpumalanga Protected Areas Expansion Strategy (MPAES)

The impumelelo site forms part of the 5-year and 20-year plan of the Mpumalanga PAES (MPAES data supplied by MTPA) (Figures 16 & 17). The MPAES 20-year plan corresponds to the NPAES (2018) map (Figures 15 & 17). As in the case of the NPAES (2018), a substantial number of turbines are located within the MPAES, i.e. those turbines falling in CBAs and ESAs.

Figure 16. Mpumalanga Protected Areas Expansion Strategy (MPAES) map of the Impumelelo site (MPAES 5-year plan supplied by MTPA). The mapped areas include mostly CBA1 (or CBA irreplaceable) and CBA2 (or CBA optimal) units.

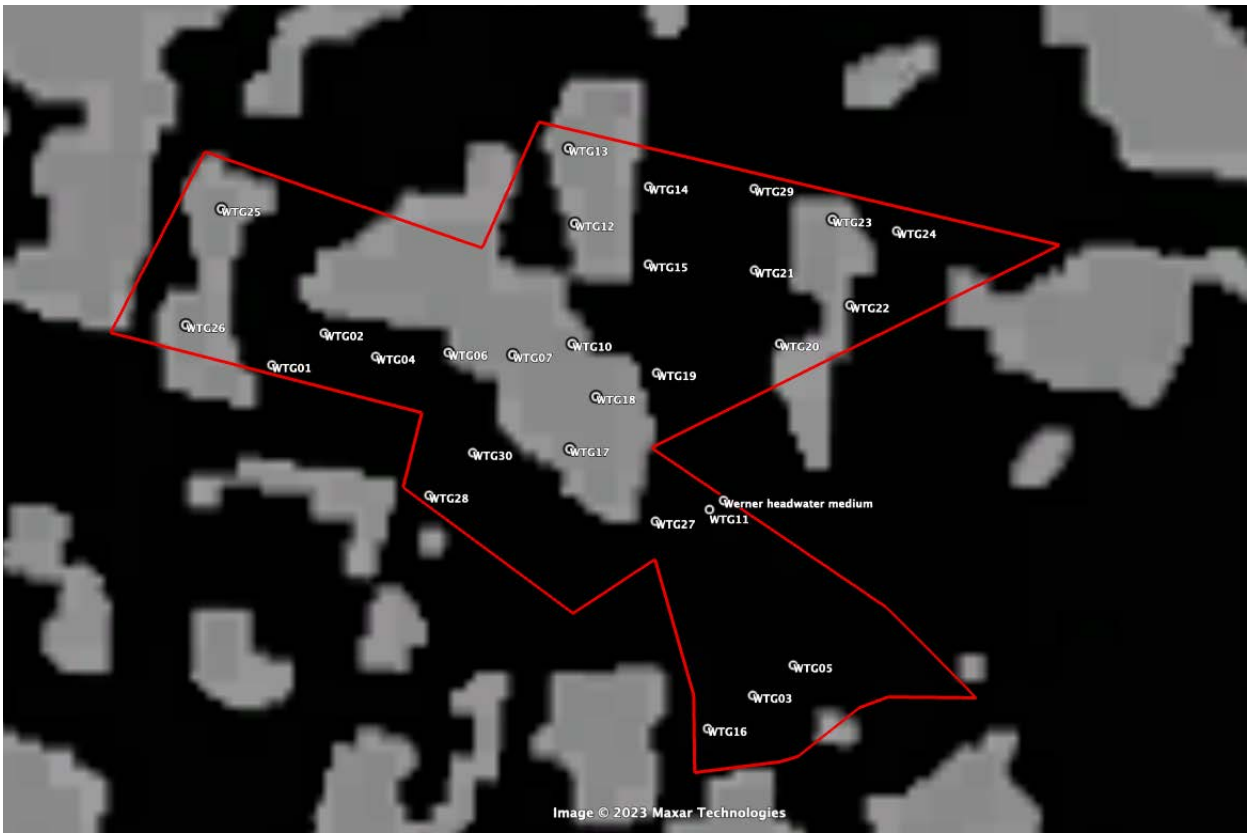


Figure 17. Mpumalanga Protected Areas Expansion Strategy (MPAES) map of the Impumelelo site (MPAES 20-year plan supplied by MTPA). The mapped units include CBA1 (or CBA irreplaceable), CBA2 (or CBA optimal) and ESAs (Landscape and Local corridors).

9.4 National list of ecosystems that are threatened and in need of protection

The site is located in the Soweto Highveld Grassland and Tsakane Clay Grassland vegetation types (Mucina & Rutherford 2006, SANBI 2006-2018), which are classified as 'Vulnerable' and 'Endangered' respectively (NEMA 2011, SANBI 2019). However, the Tsakane Clay Grassland occurs on the western boundary and covers less than one hectare of the site.

9.5 Terrestrial Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) and Other Natural Areas (ONAs)

9.5.1 Land use guidelines within land-use zones in spatial planning in Mpumalanga (MBSP 2014)

Land-use activity descriptions used in the spatial planning zonation scheme used in Mpumalanga are outlined in the MBSP (2014) Handbook. Wind farms and power lines are included in the Utilities (U) zone where land is allocated for the provision of a diverse range of services. Wind farms are listed under the category "Waterworks, Sewerage Works". None of the land-uses in this category are biodiversity-compatible and should not be located in CBAs or ESAs. They should be located in ONAs or heavily modified areas, subject to the appropriate authorisations.

However, Table 18 in the MBSP (2014) handbook indicates some flexibility in land-use options in the case of a CBA1 (or irreplaceable), CBA2 (or CBA optimal) and ESAs. Three land-use classes are used in Table 18, i.e.

- Permissible land-uses that are unlikely to compromise the biodiversity objective (green dot);
- Land-uses that may compromise the biodiversity objective and that are only permissible under certain conditions (yellow dot);
- Land-uses that will compromise the biodiversity objective and are not permissible (red dot).

The CBA1 and CBA2 and all ESA categories in the Utilities zone which includes energy-generation facilities are marked with a yellow dot **thus implying land-uses that are permissible under certain conditions.** The Utilities zone (which includes energy-generation facilities) should be located at a distance from residential or other land-uses where they may detract from levels of amenity or safety. They should also be located such that disruption to natural areas and water courses through the laying of service pipelines or cables is minimised by adhering to sound environmental management principles (MBSP 2014).

9.5.2 Terrestrial Critical Biodiversity Areas (CBAs)

Critical Biodiversity Areas (CBAs) are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species. The definitions for CBAs are (SANBI 2018):

- CBA 1: Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas (SANBI 2018).
- CBA 2: Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses.

According to the Mpumalanga Biodiversity Sector Plan Handbook (MBSP 2014), the terms 'CBA irreplaceable' and 'CBA optimal' are used. However, in this report the terms CBA1 and CBA2 will be used to be in line with SANBI (2018). The MBSP (2014) defined a CBA1 (or CBA irreplaceable) as (1) areas required to meet targets and with irreplaceability

values of more than 80%; (2) critical linkages in the landscape that must remain natural; and (3) critically endangered ecosystems. CBA2s (or CBA optimal) 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.

The main reasons provided for the mapping of the CBAs in the Impumelelo planning units were (data provided by MTPA):

- Soweto Highveld Grassland
- Mesic Highveld Grassland (wetlands) – Group 1
- Intact grassland patches
- *Gladiolus robertsoniae*
- *Kniphofia typhoides*
- African bullfrog *Pyxicephalus adspersus*
- African Grass Owl *Tyto capensis*
- Blue korhaan *Eupodotis caerulescens*
- Barrows korhaan *Eupodotis senegalensis*
- Secretarybird *Sagittarius serpentarius*
- Climate change land facets
- Macro corridor
- Critical linkages
- Core and supporting corridors

With the possible exception of the African bullfrog *Pyxicephalus adspersus,* that prefers sandy soils above the clay soils on the site, all reasons mentioned above are applicable to the site.

The CBA map indicates the presence of CBA1s and CBA2s across large sections of the Impumelelo site, mostly in Habitat 4 (natural grassland) (Figure 18). These natural grasslands form large intact patches on Impumelelo (see vegetation map, Figure 6) that are prime examples of the Soweto Highveld Grassland.

Some of the turbines and other infrastructure currently located within CBAs are:

- Turbines 02, 04, 05, 14, 19, 21, 24, 29 and 30 fall in a CBA1
- Turbines 03, 11, 16 and 27 fall in a CBA2
- Turbine 01 falls in an ESA.
- Construction site 1 falls in a CBA1
- Construction site 2 falls partly in a CBA2
- Construction site 3 falls in a CBA2
- Construction site 4 falls partly in a ONA and CBA1
- Construction site 5 fall in a moderately modified area.
- Substation 1 (SS1) falls partly within a CBA1
- Substation 2 (SS2) falls partly in a CBA1 and CBA2

Only low-impact land-uses that are compatible with maintaining CBAs in a natural state with no loss of habitat or species, may be allowed (MBSP 2014). Extensive, well-managed, low-intensity livestock or game ranching is considered compatible in a CBA1 (irreplaceable) if specific biodiversity features and vulnerabilities are taken into account. Ideally, conservation management activities should be the primary land-use in all irreplaceable areas. Acceptable land-uses in a CBA2 (optimal) includes those that are the least harmful to biodiversity e.g. conservation management or extensive livestock or game farming. Development in CBAs should be avoided, although Table 18 in the MBSP (2014) handbook indicates that turbines are permissible in CBA1s and CBA2s under certain conditions.

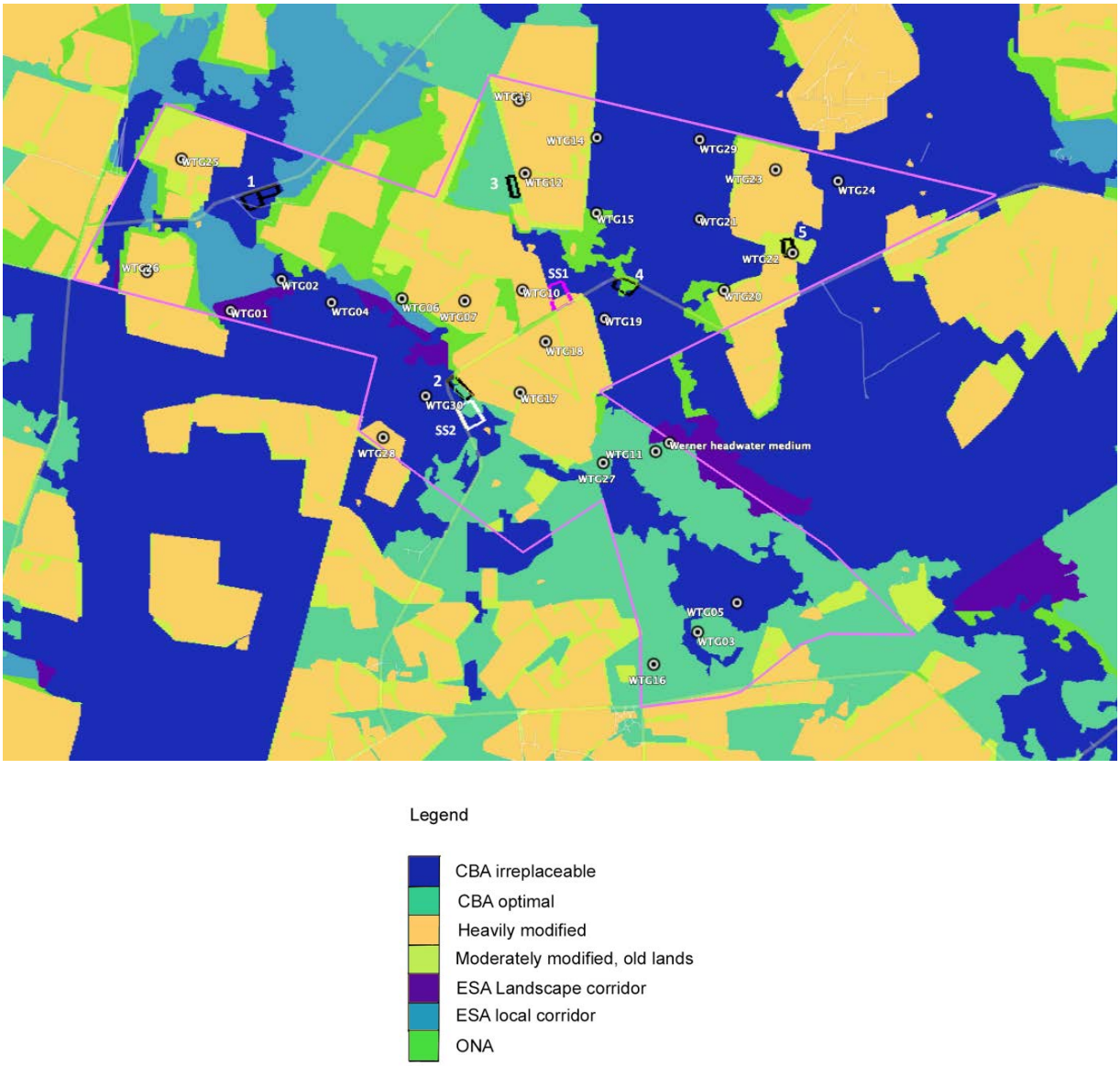


Figure 18: Critical Biodiversity Areas (CBAs), Ecological Support Areas (corridors), Other Natural Areas (ONAs), and moderately and heavily modified areas on the Impumelelo site (MBSP 2014; biodiversityadvisor.sanbi.org). Black squares = construction sites 1 - 5; Pink square = Substation 1 (SS1); White square = Substation 2 (SS2).

9.5.3 Ecological Support Areas (ESAs)

An Ecological Support Area (ESA) is not essential for meeting biodiversity targets, but plays an important role in supporting the ecological functioning of CBAs and that deliver important ecosystem services. ESAs need to be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable. It is important that the project should not compromise the functional (natural) state of the ESAs (Pool-Stanvliet *et al.* 2017). According to the MBSP (2014), an ESA Landscape Corridor is the best option to support landscape-scale ecological processes, especially allowing for adaptation to the impacts of climate change. An ESA Local Corridor refers to finer-scale alternative pathways that builds resilience into the corridor network by ensuring connectivity between climate change focal areas, reducing reliance on single landscape-scale corridors. The management objective in an ESA is to 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 thus allowed in ESAs, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.

There are some ESA Local Corridors and Landscape Corridors demarcated within the Impumelelo site but only one turbine (WTG01) occurs in an ESA Landscape Corridor (Figure 18). This turbine should preferably be relocated or microsited prior to approval of final layout because it falls in natural grassland (Habitat 4). However, Table 18 in the MBSP (2014) handbook indicates that turbines are permissible in ESAs under certain conditions.

9.5.4 Other Natural Areas (ONA)

Other Natural Areas (ONAs) are 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 (MBSP 2014). Land use guidelines for Terrestrial Other Natural Areas (ONAs) are not required to meet biodiversity targets. Some ONAs were demarcated within the Impumelelo site (Figure 18; MBSP 2014), however turbines are permissible in ONAs under certain conditions subject to the appropriate authorisations.

9.5.5 Heavily or Moderately Modified Areas

Relatively large portions of the site are demarked as either 'Heavily modified' or 'Moderately modified – old lands', especially in the central parts (Figure 18). These MBSP (2014) categories, do not have equivalent categories in the SANBI CBA classification system and must be assumed to degraded to such an extent that they cannot qualify as ESAs or ONAs. Wherever possible, turbines should be placed in these units. Heavily modified areas are all areas currently modified to such an extent that any valuable biodiversity and ecological functions have been lost. Moderately modified areas refer to old cultivated lands that have been allowed to recover (within the last 80 years), and support some natural vegetation. These are 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 and cultivation (MBSP 2014). Although biodiversity pattern and ecological functioning may have been compromised, the areas may still play a role in supporting biodiversity and providing ecosystem services.

9.6 Freshwater Ecosystem Priority Areas (FEPAs)

Freshwater Ecosystem Priority Area (FEPA) are priority areas for conserving freshwater ecosystems and supporting sustainable use of water resources and upstream management areas (Driver *et al*. 2012). The entire Impumelelo site is contained in an Upstream Management Area as river FEPA (biodiversityadvisor.sanbi.org). Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. However, the area mapped as river FEPA did not emerge as being highly sensitive in the current assessment and the sensitivity model that was applied to the vegetation, classified only the drainage lines in the FEPA as being of high sensitivity with most of the area classified as low sensitivity and a few spots of medium sensitivity.

Channelled valley-bottom wetlands, unchanneled valley-bottom wetlands, seeps and dams are indicated in Figure 19 (MPHG 2014). All the wind turbines avoid the wetland habitats. The buffer zones as indicated by the aquatic specialist should be observed.

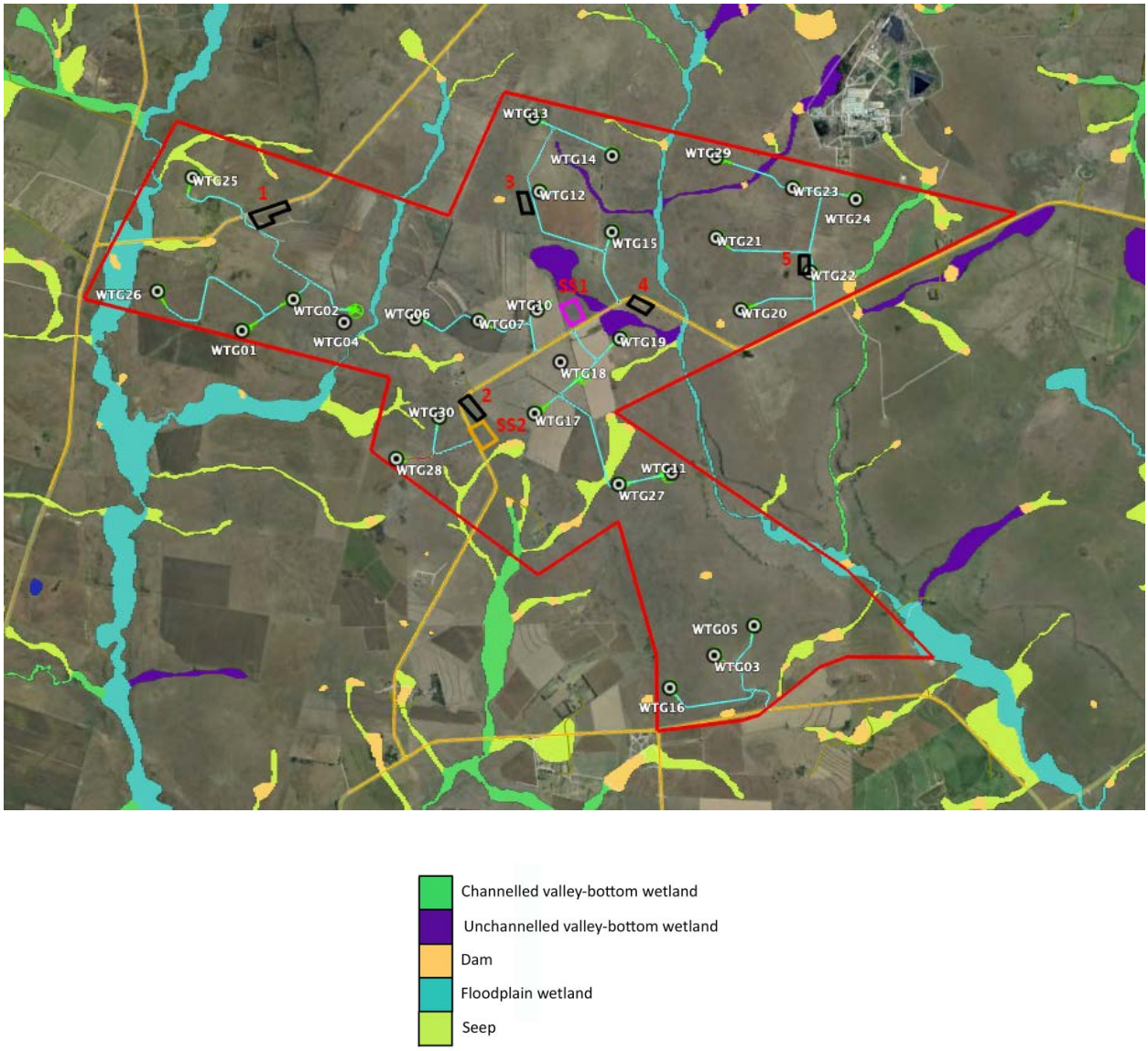


Figure 19: Mpumalanga Highveld Wetlands in the Impumelelo site (MPHG 2014; biodiversityadvisor.sanbi.org). The positions of the wind turbines are superimposed on the map. Black squares 1 – 5 = construction sites; Pink square = Substation 1 (SS1), Orange square = Substation 2 (SS2).

9.7 Ecological processes, functioning and drivers

Ecological processes include primary production, decomposition, nutrient cycling and fluxes of nutrients and energy. These processes will be altered by the clearing of the vegetation at the footprint of the WEF infrastructure. However, the impact is expected to be fairly small. Since grasses are wind pollinated, pollination of the grass component should not be unduly affected by the development, although the forbs depend on pollinators and in some case specialised pollinators. Migration of ground-dwelling organisms will be hindered locally during construction, but ecological connectivity should not be disrupted during the operational phase. Overall, broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions should be able to continue due to the small footprint of the turbine development. The infrastructure, if properly planned, should not cause migration barriers or cut off ecological corridors and consequently, habitat fragmentation due to the development should be slight.

The disturbance caused during construction will create conditions favourable for invasion by alien species. The level

of alien infestation at the site was moderate, but an alien invasive plant species monitoring and control programme needs to be initiated to control invasions.

Fire is considered an important driver of vegetation dynamics in the Grassland and Savanna Biomes. Should fire be suppressed on site this could have long-term effects on the vegetation dynamics. If the grass layer is regularly mowed/brush cut, it should prevent grasses from becoming moribund in the absence of fire although mowing and cutting could reduce seed set.

Grasslands have evolved under the grazing pressure from large ungulates. Mesic Highveld Grasslands are reasonably well adapted to grazing pressure under low to moderate stocking rates with adequate rest periods. The WEF development will still allow livestock grazing.

9.8 Indigenous forests

No indigenous forests occur on the site.

9.9 Strategic Water Source Areas (SWSA)

The Impumelelo site is not located within a SWSA (biodiversityadvisor.sanbi.org).

10. ECOLOGICAL SENSITIVITY ANALYSIS OF THE VEGETATION

10.1 Introduction

Sensitivity is the vulnerability of a plant community or habitat to an impact, for example a wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be assessed to derive a sensitivity score, such as:

1. Threatened status of the regional vegetation types wherein the proposed site is situated.
2. Percentage of IUCN threatened (red-listed) plant species per habitat.
3. Number of protected tree species per habitat.
4. Percentage of provincially protected plant species per habitat.
5. Presence of endemic plant species per habitat or site (endemic to vegetation type).
6. Conservation value of plant community (habitat).
7. Species richness per habitat or per sample plot (number of plant species).
8. Degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating.
9. Soil erosion potential.
10. Resilience (this is a measure of the ability of a particular habitat to recover after an impact, i.e. high resilience infers low rating).

10.2 Sensitivity model

The following **sensitivity model** (Table 5, Figure 20) was applied to the data for each habitat on site. This was achieved by weighting each criterion and calculating the sum for the habitat, which reflects the sensitivity and sensitivity ranking. A brief description of the sensitivity rating of the parameters is provided below:

1. **Threatened status of the ecosystem** (depends on the percentage area intact, or degree of transformation) (Mucina & Rutherford 2006, NEM:BA 2011, SANBI 2019). The ecosystems are classified into the following categories:
   - Low sensitivity: If "Least Concern", the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.
   - Medium sensitivity: If “Vulnerable”, the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species, but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.
   - High sensitivity: If “Endangered”, the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.
   - Very high sensitivity: If “Critically Endangered”, the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

   Category rating:

Low	(LC)	= 1
Medium	(VU)	= 2
High	(EN)	= 3
Very high	(CE)	= 4

2. **Percentage of IUCN (red-listed) plant species** (IUCN status higher than least Concern): The rating is determined by the presence of red-listed flora in a habitat (calculated as percentage of the total number of species per habitat).

Category rating:

None	(0%)	= 0
Low	(>0 – 2%)	= 1
Medium	(>2 – 5%)	= 2
High	(>5%)	= 3

3. **Presence of protected tree species** (NFA 2023): The presence protected tree species in a habitat is rated as follows:

Category rating:

None	(0 species)	= 0
Low	(1 - 2 species)	= 1
Medium	(3 – 4 species)	= 2
High	(>4 species)	= 3

4. **Percentage of Mpumalanga protected plant species** (MNCA 1998): The rating depends on the percentage of protected species in relation to the total plant species per habitat.

Category rating:

None	(0%)	= 0
Low	(>0 - 10%)	= 1
Medium	(>10 – 20%)	= 2
High	(>20%)	= 3

5. **Percentage of plant species endemic to the particular vegetation type of Mucina & Rutherford (2006):** Refers to the number of species expressed as a percentage of the total number of species per habitat.

Category rating:

None	(0%)	= 0
Low	(>0 - 2%)	= 1
Medium	(2–5%)	= 2
High	(>5%)	= 3

6. **Species richness per habitat:** Expressed as mean number of species per plot in a habitat.

Category rating:

Low	(<40)	= 1
Medium	(40 – 60)	= 2
High	(>60)	= 3

7. **Conservation value of the habitat:** The assessment is made for the habitat in the broader region. The criteria are low, medium and high. The presence of e.g. quartz outcrops, ridges, wetlands and dunes should be considered to have a medium to high conservation value. However, this should be seen in the context of the presence of representative habitat in the broader region or in conservation areas.

Category rating:

Low	= 1
Medium	= 2
High	= 3

8. **Degree of connectivity and/or fragmentation of the ecosystem:** The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of habitats, thus high degree of connectivity and low degree of fragmentation infer a high rating.

Category rating (note reverse order)*:*

Low	= 3
Medium	= 2
High	= 1

9. **Erosion potential of the soil:** The erosion potential of the soil is indicated as low, medium or high, e.g. coarse sandy soils on plains have a low erosion potential.
Category rating:

Low	= 1
Medium	= 2
High	= 3

10. **Resilience:** Is a measure of the ability of a particular habitat to recover to its current state after an impact, i.e. high resilience infers low rating.
Category rating (note reverse order):

Low	= 3
Medium	= 2
High	= 1

Each criterium is weighted as follows in the model:

Threatened status of the vegetation type	x5
Percentage of threatened plant species	x4
Presence of protected tree species	x3
Percentage of Mpumalanga protected species	x4
Percentage of endemic species to vegetation type	x2
Species richness	x2
Conservation value (habitat)	x4
Degree of connectivity/fragmentation of habitat	x2
Erosion potential	x2
Resilience	x3

10.2.1 Sensitivity rating

The sum of all criteria is obtained per habitat and the sensitivity rating interpreted as follows:

≤ 40	= low	(L)	(rating scale = 1)
41– 50	= medium	(M)	(rating scale = 2)
51 – 65	= high	(H)	(rating scale = 3)
> 65	= very high	(VH)	(rating scale = 4)

In general, these sensitivity ratings are interpreted as follows:

- **Low** sensitivity means the sensitivity should not have an influence on the decision about the project. It is usually applicable to habitats that have been transformed, especially by human activities. However, no protected species may be removed/destroyed without a permit.
- **Medium** means a sensitivity rating that is real and sufficiently important to require management, e.g. mitigation measures, management or protection of the rare/threatened fauna and flora, protection of a specific habitat on the property and/or rehabilitation.
- **High** means a sensitivity rating where the habitat should be excluded from any development.
- **Very high** means a sensitivity rating that should influence the decision whether or not to proceed with the project.

Table 5: Sensitivity of the different habitats (plant communities) identified on site (see Figure 20).

Community/Habitat	1	2	3	4	5	6	7
Threatened status (x5)	10	10	10	10	10	10	10
% Threatened species (x4)	4	0	0	0	0	0	0
Number of protected trees (x3)	0	0	0	0	0	0	0
Mpumalanga species (x4)	4	4	8	8	12	0	8
Endemic species (x2)	0	0	0	0	0	0	0
Species richness (x2)	2	2	4	2	2	2	2
Conservation value (x4)	8	4	8	8	4	4	12
Connectivity (x2)	4	2	4	2	2	2	4
Erosion (x2)	4	4	4	4	2	4	6
Resilience (x3)	9	3	6	3	3	3	9
Sum:	45	29	44	37	35	25	51
Sensitivity rating:	M	L	M	L	L	L	H

Overall, the grassland on shallow soils (rocky sheets) (Habitat 1 – medium sensitivity), grassland of rocky outcrops (Habitat 3 – medium sensitivity) and drainage lines (including dams) (Habitat 7 – high sensitivity) were more sensitive than the other habitats on site. Habitats 6, 8, 9 & 10 are man-made habitats with a low sensitivity rating, e.g. cropland, planted pasture, plantations, wind breaks and diggings.

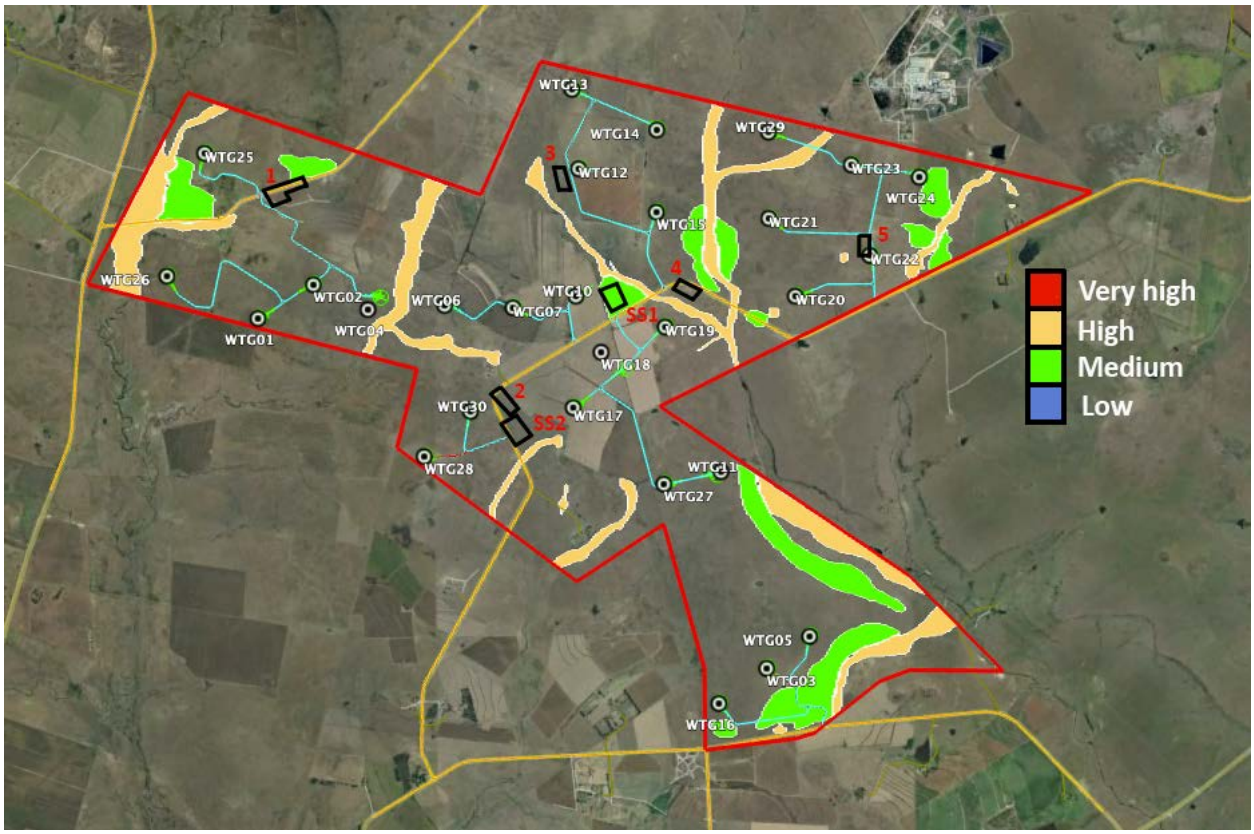


Figure 20: Vegetation sensitivity map of the habitats on the Impumelelo site. Substation 1 = SS1; Substation 2 = SS2. The sensitivity map is additionally provided as a .kmz file. The areas not coloured = low sensitivity.

Substation 1 (SS1) falls in a medium sensitivity area (Figure 20). The current locations of the turbines and the other optional substation (SS2) avoid the medium and high sensitivity areas on Impumelelo (Figure 20). Along the watercourses, buffers are applicable to the development. A buffer zone of 32 m is usually applied to drainage lines,

but the aquatic specialists may apply wider buffer zones along these habitats. **No buffer has been applied in Figure 20, since it is advised to follow the recommendations of the aquatic specialist in this regard.**

Apart from the drainage lines, with high sensitivity, the vegetation in the CBAs did not emerge as being highly sensitive in the sensitivity model that was applied.

By avoiding the drainage lines/watercourses and other wetlands as well as Habitats 1 and 3 with a medium vegetation sensitivity, most of the SCC and MNCA and Mpumalanga red list plant species occurring on site will be avoided.

11. SCREENING TOOL REPORT

11.1 Summary of screening tool results

11.1.1 Plant Species Theme

The screening tool rated the sensitivity of the Plant Species Theme as high (Figure 21) and highlighted four species with an IUCN status of Vulnerable as being of concern.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

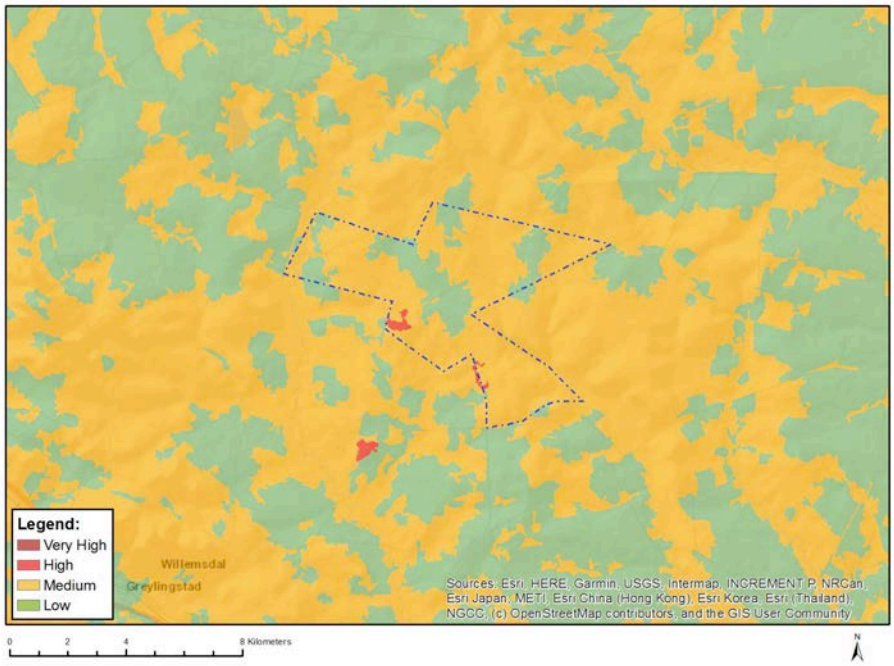


Figure 21: Map and outcome of the Plant Species Theme sensitivity generated by the screening tool.

The following plant species were highlighted as being of concern:

Sensitivity	Feature(s)
High	Sensitive species 691
Medium	Sensitive species 1252
Medium	*Khadia beswickii*
Medium	Sensitive species 691
Medium	Sensitive species 1248
Low	Low Sensitivity

Please take note of the following email communication from SANBI: 'As per the best practise guideline that accompanies the protocol and screening tool, please, remember that the **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 *sensitive plant* or *sensitive animal* and its threat status may be included, e.g. *critically endangered sensitive*

plant or *endangered sensitive animal*.' It should be noted that the numeric code of the sensitive species is not an unique identifier, since the numbers are randomised from time to time.

11.1.2 Animal Species Theme

The screening tool rated the sensitivity of the Animal Species Theme as high (Figure 22).

Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Figure 22: Map and outcome of Animal Species Theme sensitivity generated by the screening tool.

Animal species highlighted by the screening tool for the site:

Sensitivity	Feature(s)
High	Aves-*Circus ranivorus*
High	Aves-*Eupodotis senegalensis*
High	Aves-*Hydroprogne caspia*
High	Aves-*Polemaetus bellicosus*
High	Aves-*Sagittarius serpentarius*
High	Aves-*Mycteria ibis*
Medium	Aves-*Tyto capensis*
Medium	Aves-*Circus ranivorus*
Medium	Aves-*Hydroprogne caspia*
Medium	Aves-*Eupodotis senegalensis*
Medium	Insecta-*Lepidochrysops procera*
Medium	Mammalia-*Crocidura maquassiensis*
Medium	Mammalia-*Hydrictis maculicollis*
Medium	Mammalia-*Ourebia ourebi ourebi*

11.1.3 Relative Terrestrial Biodiversity theme

The screening tool rated the sensitivity of the Relative Terrestrial Biodiversity theme as very high (Figure 23).

Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Figure 23: Map and outcome of Relative Terrestrial Biodiversity sensitivity generated by the screening tool.

The following features were highlighted:

Sensitivity	Feature(s)
Very high	Critical Biodiversity Area 1
Very high	Critical Biodiversity Area 2
Very high	Ecological support area: landscape corridor
Very high	Ecological support area: local corridor
Very high	Endangered ecosystem: Tsakane Clay Grassland
Very high	Vulnerable ecosystem: Soweto Highveld Grassland
Very high	Protected Areas Expansion Strategy

11.2 Screening tool in relation to background study and site verification

11.2.1 Plant Species Theme

Our field survey and application of a sensitivity model indicated that the vegetation in most of the habitats (plant communities) on site had a **low** sensitivity.

- Sensitive species 691 is known to occur on site (MTPA database). It occurs in damp depressions in shallow soil over rock sheets. This habitat should be avoided by the development.
- None of the other SCC highlighted by the screening tool were recorded on site.
- The habitats on site do not present suitable habitat for sensitive species 1252 and 1248 because of a lack of suitable wooded habitat. Moreover, the rocky outcrops on hilly terrain with a sparse woody cover were avoided by the development. Neither of these species were listed for the region on the NewPosa database nor in the MTPA database for the farms in the immediate vicinity of the Impumelelo site (data provided by MTPA; MBSP 2022).
- *Khadia beswickii* occurs in rocky habitats on shallow soil (sheetrock) but usually on ridges or hilltops. It was not recorded on site. One location for *Khadia beswickii* was indicated in the region to the south of the site

(data provided by MTPA). Furthermore, as a precautionary measure, the rocky habitats (Habitats 1, 2 & 3) were avoided in the layout of the infrastructure on the Impumelelo site.

11.2.2 Animal Species Theme

- **The avifaunal and bat components will be addressed by the avifaunal and bat specialists.**
- The Screening Tool listed *Lepidochrysops procera* (Lepidoptera) as a SCC for the site. However, it was not listed in the ADU database, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops procera* was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was scarce and only recorded in one location.
- The oribi *Ourebia ourebi* is found in patchy distributions in open and wooded mesic grassland. Their habitat is largely fragmented due to human socio-economic activities including agriculture, forestry and mining. It was not recorded during the survey or mentioned by the landowners on site.
- The Maquassie Musk Shrew *Crocidura maquassiensis* was not listed for the region in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province. It was not recorded on site during the survey. The Maquassie Musk Shrew depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. The main threats to shrews are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. *Crocidura maquassiensis* has not been reported from Mpumalanga Province post-1999 and thus there is a very low probability for it to occur on site.
- The spotted-necked otter *Hydrictis maculicollis* was not listed for the region in the ADU mammal species list but was included in the MNCA (1998) lists for the Mpumalanga province. It was not recorded on site during the survey. Marginally suitable habitat for the spotted-necked otter is available on site. It occurs widespread, but it is restricted to areas of permanent fresh water offering good shoreline cover and an abundant prey base. The proposed WEF will not encroach into any drainage lines.
- What the screening tool did not highlight was the possible presence of the giant girdled lizard, a species with a Vulnerable IUCN status. However, the species was not recorded on site nor listed in the MTPA database for the farms in the immediate vicinity of the Impumelelo site. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelelo site.
- The screening tool did also not highlight the presence of three Near Threatened species, viz. the Southern African hedgehog (*Atelerix frontalis*), serval (*Leptailurus serval*) and Southern African vlei rat (*Otomys auratus*), which have been reported for the Impumelelo site. It is unlikely that the development will affect the Southern African vlei rat, since the vlei habitat should be avoided. During construction the serval will avoid the area, but it could return during the operational phase. Construction workers should be made aware of not harming the Southern African hedgehog, however due to its size most individuals will go unnoticed.
- Overall sensitivity of the animal theme (**avifaunal and bat components excluded**) is thus rated as **medium.** However, if the suggested mitigation measures are followed the animal SCC should not be negatively affected.

11.2.3 Relative Terrestrial Biodiversity Theme

- This theme considers the presence of protected areas, Endangered ecosystem, Vulnerable ecosystem, Protected Area Expansion Strategy (NPAES), CBAs, ESAs and National Freshwater Ecosystem Priority Areas (NFEPAs).
- The study area is not located in a protected area but does fall partly in an area earmarked for the NPAES (NPAES 2018) and the 5-year and 20-year MPAES plan (data supplied by MTPA).

- The endangered vegetation type or ecosystem highlighted in the Screening Tool refers to the Tsakane Clay Highveld, which covers only about one hectare in the far west of the Impumelelo site and no infrastructure is planned for that area.
- The Soweto Highveld Grassland is classified as a Vulnerable vegetation type. However, large portions of the site have been heavily or moderately modified (compare CBA map, Figure 18) and are not prime examples of the Soweto Highveld Grassland. If the development is thus contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered for the allocation of a vulnerable status of the vegetation type.
- Our background study indicated that there are CBAs and ESAs present on site. Our vegetation sensitivity analysis rated most of these areas as being of low sensitivity except for the wetlands (Habitat 7), which have a high sensitivity. Sensitivity of Habitats 1 and 3 was rated as moderate, but the development has not encroached onto these habitats. Nevertheless, wind turbines should avoid CBA1s and wherever possible not be located within areas demarcated as CBA2s and relocating or micrositing of approximately thirteen turbines might be necessary.
- There are ESA Landscape corridors and ESA Local corridors indicated on site (Figure 18) The MBSP (2014) was ambiguous as to whether energy-generation facilities such as wind farms (mentioned under Utilities zone, U) could under certain conditions be located in ESAs. In the text of the MBSP (2014), this category (U) was not biodiversity-compatible and should not be located in CBAs or ESAs, whereas Table 18 indicated that CBAs and ESAs are permissible under certain conditions. One turbine (MK01) is located in an ESA Landscape Corridor.

Freshwater Ecosystem Priority Areas (FEPAs) or water catchments were not flagged by the screening tool. Based on the site assessment of the vegetation most of the area mapped as upstream river FEPA was rated as having a low or medium sensitivity, with only the drainage lines having a high sensitivity. Several Mgumalanga Highveld Wetlands are present on site (Figure 19)(see aquatic specialist report), but these were also not highlighted by the Screening Tool.

Unfortunately, the screening tool on site limits the sensitivity outcome of the Relative Terrestrial Biodiversity Theme to either Very High or Low. This is an issue which should be revisited by DFFE since it does not give a proper representation of the site conditions. Although we agree with the presence of the CBAs, ESAs, NPAES, MPAES and Vulnerable ecosystem, the entire site does not qualify as having a 'Very High Sensitivity', since a relative large proportion of the site (approximately 32%) is degraded and moderately or heavily modified.

12. ENVIRONMENTAL IMPACTS

12.1 Introduction

In this section the issues, risks and impacts associated with the project from a terrestrial biodiversity and species viewpoint are presented.

12.2 Key issues

- The key issues are that parts of the site have been identified as CBAs and ESAs as well as Priority Focus Areas (NPAES 2018). Infrastructure positioning should be modified/amended to avoid the CBA1s and as far as possible the CBA2s. Any sites within CBAs should where possible be micro-sited prior to approval of final layout.
- Furthermore, the site falls mostly within a 'Vulnerable' vegetation type (Soweto Highveld Grassland) as well as in a very small area of an 'Endangered' vegetation type (Tsakane Clay Grassland). Their status is due to high percentages of transformed habitat. Preference should therefore be given to heavily or moderately modified areas to locate turbines.

12.3 Impacts during the construction phase

12.3.1 Direct impacts during the construction phase

- Potential impact 1: The clearing of natural vegetation
- Potential impact 2: Construction of roads
- Potential impact 3: The loss of threatened, protected, CITES listed and/or endemic plants/animals
- Potential impact 4: Loss of faunal habitat
- Potential impact 5: Direct faunal mortalities due to construction and increased traffic
- Potential impact 6: Increased dust deposition
- Potential impact 7: Increased human activity, noise and light levels

12.3.2 Indirect impacts during the construction phase

- Potential impact 1: Establishment of alien vegetation
- Potential impact 2: Increased water run-off and erosion
- Potential impact 3: Changes in animal behaviour

12.4 Impacts during the operational phase

12.4.1 Direct impacts during the operational phase

- Potential impact 1: Direct faunal mortalities
- Increased light and noise levels and changes in animal behaviour

12.4.2 Indirect impacts during the operational phase

- Potential impact 1: Establishment of alien vegetation
- Potential impact 2: Increased water run-off and erosion
- Potential impact 3: Changes in animal behaviour

12.5 Impacts during the decommissioning phase

12.5.1 Direct impacts during the decommissioning phase

- Potential impact 1: Direct faunal mortalities
- Potential impact 2: Increased dust deposition

12.5.2 Indirect impacts during the decommissioning phase

- Potential impact 1: Establishment of alien vegetation
- Potential impact 2: Increased water run-off and erosion

12.6 Cumulative impacts

- Cumulative impact 1: Vegetation loss and habitat destruction
- Cumulative impact 2: Compromising integrity of CBAs, ESAs and NPAES
- Cumulative impact 3: Reduced ability to meet conservation obligations & targets
- Cumulative impact 4: Loss of landscape connectivity and disruption of broad-scale ecological processes

13. ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACT

13.1 Introduction

The impacts of the proposed development on the terrestrial biodiversity and species were assessed based on the knowledge gained during the site visit and literature review. Each of the impacts is briefly described below in terms of the nature; proposed mitigation measures; and the significance of the impact without and with the mitigation measures applied. The methodology follows the guidelines provided by the CSIR as set out below (DEAT Guideline 5: Assessment of Alternatives and Impacts (DEAT 2006)), and the following methodology is applied to the prediction and assessment of impacts and risks:

Potential impacts and risks have been rated in terms of the direct, indirect and cumulative impacts:

- **Direct impacts:** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts:** are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- **Cumulative impacts:** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts. The cumulative impacts are assessed by identifying other wind and solar energy project proposals and other applicable projects, such as construction and upgrade of electricity generation, and transmission or distribution facilities within 30 km of the proposed Impumelelo site that have been approved (i.e. positive EA has been issued) or is currently underway.

The impact assessment methodology includes the following aspects (methodology provided by CSIR):

- **Nature of impact/risk** - The type of effect that a proposed activity will have on the environment.

- **Status** - Whether the impact/risk on the overall environment will be
    - Positive - environment will benefit overall from the impact/risk.
    - Negative - environment will be adversely affected overall by the impact/risk.
    - Neutral - environment overall will not be affected.

- **Spatial extent** – The size of the area that will be affected by the impact/risk:
    - Site specific.
    - Local (<10 km from site).
    - Regional (<100 km of site).
    - National.
    - International (e.g. Greenhouse Gas emissions or migrant birds).

- **Duration** – The timeframe during which the impact/risk will be experienced:
    - Very short term – instantaneous.
    - Short term - less than 1 year.

  - Medium term - 1 to 10 years.
  - Long term - the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration).
  - Permanent - mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning).

- **Consequence (Severity)** – The anticipated consequence of the risk/impact:
  - Extreme - extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease.
  - Severe - severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease.
  - Substantial - substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease.
  - Moderate - notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function, but in a modified manner.
  - Slight - negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected.

- **Reversibility of the Impacts** - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High reversibility - impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment.
  - Moderate reversibility of impacts.
  - Low reversibility of impacts.
  - Impacts are non-reversible - impact is permanent, i.e. this is the least favourable assessment for the environment.

- **Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks** – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High irreplaceability of resources - project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment.
  - Moderate irreplaceability of resources.
  - Low irreplaceability of resources.
  - Resources are replaceable - the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment.

Using the criteria above, the impacts are further assessed in terms of the following:

- **Probability** – The probability of the impact/risk occurring:
  - Extremely unlikely (little to no chance of occurring)
  - Very unlikely (<30% chance of occurring)
  - Unlikely (30– 50% chance of occurring)
  - Likely (51 – 90% chance of occurring)
  - Very Likely (>90% chance of occurring regardless of prevention measures).

To determine the significance of the identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 24).

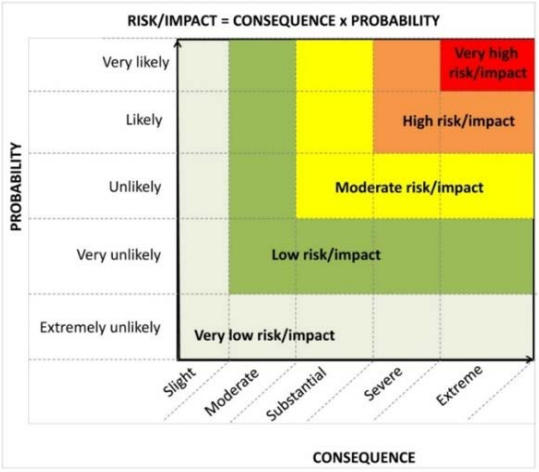


Figure 24: Guide to assessing risk/impact significance as a result of consequence and probability.

- **Significance** – Will the impact cause a notable alteration of the environment?
    - Very low - the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making.
    - Low - the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making.
    - Moderate - the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated.
    - High - the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making.
    - Very high - the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5
- Low = 4
- Moderate = 3
- High = 2
- Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- Low
- Medium
- High

13.2 Impacts during the construction phase and their significance

13.2.1 Direct impacts during the construction phase

The clearing of natural vegetation

Nature: Natural vegetation will be cleared for the turbines and crane pads, new access roads, upgrading of existing tracks, laydown site, construction site and batching plant and substation. The removal of indigenous vegetation may cause a loss of individuals of threatened, protected and/or endemic species and will also be accompanied by a loss of faunal habitat. However, no threatened or endemic plant species were found on site and all provincially protected plant species have a Least Concern status. None of the SCC listed by the Screening Tool, were recorded on site. Vegetation loss is generally also associated with increased water run-off and erosion (see indirect impacts).

Since the turbine footprint is relatively small and spread across the site, the loss of prime habitat within the Soweto Highveld Grassland vegetation type can be constrained by well-planned positioning of the turbines. Service roads generally have a larger impact on vegetation clearance than the turbines, however since the roads will have a gravel surface animal movement should still be possible. Beyond the permanent infrastructure footprint, environmental functions and processes should however, not be altered.

Proposed mitigation measures:

- Avoid CBA1s and wherever possible, CBA2s should preferably be avoided.
- A preconstruction walk-through of the development footprint for the purpose of turbine and crane pad micrositing could ensure that no SCC are present at these sites.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. This includes awareness as to remaining within demarcated construction areas, no littering, handling of pollution and chemical spills, avoiding fire hazards and minimising wildlife interactions.
- Ensure that all temporary use areas e.g. laydown areas and construction camp, are located in areas of low sensitivity.
- Footprints of the turbines, crane pads, roads, construction and substation locations should be clearly demarcated. Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided.
- Watercourses, wetlands, rocky outcrops/sheets and rocky grasslands should be avoided where possible (Habitats 1, 3 & 7).
- Observe buffer zones along drainage lines (see Environmental Impact Report of aquatic specialist).
- All vehicles are to remain on demarcated roads and no driving through the veld should be allowed.
- The ECO is to provide supervision on vegetation clearing activities and other activities that may cause damage to the environment, especially when construction commences and most vegetation clearing is taking place.
- No plants may be translocated or otherwise uprooted or disturbed without express permission from the ECO.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Medium term
Consequence (Severity)	Substantial	Moderate
Probability	Very likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Low
Significance	**Moderate**	**Low (entire site)**
Confidence level of assessment	Medium	Medium

Construction of roads

Nature: Roads are referred to under several impacts, but a summary is provided in this section. Even in natural regions roads are intrusive and destructive and cause a disturbance. Their construction destroys the vegetation, leads to compaction of the soil and loss of habitat for small animals. Roads create barriers for small animals, cutting off dispersal routes and fragmenting habitats. Animals crossing or moving along roads can become easy targets for predators. Compacted roads also impact on the movement of subterranean and burrowing animals. Dust kicked up by vehicles coat the roadside plants making them less attractive to animals. Poorly planned roads often result in water erosion problems and busy roads affect the movement of especially shy animals. Some destruction of the vegetation adjacent to the footprint will also inevitably occur when preparing the sites. Unnecessary clearing of vegetation beyond the footprint of the development can however, largely be avoided.

Proposed mitigation measures:

- Wherever possible, existing roads should be used.
- The construction of a road should be done in the most environmentally sensitive manner possible.
- A suitably qualified person should plan, design and supervise the proper construction of roads to minimize the impact on the environment.
- Roads should be provided with run-off structures to reduce the risk of erosion.
- Proper road maintenance procedures should be in place.
- A long-term commitment to the maintenance of the road should be accepted. Roads can easily become ruts and erosion gullies if not properly planned and maintained.
- Driving in wet clayey soils after rain also result in deep tracks that damage the road surface and lead to other users bypassing such areas, thereby forming new tracks alongside the original ones.
- River/stream crossings should not be placed in areas with extensive wetlands and preferably in areas where the risk of disruption and erosion is low. All river/stream crossings should be inspected by the aquatic specialist to ensure that optimal and acceptable locations have been chosen for river crossings.
- River/stream crossings should be specifically designed not to impede or disrupt the direction and flow of the water. Specific guidelines of the aquatic specialist should be followed.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site-specific	Site-specific
Duration	Long-term	Long-term
Consequence (Severity)	Substantial	Moderate
Probability	Very likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Moderate**	**Low**

Confidence level of assessment	Medium	Medium

The loss of threatened, protected & endemic plant species

Nature: The loss of the vegetation for the turbines and crane pads, new access roads, upgrading of existing tracks, construction site and substation may cause a loss of individuals of threatened, protected or endemic plant species. The site visit and records provide by MTPA revealed the presence of Sensitive species 691 with an IUCN threatened status; two SCC with a Near Threatened status (*Gladiolus robertsoniae* and *Kniphofia typhoides*) and several MNCA protected species, while no endemic species are listed for either the Soweto Highveld Grassland or the Tsakane Clay Grassland. As the other protected plant species at the site are not threatened, the loss of a small number of individuals (if any) is not likely to threaten the local or regional population of these species.

Proposed mitigation measures:

- A preconstruction walk-through of the development footprint for the purpose of turbine and crane pad micrositing could ensure that no SCC are present at these sites.
- Placement of infrastructure should be done in such a way as to minimise the impact on protected species.
- The construction crew should undergo environmental training (induction) to make them aware of the importance of protected species.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Long-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Unlikely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Very low**	**Very Low**
Confidence level of assessment	Medium	Medium

Loss of faunal habitat

Nature: The loss of the vegetation due to turbines and crane pads, new access roads, upgrading of existing tracks, construction site and substation will be accompanied by a loss of faunal habitat.

Rare species reported for the region by the landowners, include the Near Threatened serval *Leptailurus serval*, Southern African hedgehog *Atelerix frontalis* and the Southern African vlei rat *Otomys auratus.* The screening report refers to *Crocidura maquassiensis* (Maquassie musk shrew), *Hydrictus maculicollis* (spotted-necked otter) and the oribi *Ourebia ourebi* as the species of concern. The Maquassie musk shrew depends on wetlands as suitable habitat. It is very rare and for example has not been reported from Mpumlanga post-1999. It is patchily distributed and the nearest recording was at Loskop Dam to the north. It may tolerate a wide range of habitats, including urban and rural landscapes. However, there is a very low probability for it to occur on site. Marginally suitable habitat for the spotted-necked otter is also available on site. However, even if the species did occur on site it is unlikely that they would be affected by the development since their habitats will be avoided by the development. The oribi was not recorded during the survey or mentioned by the landowners on site. The Lepidopteran species is unlikely to occur on site even though their host plant *Ocimum obovatum* was recorded on site.

Proposed mitigation measures:

- Placement of infrastructure should be done in such a way as to minimise the impact on protected species.
- Vegetation clearance should be confined to the smallest possible footprint of the development and unnecessary clearance should be avoided.
- Construction crew should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Speed limits should be set on all roads and strictly adhered to.
- Development should avoid watercourses, wetlands and rocky outcrops/sheets.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the sites.
- Observe buffer zones along drainage lines.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Unlikely
Reversibility	Low	**Low**
Irreplaceability	Moderate	Moderate
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Direct faunal mortalities due to construction and increased traffic

Nature: Faunal mortalities may be caused by construction at the footprint of the infrastructure, construction vehicles or other operational activities and by electrical fences, should they be erected around the construction site and substation. In particular slow-moving species such as tortoises, might be prone to these mortalities. When animals ingest waste material or become ensnared in wires, fatalities might also occur.

Larger more mobile fauna such as antelope and larger predators will most likely move away from areas of high activity during the construction phase. Smaller and less-mobile animals are not as capable of moving away and may seek shelter down burrows and other shelter sites. None of the threatened species occurring regionally were encountered on site and generally these species occur at a low density and thus it is unlikely that they would be directly encountered by construction workers. None of the SCC listed in the screening tool were encountered on site.

Proposed mitigation measures:

- Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns in order to reduce the number of kills during construction and on roads. The crew should also be made aware of not harming or collecting species such as snakes, tortoises and owls.
- Proper waste management procedures should be in place to avoid litter, food or other foreign material from lying around and all waste material should be removed from the site.
- No activity, including night driving, should be allowed at the site.
- Speed limits should be set on all roads on site.
- Personnel should not be allowed to roam into the veld.
- Ensure that cabling and electrical infrastructure at the site are buried sufficiently deeply to avoid being excavated by fauna and that where such infrastructure emerges above-ground that it is sufficiently protected from gnawing animals.

- Any dangerous fauna (e.g. snakes, scorpions) that are encountered during construction should not be harmed by construction staff and the ECO (or other suitably qualified person) should be contacted to remove the animals to safety.
- Holes and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days, should have an escape ramp to allow any fauna that fall in to escape.
- If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals.
- Should electrical fences be erected it must be done according to the norms and standards of the Nature Conservation Authorities in Mpumalanga.
- Access to the site should be regulated to reduce opportunities for poaching.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Low**	**Very Low**
Confidence level of assessment	Medium	Low

Increased dust deposition

Nature: Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing. The increased dust levels will however be temporary.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water onto the exposed soil surface.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Unlikely
Reversibility	High	High
Irreplaceability	-	-
Significance	**Low**	**Very Low**
Confidence level of assessment	High	High

Increased human activity, noise and light levels

Nature: Construction activities will increase human presence, noise and light levels at the site. These activities may affect animal behaviour. However, increased noise and light levels associated with the construction phase are temporary.

Proposed mitigation measures:

- The SANS standards should be adhered to in terms of noise levels.
- No construction should be done at night.
- If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Substantial	Moderate
Probability	Likely	Likely
Reversibility	High	High
Irreplaceability	-	-
Significance	**Moderate**	**Low**
Confidence level of assessment	High	High

13.2.2 Indirect impacts during the construction phase

Establishment of alien vegetation

Nature: As a result of the clearance of indigenous vegetation and resulting degradation, alien species might invade the area. Twelve declared alien invasive plant species were recorded on the three Enertrag sites and 35 naturalised species (Appendic B). Another four naturalised alien species were listed by NewPosa for the region.

Six declared invasive species were noted on the Impumelelo site and increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation. Bare areas that are not actively rehabilitated and areas receiving runoff are particularly vulnerable to alien infestation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- A control program should be employed to combat declared alien invasive plant species in the most environmentally friendly manner that does not result in undesirable secondary impacts.
- Herbicides for the control of alien species should be applied according to the relevant instructions and by appropriately trained personnel.
- No alien species should be used in rehabilitation or landscaping.
- Use only plants and seed collected on-site for revegetation.
- Cleared areas may need to be fenced-off during rehabilitation to exclude livestock and wildlife.
- Material brought onto site e.g. building sand should be regularly checked for the germination of alien species.
- Revegetate all construction sites as soon as they are no longer needed.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight

Probability	Likely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

Increased water run-off and erosion

Nature: Increased water run-off and erosion will be caused by the clearing of the indigenous vegetation and compaction of soil on the crane pads. The roads traversing hill slopes will be the main source of erosion if not properly constructed and provided with structures to deflect water run-off. In addition, the hardened surfaces created by the roads, crane pads and other infrastructure will increase runoff, which will pose an erosion risk in the areas receiving the water, even if these areas have not been disturbed. Increased run-off and erosion could affect hydrological processes in the area and change water and silt discharge into the streams.

The site lies within the summer rainfall region and can experience intense thundershowers, which will increase the potential for erosion. On slopes, active rehabilitation and mitigation measures to prevent erosion will be required.

Proposed mitigation measures:

- Clearing of vegetation and compaction should be restricted to the footprint of the proposed development.
- All roads should have structures to deflect water run-off to disperse the water into the receiving area.
- A rehabilitation and revegetation plan should be developed as part of the EMP.
- Regular monitoring of the site during construction for erosion problems.
- Silt traps should be used where there is a danger of topsoil eroding and entering streams and other sensitive areas.
- If applicable, topsoil should be removed and stockpiled, then reapplied as soon as possible in order to facilitate regeneration of the natural vegetation on cleared areas.
- Reduce activity on site after large rainfall events when the soils are wet. No driving off hardened roads until soils have dried out and the risk of bogging down has decreased.
- A suitably qualified person should plan, design and supervise the proper construction of roads to minimise the impact on the environment.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site-specific to regional	Local
Duration	Long-term	Long-term
Consequence (Severity)	Substantial	Moderate
Probability	Likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Moderate**	**Low**
Confidence level of assessment	Medium	Medium

Changes in animal behaviour

Nature: The increased human presence and/or construction operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels and loss of animal habitat may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and

consequently change the composition of the animal communities. Species with small territories may be negatively affected as well as species that live in the soil.

Research elsewhere showed that the response of animals to wind energy facilities was **highly species-specific** and could range from avoidance to a positive reaction. The response was apparently also depended on the level of predation, with no impact noted where predation pressure was low. Wind farms affect large terrestrial mammals mainly through an increase in human activity within the wind farm area. During the construction phase, the mobile large-mammal carnivores and ungulates may temporarily avoid the site, but when construction ceases and human presence decreases, these animals generally acclimate to the wind energy infrastructure. The impact on burrowing fauna may be higher, since these animals are usually sensitive to soil tremors and disturbances, and consequently they will likely move away from construction areas. It is anticipated that the impact of the Impumelelo site on the fauna would mostly be temporary, i.e. during the construction phase.

Proposed mitigation measures:

- Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Development should avoid wetlands and rocky sheets.
- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Appropriate lighting should be installed to minimise negative effects on nocturnal animals.
- No activity should be allowed at the site between sunset and sunrise.
- The mitigation measures as indicated by the noise specialist must be adhered to.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site-specific	Site-specific
Duration	Long-term	Medium-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

13.3 Impacts during the operational phase and their significance

13.3.1 Direct impacts during the operational phase

Direct faunal mortalities

Nature: Faunal mortalities may be caused by maintenance vehicles or other maintenance activities, electric fences and ingestion of waste material. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals become ensnared in wires or in electric fences. Bird and bat collisions with the wind turbine blades will be addressed by the avifaunal and bat specialists.

Although activity at the site is likely to be relatively low during operation, some impact on fauna may still occur as a result of personnel present on site as well as the operation of maintenance vehicles. Direct interactions between the turbines

and terrestrial fauna (excluding avifauna) are likely to be low. Major risk factors during operation are likely to be from vehicle collisions with fauna.

Proposed mitigation measures:

- Maintenance crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Access to the site should be strictly controlled.
- All excess wires, cables and waste material should be removed from the site.
- All vehicles at the site should adhere to a low speed limit and slow-moving fauna such as tortoises on roads should be moved off the road.
- No activity should be allowed at the site between sunset and sunrise.

Additional mitigation measures proposed:

- Electrical fences should be erected according to the norms and standards of the Nature Conservation Authorities in Mpumalanga.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Long-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Very low**	**Very low**
Confidence level of assessment	Medium	Medium

Increased light and noise levels and changes in animal behaviour

Nature: The loss of vegetation cover, compacting of soils, increased noise levels and the increased human presence will alter animal behavioural patterns by making certain areas unavailable and making roads more difficult to traverse. Some animal species will be more affected than others. These species might undergo a reduction in their population size.

According to Todd & Skowno (2014) small mammals, reptiles and amphibians are not likely to move away from the turbines on account of the noise as these animals do not rely on sound to forage and rely largely on plant cover and other avoidance measures to avoid predators. Although frogs communicate with their calls, the pitch of the noise generated by the turbines is not likely to be similar to that of the frogs and a significant impact is unlikely. Fauna which rely heavily on hearing for foraging or predator avoidance are potentially worst affected by the noise. This would include species such as hares which rely on hearing for predator avoidance. However, it is difficult to predict the impact on these species without entering into a high degree of speculation as there has been little research on this topic and hence there is no baseline in terms of known impacts due to turbine noise on fauna, especially within the South African context. However, noise due to turbines at the site will be variable and related to wind direction and operating conditions among other factors. As most fauna are adaptable with regards to noise, it is likely that any affected fauna would adapt to the local conditions and it is not likely that there would be any ecosystem-level or trophic impacts due to turbine noise. According to Todd & Skowno (2014) the possibility that predators such as jackal and caracal would prey more heavily on livestock or wildlife as a result of turbine noise, is not a likely scenario.

Proposed mitigation measures:

- The mitigation measures as indicated by the noise specialist must be adhered to.
- Maintenance crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Appropriate lighting should be installed to minimise negative effects on nocturnal animals.
- No activity should be allowed at the site between sunset and sunrise.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very Low**
Confidence level of assessment	Medium	Medium

13.3.2 Indirect impacts during the operational phase

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, primarily during the construction phase, alien species might invade the area. Alien invasive species are generally more common along roads than the adjacent undisturbed farmland. The invasion by alien species will continue unless controlled. Increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may eventually cause changes to the structure and functioning of the ecosystem which often exacerbate the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.
- No alien species should be used for landscaping, rehabilitation or any other purpose.
- Clearing of alien species should be done on a regular basis.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very Low**
Confidence level of assessment	Medium	Medium

Increased water run-off and erosion

Nature: Disturbance created during construction will take several years to fully stabilise and the increase in compacted areas as a result of roads may increase runoff which will pose an erosion risk. Particular areas of concern would be roads traversing slopes as well as any infrastructure on gentle slopes with erodible soils. Consequently, erosion risk during operation is likely to be centred on areas disturbed during construction and on areas receiving runoff from roads and similar hardened surfaces. Increased run-off and erosion could affect hydrological processes in the area and may change water discharge into the streams and increase silt load.

Proposed mitigation measures:

- Proper road maintenance procedures should be in place.
- Regular monitoring of the site during operation for erosion problems.
- Should new sections of the road be needed, a suitably qualified person should plan, design and supervise the proper construction of roads.
- Reduced activity at the site after large rainfall events when the soils are wet.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

13.4 Impacts during the decommissioning phase and their significance

13.4.1 Direct impacts during the decommissioning phase

Faunal mortalities

Nature: Faunal mortalities may be caused by vehicles or other decommissioning activities and waste. In particular slow-moving species such as tortoises, might be prone to road mortalities. When animals ingest waste material or become ensnared in it fatalities might also occur.

Proposed mitigation measures:

- Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns.
- Speed limits should be adhered to.
- Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Unlikely

Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Very Low**	**Very low**
Confidence level of assessment	Medium	Medium

Increased dust deposition

Nature: Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur. The dust layer on the vegetation may also discourage herbivores from grazing or browsing the dust covered vegetation. The increased dust levels will be temporary.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water onto the soil and/or other suitable dust suppression methods.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Unlikely
Reversibility	High	High
Irreplaceability	-	-
Significance	**Low**	**Very low**
Confidence level of assessment	High	High

13.4.2 Indirect impacts during the decommissioning phase

Establishment of alien vegetation

Nature: As a result of the decommissioning activities, areas will be disturbed and alien species might invade. Increased vehicle traffic may facilitate the introduction of seeds of alien species.

Proposed mitigation measures:

- Implement a monitoring program for at least three years after decommissioning to document vegetation recovery and alien infestation across the site.
- A control program to combat declared alien invasive plant species should be employed.
- Areas where infrastructure are removed, must be revegetated with indigenous plant species.
- No alien species should be used for rehabilitation/revegetation or any other purpose.

Note: Once rehabilitation is completed and signed off by the ECO, the Developer will have to hand over the land back to the land owner. This will then become the land owners responsibility.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Likely

Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

Increased water run-off and erosion

Nature: Some of the existing roads might have to be upgraded and increased erosion and water run-off will thus be caused by the clearing of the indigenous vegetation and soil disturbance. Decommissioning would involve the removal of the infrastructure of the facility and the rehabilitation of the roads and other hard infrastructure of the facility. If the rehabilitation is not successful, this would leave the site vulnerable to erosion. Without management, increased run-off and erosion could affect hydrological processes in the area and may change water discharge into the streams and increase silt load.

Proposed mitigation measures:

- No new roads should be built.
- Proper road maintenance procedures should be in place.
- Removal of all infrastructure components from the site.
- Rehabilitation of all cleared and disturbed areas with local species.
- Off-site disposal of all facility components.
- Monitoring programme for at least three years after decommissioning to document vegetation recovery on site.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

13.5 Cumulative impacts

Three renewable energy developments occur within 50 km from the site and were taken into consideration for cumulative impacts.

- The authorised Tutuka 65.9 MW Solar Photovoltaic (PV) Energy Facility and its associated infrastructure (Ref: 14/12/16/3/3/2/754) located southeast of the site;
- The proposed Mukondeleli WEF to be located approximately 25 km east of the site;
- The proposed Vhuvhili Solar Energy Facility (NEAS No. MPP/EIA/0001063/2022) located approximately 35 km east of the site.

Vegetation loss and habitat destruction

Nature: Vegetation loss, habitat destruction and possibly loss of SCC, can occur when considering all developments. The habitat destruction will lead to changes in the physical features of the habitat, with concomitant changes in ecological

processes. Secondary vegetation will develop at sites where the vegetation was cleared or the soil compacted. The species composition may change and alien species might invade. Vegetation loss will also constitute the loss of animal habitat. It should however be noted that in the case of wind energy facilities vegetation loss due to habitat destruction is far more contained than in the case of solar facilities. The contribution by the Impumelelo site to the cumulative impact will therefore be small.

Proposed mitigation measures:

- All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible.
- Placement of infrastructure should be done in such a way that no SCC are affected and CBAs as far as possible be avoided.
- Positioning of the wind turbines in the most environmentally responsible manner is crucial.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Substantial	Moderate
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Moderate**	**Low**
Confidence level of assessment	Medium	Medium

Compromising integrity of CBA, ESA and NPAES

Nature: Some of the proposed developments are located within NPAES, MPAES and CBAs in the current layout. Development within CBA1s should be avoided and development in CBA2s is not encouraged as such development may result in biodiversity loss and therefore compromise the integrity of the CBA. However, the contribution by the Impumelelo site to the cumulative impact will likely be small. Although there are currently not many projects within 50 km from the Impumelelo site, this could in future change and the integrity of the CBAs could be compromised and consequently the biodiversity target for the ecosystem could be affected.

It is assumed that authorisation would only be granted to projects that have similarly avoided CBAs, especially CBA1s.

Proposed mitigation measures:

- Avoid placing of turbines and other large infrastructure in CBA1s. CBA2s should also be avoided as far as possible.
- Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided.
- Minimise the development footprint as far as possible.
- Stringent construction-phase monitoring of activities at the site to ensure that mitigation measures are adhered to and that the overall ecological impact of the development is maintained at a low level.
- Align roads and other infrastructure so that transformation within the CBAs is minimised.
- The use of structures which may inhibit movement of fauna, e.g. mesh or electric fencing should be avoided, where feasible.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Unlikely
Reversibility	Low to moderate	Low to moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Reduced ability to meet conservation obligations & targets

Nature: The loss of unprotected vegetation types on a cumulative basis from the area may impact the countries' ability to meet its conservation targets. Very few statutorily conserved areas occur in the Vulnerable Soweto Highveld Grassland and almost half of it has been transformed mostly by cultivation, plantations, mining and urbanisation. It has a conservation target of 24% and was classified as Not Protected (0.6%) in the 2018 National Biodiversity Assessment (SANBI 2019). According to the current layout, some of the turbines, construction sites and substations fall in CBAs, seeps and areas of medium sensitivity and should preferably be relocated or micro-sited. Large areas of the site are heavily modified and the WEF infrastructure should seek to utilise these heavily modified areas. These areas have already been included in the transformed % for the vegetation type and will thus not affect its conservation status. Furthermore, parts of the Impumelelo site are classified as Priority Focus Areas in the NPAES (2018).

Proposed mitigation measures:

- Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided.
- Minimise the development footprint as far as possible.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Substantial	Moderate
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Moderate**	**Low**
Confidence level of assessment	Medium	Medium

Loss of landscape connectivity and disruption of broad-scale ecological processes

Nature: The presence of the facility and the associated transformation of intact vegetation, could pose a threat to the connectivity of the landscape. Subterranean species that have to emerge from the soil to cross roads will also

be affected. The severity of these impacts for subterranean species is likely to be relatively low as the roads required for operation will still be of a natural surface such as gravel and would experience low traffic volumes.

Because of the relatively small footprint of the wind turbines, the facility is unlikely to disrupt pollination and dispersal processes that could cause spatial fragmentation of populations. In the long-term the facility is not likely to create significant local or regional population-level impact on fauna or vegetation.

Proposed mitigation measures:

- Preconstruction walk-through of the facility infrastructure to ensure that sensitive areas are avoided and least-impact locations are identified for river/stream crossings.
- Minimising the development footprint wherever possible.
- Revegetation of all cleared and bare areas created by the facility with local plant species.
- Fences and other structures which impede faunal movement should be avoided.
- Roads should not have steep curbs.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

13.6 Impact assessment summary

Tables 6-9 summarise the impact assessment across all phases of the development and the integrated assessment post-mitigation per phase is provided in Table 9.

Table 6: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the construction phase

(a) Direct impacts

Impact	***Impact Criteria (after mitigation)***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
CONSTRUCTION PHASE: DIRECT IMPACTS						
The clearing of natural vegetation	Status	Negative	Moderate	• Avoid all CBA1s and wherever possible preferably also CBA2s. • A preconstruction walk-through of the development footprint for the purpose of turbine and crane pad micrositing could ensure that no SCC are present at these sites. • Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. This includes awareness as to remaining within demarcated construction areas, no littering, handling of pollution and chemical	Low - 4	Medium
	Spatial Extent	Site specific				
	Duration	Medium term				
	Consequence	Moderate (considering entire site)				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

				spills, avoiding fire hazards and minimising wildlife interactions. • Ensure that all temporary use areas e.g. laydown areas and construction camp, are located in areas of low sensitivity. • Footprints of the turbines, crane pads, roads, construction and substation locations should be clearly demarcated. Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. • Watercourses, wetlands, rocky outcrops/sheets and rocky grassland should be avoided (Habitats 1, 3 & 7). • Observe buffer zones along drainage lines (see Environmental Impact Report of aquatic specialist). • All vehicles are to remain on demarcated roads and no driving through the veld should be allowed. • The ECO is to provide supervision on vegetation clearing activities and other activities that may cause damage to the environment, especially when construction commences and most vegetation clearing is taking place. • River/stream crossings should be placed in areas without extensive wetlands and preferably in areas where the risk of disruption and erosion is low. All river/stream crossings should be inspected by the aquatic specialist to ensure that optimal and acceptable locations have been chosen for river crossings. River/stream crossings should be specifically designed not to impede or disrupt the direction and flow of the water. Specific guidelines of the aquatic specialist should be followed. • No plants may be translocated or otherwise uprooted or disturbed without express permission from the ECO.		
Construction of roads	Status	Negative	Moderate	• Wherever possible, existing roads should be used. • The construction of a road should be done in the most environmentally sensitive manner possible. • A suitably qualified person should plan, design and supervise the proper construction of roads to minimize the impact on the environment. • Roads should be provided with run-off structures to reduce the risk of erosion. • Proper road maintenance procedures should be in place. • A long-term commitment to the maintenance of the road should be accepted. Roads can easily become ruts and erosion gullies if not properly planned and maintained. • Driving in wet clayey soils after rain also result in deep tracks that damage the road surface and lead to other users bypassing such areas, thereby forming new tracks alongside the original ones.	Low - 4	Medium
	Spatial Extent	Site-specific				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	Moderate				

				• River/stream crossings should be placed in areas without extensive wetlands and preferably in areas where the risk of disruption and erosion is low. All river/stream crossings should be inspected by the aquatic specialist to ensure that optimal and acceptable locations have been chosen for river crossings. • River/stream crossings should be specifically designed not to impede or disrupt the direction and flow of the water. Specific guidelines of the aquatic specialist should be followed.		
The loss of threatened, protected & endemic plant and animal species	Status Spatial Extent Duration Consequence Probability Reversibility Irreplaceability	Negative Site specific Long-term Slight Unlikely Low Moderate	Very Low	• A preconstruction walk-through of the development footprint for the purpose of turbine and crane pad micrositing could ensure that no SCC are present at these sites. • Placement of infrastructure should be done in such a way as to minimise the impact on protected species. • The construction crew should undergo environmental training (induction) to make them aware of the importance of protected species.	Very low - 5	Medium
Loss of faunal habitat	Status Spatial Extent Duration Consequence Probability Reversibility Irreplaceability	Negative Site-specific Long-term Moderate Unlikely Low Moderate	Low	• Placement of infrastructure should be done in such a way as to minimise the impact on protected species. • Vegetation clearance should be confined to the smallest possible footprint of the development and unnecessary clearance should be avoided. • Construction crew should undergo environmental training (induction) to increase their awareness of environmental concerns. • Speed limits should be set on all roads and strictly adhered to. • Development should avoid watercourses, wetlands and rocky outcrops/sheets. • Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the sites. • Observe buffer zones along drainage lines.	Low - 4	Medium
Direct faunal mortalities	Status Spatial Extent Duration Consequence Probability Reversibility Irreplaceability	Negative Site specific Short-term Slight Likely Low Moderate	Low	• Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns in order to reduce the number of kills during construction and on roads. The crew should also be made aware of not harming or collecting species such as snakes, tortoises and owls. • Proper waste management procedures should be in place to avoid litter, food or other foreign material from lying around and all waste material should be removed from the site. • No activity, including night driving, should be allowed at the site. • Speed limits should be set on all roads on site. • Personnel should not be allowed to roam into the veld.	Very low - 5	Medium

				• Ensure that cabling and electrical infrastructure at the site are buried sufficiently deeply to avoid being excavated by fauna and that where such infrastructure emerges above-ground that it is sufficiently protected from gnawing animals. • Any dangerous fauna (e.g. snakes, scorpions) that are encountered during construction should not be harmed by construction staff and the ECO (or other suitably qualified person) should be contacted to remove the animals to safety. • Holes and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days, should have an escape ramp to allow any fauna that fall in to escape. • If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals. • Should electrical fences be erected it must be done according to the norms and standards of the Nature Conservation Authorities in Mpumalanga. • Access to the site should be regulated to reduce opportunities for poaching.		
Increased dust deposition	Status	Negative	Low	• Excessive dust can be reduced by spraying water onto the soil and/or other suitable dust suppression methods.	Very low - 5	High
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	-				
Increased human activity, noise & light levels	Status	Negative	Moderate	• The SANS standards should be adhered to in terms of noise levels. • No construction should be done at night. • If there is any part of the site that needs to be lit at night for security reasons, then appropriate lighting should be installed to minimise negative effects on nocturnal animals.	Low - 4	High
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	-				

(b) Indirect impacts

Impact	*Impact Criteria (after mitigation)*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Low	• Implement a monitoring program for the early detection of alien invasive plant species. • A control program should be employed to combat declared alien invasive plant species in the most environmentally friendly manner that does not result in undesirable secondary impacts. • Herbicides for the control of alien species should be applied according to the relevant instructions and by appropriately trained personnel. • No alien species should be used in rehabilitation or landscaping.	Very Low - 4	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				

				• Use only plants and seed collected on-site for revegetation. • Cleared areas may need to be fenced-off during rehabilitation to exclude livestock and wildlife. • Material brought onto site e.g. building sand should be regularly checked for the germination of alien species.		
Increased erosion and water run-off	Status	Negative	Moderate	• Clearing of vegetation and compaction should be restricted to the footprint of the proposed development. • All roads should have structures to deflect water run-off to disperse the water into the receiving area. • A rehabilitation and revegetation plan should be developed as part of the EMP. • Regular monitoring of the site during construction for erosion problems. • Silt traps should be used where there is a danger of topsoil eroding and entering streams and other sensitive areas. • If applicable, topsoil should be removed and stockpiled, then reapplied as soon as possible in order to facilitate regeneration of the natural vegetation on cleared areas. • Reduce activity on site after large rainfall events when the soils are wet. No driving off hardened roads until soils have dried out and the risk of bogging down has decreased. • A suitably qualified person should plan, design and supervise the proper construction of roads to minimise the impact on the environment.	Low - 4	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	Moderate				
Changes in animal behaviour	Status	Negative	Low	• Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns. • Development should avoid wetlands and rocky sheets. • Soil compaction should be kept to a minimum by restricting driving to designated roads. • Appropriate lighting should be installed to minimise negative effects on nocturnal animals. • No activity should be allowed at the site between sunset and sunrise. • The mitigation measures as indicated by the noise specialist must be adhered to..	Low - 4	Medium
	Spatial Extent	Site-specific				
	Duration	Medium-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 7: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the operational phase

(a) Direct impacts

Impact	*Impact Criteria (after mitigation)*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE: DIRECT IMPACTS						
Direct faunal mortalities	Status	Negative	Very low	• Maintenance crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.	Very low - 5	Medium
	Spatial Extent	Site specific				
	Duration	Long-term				
	Consequence	Slight				
	Probability	Unlikely				

	Reversibility	Moderate		• Access to the site should be strictly controlled. • All excess wires, cables and waste material should be removed from the site. • All vehicles at the site should adhere to a low speed limit and slow-moving fauna such as tortoises on roads should be moved off the road. • No activity should be allowed at the site between sunset and sunrise.		
	Irreplaceability	Low				

(b) Indirect impacts

Impact	*Impact Criteria (after mitigation)*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Low	• Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed. • No alien species should be used for landscaping, rehabilitation or any other purpose. • Clearing of alien species should be done on a regular basis.	Very low - 5	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Increased erosion and water run-off	Status	Negative	Low	• Proper road maintenance procedures should be in place. • Regular monitoring of the site during operation for erosion problems. • Should new sections of the road be needed, a suitably qualified person should plan, design and supervise the proper construction of roads. • Reduced activity at the site after large rainfall events when the soils are wet.	Low - 4	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 8: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the decommissioning phase

(a) Direct impacts

Impact	*Impact Criteria (after mitigation)*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISSIONING PHASE: DIRECT IMPACTS						
Increased dust deposition	Status	Negative	Low	• Excessive dust can be reduced by spraying water onto the soil.	Very low - 5	High
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	-				
Direct faunal mortalities	Status	Negative	Very low	• Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns. • Speed limits should be adhered to. • Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.	Very low - 5	Medium
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				

(b) Indirect impacts

Impact	*Impact Criteria (after mitigation)*	*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*

DECOMMISSIONING PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Low	• Implement a monitoring program for at least three years after decommissioning to document vegetation recovery and alien infestation across the site. • A control program to combat declared alien invasive plant species should be employed. • Areas where infrastructure are removed, must be revegetated with indigenous plant species. • No alien species should be used for rehabilitation/revegetation or any other purpose.	Very low - 5	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Increased erosion and water run-off	Status	Negative	Low	• No new roads should be built. • Proper road maintenance procedures should be in place. • Removal of all infrastructure components from the site. • Rehabilitation of all cleared and disturbed areas with local species. • Off-site disposal of all facility components. • Monitoring programme for at least three years after decommissioning to document vegetation recovery on site.	Low - 4	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 9: Summary assessment of cumulative impacts

Impact	***Impact Criteria (after mitigation)***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
Loss of vegetation, habitat and threatened species	Status	Negative	Moderate	• All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible. • Placement of infrastructure should be done in such a way that no SCC are affected and CBAs as far as possible be avoided. • Location of the infrastructure in the most environmentally responsible manner is crucial.	Low - 4	Medium
	Spatial Extent	Regional				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Compromising integrity of CBA, ESA and NPAES	Status	Negative	Moderate	• Amend placement of turbines and other large infrastructure to avoid CBA1s and also CBA2s as far as possible. • Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided. • Minimise the development footprint as far as possible. • Maintain a vegetation ground layer in the servitude. • Stringent construction-phase monitoring of activities at the site to ensure that mitigation measures are adhered to and that the overall ecological impact of the development is maintained at a low level. • Align roads and other infrastructure so that transformation within the CBAs and ESAs is minimised. • The use of structures which may inhibit movement of fauna, e.g. mesh	Moderate - 3	Medium
	Spatial Extent	Regional				
	Duration	Long-term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	Low to Moderate				
	Irreplaceability	Low				

				or electric fencing should be avoided, where feasible.		
Reduced ability to meet conservation obligations & targets	Status	Negative	Moderate	• Preconstruction walk-through of the facility infrastructure to ensure that sensitive areas are avoided and least-impact locations are identified for river/stream crossings. • Minimise the development footprint as far as possible. • Maintain a vegetation ground layer in the servitude.	Moderate - 3	Medium
	Spatial Extent	Regional				
	Duration	Long-term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Loss of landscape connectivity and disruption of broad-scale ecological processes	Status	Negative	Low	• Preconstruction walk-through of the facility infrastructure to ensure that sensitive areas are avoided and least-impact locations are identified for river/stream crossings. • Minimising the development footprint wherever possible. • Maintain a vegetation ground layer in the servitude. • Revegetation of all cleared and bare areas created by the facility with local plant species. • Fences and other structures which impede faunal movement should be avoided. • Roads should not have steep curbs.	Low - 4	Medium
	Spatial Extent	Regional				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 10: Overall Impact Significance (**Post Mitigation**)

Phase	**Overall Impact Significance after mitigation**
Construction	Low
Operational	Low to Very low
Decommissioning	Low to Very low
Cumulative	Low to Moderate

14. LEGISLATIVE AND PERMIT REQUIREMENTS

The following legislation is relevant to the development and may require permits from the relevant authority.

14.1 National Forest Act (Act No. 84 of 1998)(NFA 2023)

The National Forest Act provides for the protection of forests, as well as for specific tree species. In the case where a protected tree would have to be destroyed by the development an application for a license would have to be made. However, **no protected trees,** according to the protected tree list (NFA 2023), were observed and it is unlikely that any such species occur within the development footprint.

14.2 National Environmental Management: Biodiversity Act (Act No. 10 of 2004)(ToPS list)(NEMBA 2007c)

The NEMBA ToPS list deals with endangered, threatened and otherwise controlled species, under the ToPS Regulations (Threatened or Protected Species Regulations). A ToPS permit is required for any activities involving a ToPS listed species.

No threatened or protected plant species (ToPS; NEMA 2007c)) were recorded during the Impumelelo site survey, thus none of the ToPs listed plant species are expected to be negatively affected by the development.

The following protected threatened or protected **faunal species** (ToPS) are listed for the general region:

Mammals:

Aonyx capensis	African Clawless otter	Protected
Atelerix frontalis	Southern African hedgehog	Protected
Connochaetes gnou	Black wildebeest	Protected
Felis nigripes	Black-footed cat	Vulnerable
Leptailurus serval	Serval	Protected
Ourebia ourebi	Oribi	Endangered
Panthera pardus	Leopard	Vulnerable
Vulpes chama	Cape fox	Protected

The Southern African hedgehog and serval do occur on site according to the landowners. None of the herbivores or carnivores are expected to be negatively affected by the development, but avifaunal and bat collisions need to be monitored (see avifaunal and bat reports).

Reptiles:

The giant girdled lizard (*Smaug giganteus*), classified as Endangered in the NEMBA (2007c) ToPS list, is listed for the region on the ADU database, but was not highlighted by the Screening Tool nor listed in the MTPA database for the farms in the immediate vicinity of the Impumelelo site. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelo site. No individuals were recorded on site.

Amphibians:

None of the listed amphibians for the region are ToPS protected species.

14.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species.

Seven declared invasive alien species were noted on site. Currently alien species abundance at the site is low to moderate in places. Disturbance associated with the construction phase would encourage alien invasion and the alien invasive species would need to be cleared on a regular basis. No permitting would be required for such activities, but an alien invasive species control programme should be initiated. Invasive alien species (and their category) likely to occur on site as listed in Chapter 6 and Appendix B.

14.4 Mpumalanga Nature Conservation Act (No. 10 of 1998)(MNCA 1998) – permit requirements

The Mpumalanga Tourism and Parks Agency (MTPA) is the regulatory authority in Mpumalanga for the issuing of permits for fauna, flora, hunting and CITES.

14.4.1 Flora (see Appendix B):

Provisions applying to Schedule 11 Protected plants and Schedule 12 Specially Protected plants in terms of the Mpumalanga Natura Conservation Act (No. 10 of 1998) (Chapter 6):

- No person shall pick a Protected plant without a permit.
- No person shall pick an indigenous plant in a nature reserve without a permit.
- No person shall pick an indigenous plant on a public road, land next to a public road or within a distance of 100 meters from the centre of the road without a permit.
- No person shall pick an indigenous plant which is not a Protected plant or Specially Protected plant on land which he or she is not the owner or occupier.
- No person shall donate, sell, export or remove from the Province a Protected plant without a permit.
- No person shall possess, pick, sell, purchase, donate or receive as a donation, import or export or remove from the Province a Specially Protected plant without a permit.

Schedule 11: Protected Plants (Section 69(1)(a) of the MNCA 1998)

A total of thirty (30) plant species are listed as Schedule 11 Protected plant species in the region according to the MNCA (1998) (Appendix B). Most of these species are members of the Amaryllidaceae and Orchidaceae. Twelve Protected plant species (Schedule 11) were recorded during the survey of the three Enertrag sites in December 2021 of which nine species were recorded on Impumelelo.

The 12 species recorded on all three Enertrag sites:

Aloe ecklonis	*Gladiolus crassifolius**
*Aloe transvaalensis**	*Gladiolus dalenii**
*Boophone disticha**	*Gladiolus robertsoniae**

*Crinum bulbispermum**	*Haemanthus humilis*
Cyrtanthus stenanthus	*Haemanthus* sp.*
*Eucomis autumnalis**	*Huernia hystrix**

*species recorded on the Impumelelo site

Another five species are on the Mpumalanga Red list although not included in the MNCA (1998) list for the farms concerned:

Hypoxis hemerocallidea	LC
Khadia beswickii	VU
Nerine gracilis	VU
Trachyandra erythrorrhiza	NT

Schedule 12: Specially Protected Plants (Section 69(1)(b) of the MNCA 1998)

No Schedule 12 plant species are listed or were recorded during the site survey.

Schedule 13: Invader weeds and plants (MNCA 1998)

Six Schedule 13 species were recorded on site (Appendix B). No person shall possess, sell, purchase, donate or receive as a donation, convey, import or cultivate a Schedule 13 declared invader weed or plant without a permit.

14.4.2 Fauna (see Appendix C)

Schedule 1: Specially Protected Game (Section 4 (1)(a) of MNCA 1998)

No Schedule 1 species are listed or were recorded on site during the site survey.

Schedule 2: Protected Game (Section 4 (1)(a) of MNCA 1998)

Under the provincial Act (MNCA 1998), the majority of mammals, reptiles and amphibians are listed as Schedule 2: Protected Game (see Appendix C). Three species (steenbok, Southern African hedgehog and serval) were recorded on site or confirmed by the landowners for Impumelelo (Appendix C).

Schedule 3: Ordinary Game (Section 4(1)(c) of MNCA 1998)

Three species (springbok, blesbok and scrub hare) were recorded on site or confirmed by the landowners for Impumelelo (Appendix C).

Schedule 4: Protected Wild Animals (Section 4(1)(d) of MNCA 1998)

No species were recorded on site (Appendix C).

Schedule 5: Wild Animals to which Section 33 apply (MNCA 1998)

Provisions of Section 33 apply (MNCA 1998): No person shall import into the province, keep, possess, sell, purchase, donate or receive as a donation or convey a Schedule 5 live wild animal without a permit. Five species were recorded on site or confirmed by the landowners (Appendix C): serval, Egyptian mongoose, yellow mongoose, slender mongoose, common genet, meerkat, springhare, civet and rinkhals.

Schedule 6: Exotic Animals to which the provisions of Section 34 apply (MNCA 1998)

Provisions of Section 34 apply (MNCA 1998): No person shall keep, possess, sell, donate or receive as a donation or convey a Schedule 6 live exotic animal without a permit. No species were recorded on site (Appendix C).

Schedule 7: Invertebrates (Section 35 (1) of the MNCA 1998)

Provisions of Section 35(1) apply (MNCA 1998): No person shall collect, catch, kill, keep, purchase, sell, donate or receive as a donation, convey, import or export a Schedule 7 invertebrate without a permit.

Schedule 8: Problem Animals (Section 44(1) of the MNCA 1998)

One species (black-backed jackal) was recorded on site (Appendix C).

No permits are required for animal species since none should be harmed by the development.

14.5 CITES (Convention on the International Trade in Endangered Species of Wild Fauna and Flora)

South Africa is a signatory to CITES and as such must comply with the import, export and re-export procedure as stipulated by CITES. MTPA is the CITES Management and Scientific Authority for exports out of and imports into the respective province from or to other countries. Therefore no person shall import into or export or remove from the Province an endangered species or a rare species, unless he is the holder of a permit which authorises him to do so. No permits are required for animal species since none should be harmed by the development on Impumelelo.

The following species listed for the region on the ADU database are CITES listed fauna (Appendix C):

Fauna:

Mammal:	Serval	(CITES Appendix II)
Reptiles:	Giant Girdled Lizard	(CITES Appendix II)
	Common Girdled Lizard	(CITES Appendix II)

Flora:

Aloe transvaalensis and *Euphorbia clavarioides* were the only CITES listed plant species recorded on the Impumelelo site. Ten species of the Orchidaceae are also listed for the region, but none were encountered.

15. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUT

Impact	Mitigation / Management Objectives	Mitigation / Management actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
A. IMPACTS ON TERRESTRIAL BIODIVERSITY AND SPECIES					
A. DESIGN PHASE					
Potential impact on terrestrial biodiversity and species as a result of the proposed WEF.	Avoid or minimise impacts on terrestrial biodiversity and species on site regarding the placement of the infrastructure. Avoiding wetlands, rocky sheets and rocky outcrops will reduce the chances of loss of protected species. Avoid areas delineated as CBA as far as possible.	Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on sensitive habitats and protected species. Avoid areas delineated as CBA1s and preferably also CBA2s as far as possible.	Ensure that this is taken into consideration during the planning and design phase. As a precautionary measure it is recommended that a survey be done for the giant girdled lizard once the proposed final layout has been established.	During design cycle and before construction commences.	Project Developer and Appointed Ecological Specialist.
B. CONSTRUCTION PHASE					
Clearance of vegetation	Confine vegetation clearance to footprint and minimise disturbance of adjacent areas.	Demarcate all infrastructure sites clearly to avoid unnecessary clearance of the vegetation. Permits have to be obtained for the removal of Mpumalanga protected species within the footprint of the development.	Ensure that mitigation measures are enforced.	Daily	The Environmental Control Officer (ECO) should monitor and report any incidents to the Holder of the EA
Impact on animal species	Avoid or minimise impacts that could potentially affect animal behaviour.	Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. Holes and trenches should not be left open for long periods of time. These should be regularly inspected for the presence of trapped animals. Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site. Speed limits should be strictly adhered to. No activity should be allowed on site at night.	Ensure compliance with these mitigation measures.	Daily	The ECO should monitor and report to the Holder of the EA.
Increased dust levels	Avoid or minimise increased dust levels.	Dust control measures should be implemented.	Ensure that dust control measures are in place.	Daily	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species. Employ a control program to combat declared alien invasive plant species.	Ensure implementation of a control programme to combat alien invasive plants.	Daily	The ECO should monitor and report to the Holder of the EA.

Impact	Mitigation / Management Objectives	Mitigation / Management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
C. OPERATIONAL PHASE					
Impact on animal species	Avoid or minimise impacts that could potentially affect animal behaviour.	Proper waste management procedures should be put in place.	Ensure compliance with these mitigation measures.	Monthly	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and employ a control program to combat declared alien invasive plant species.	Ensure implementation of a monitoring and control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.
C. DECOMMISSIONING PHASE					
Clearance of vegetation	Minimise disturbance and clearance of vegetation.	Unnecessary clearance of natural vegetation should be avoided.	Ensure that mitigation measures are enforced.	Daily	The ECO should monitor and report to the Holder of the EA.
Impact on animal behaviour	Avoid or minimise impacts that could potentially affect animal behaviour.	Proper waste management procedures should be put in place.	Ensure compliance with these mitigation measures.	Daily	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and employ a control program to combat declared alien invasive plant species.	Ensure implementation of a monitoring and control programme to combat alien invasive plants.	Daily during decommissioning thereafter every three months	The ECO should monitor and report to the Holder of the EA.

16. SUMMARY OF ISSUES IDENTIFIED DURING THE PUBLIC PARTICIPATION PROCESS

To be completed after comments have been received from Stakeholders during the Public Consultation Phase

17. Final Specialist Statement and Authorisation Recommendation

Our findings related to the Terrestrial Ecology and Species are the following:

Provided all mitigation measures and management actions, proposed to conserve protected fauna and flora on the site, are taken into consideration, and the positioning of infrastructure is amended to avoid sensitive habitats, the resulting low sensitivity rating and low impact significance for many of the habitats means the project could go ahead provided all mitigation measures are implemented.

A brief summary of the most important considerations is provided below:

Vegetation and flora:

- **Screening Tool:** None of the species highlighted by the Screening Tool were encountered on site during the vegetation survey. However, Vulnerable Sensitive species 691 was recorded at one location on site (MTPA data). The succulent *Khadia beswickii* (VU) was not recorded on site and the one location indicated by MTPA was to the south of the Impumelelo site.
- **Vegetation types:** The Soweto Highveld Grassland vegetation type is listed as "Vulnerable" and consequently the layout of the wind infrastructure should give preference to the habitats on site where past disturbance has occurred e.g. disturbed areas, cultivated cropland or abandoned cropland. The Endangered Tsakane Clay Grassland covers a very small area on the western boundary of the site and although it falls within the Hartbeesfontein farm boundary no WEF infrastructure has been planned for this small section.
- **Threatened plant species:** No IUCN threatened or red-listed plant species were encountered during the field survey. However, according to MTPA data Vulnerable Sensitive species 691 was recorded at one location on site. *Khadia beswickii* occurs to the south of the site.
- **Near Threatened Species:** *Gladiolus robertsoniae* and *Kniphofia typhoides* occur on site. *Gladiolus robertsoniae* was recorded in Habitat 1 a habitat that was avoided in the current layout of the wind turbines. However, Substation 1 (SS1) falls in Habitat 1, which was rated as having a medium sensitivity for the vegetation.
- **Protected plant species:** No ToPS species or protected tree species were recorded on site. A number of other Mpumalanga protected species without a threatened IUCN status were recorded on site (see bullets above for the threatened and Near Threatened species on site).
- **CITES:** Two CITES listed species occur on site, i.e. *Aloe transvaalensis* and *Euphorbia clavarioides.*
- **Habitats:** Four of the seven habitats on site had a low sensitivity rating with two habitats rated as of medium sensitivity (Habitat 1: rocky sheets and Habitat 3: rocky grassland). The wetland habitat (Habitat 7) had a high sensitivity.
- **Overall sensitivity of plant species theme based on the status of the habitats (plant communities):** Rated as **medium** – provided some infrastructure is repositioned to habitats of low sensitivity and, where possible, to avoid highly sensitive habitats and all CBA1s and preferably also CBA2s as far as possible.

Fauna (avifaunal and bat component excluded):

- **Screening Tool:** The species that were highlighted by the Screening tool, included *Crocidura maquassiensis, Hydrictis maculicollis*, *Ourebia ourebi ourebi* and *Lepidochrysops procera.* None of these species were listed in the MTPA database for the farms participating in the proposed Impumelelo WEF development and none were encountered during the site visit. The spotted-necked otter (*Hydrictis maculicollis*), Maquassie musk shrew (*Crocidura maquassiensis*) and *Lepidochrysops procera* are also not listed on the ADU database for the region. The Impumelelo site falls marginally within the distribution range of *Ourebia ourebi ourebi.*

- **Threatened animal species:** The giant girdled lizard (*Smaug giganteus*), a reptile with a Vulnerable IUCN status occurs in the broader region. This species was however not highlighted by the Screening Tool and is not listed in the MTPA database for the region. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelelo site.
- **Near Threatened species:** Three Near Threatened mammal species are reported for the site according to the land owners, i.e. the serval *Leptailurus serval*; Southern African hedgehog *Atelerix frontalis* and the Southern African vlei rat *Otomys auratus*). None of these species were however highlighted by the Screening Tool as SCC.
- **Overall sensitivity of animal theme (avifaunal and bat component excluded):** This is rated as **medium.** If the suggested mitigation measures are followed the animal SCC should not be negatively affected.

Conservation:

- **Protected Areas:** The study area is not located in a protected area.
- **National Protected Areas Expansion Strategy (NPAES):** Portions of the site are marked as 'Priority Focus Areas' in the NPAES (2018).
- **Mpumalanga Protected Areas Expansion Strategy (MPAES):** Portions of the site are earmarked in the 5- and 20-year plan of the Mpumalanga PAES.
- **Critical Biodiversity Areas (CBAs):** Thirteen of the 28 turbines, four of the five constructions sites and the two substations fall partly or entirely in CBA1s or CBA2s. These sites must be micro-sited prior to approval of final layout.
- **Ecological Support Areas (ESAs):** ESA Landscape corridors and ESA Local corridors occur within the boundary of the Impumelelo site and were mostly avoided in the current layout. Turbines are permissible in ESAs under certain conditions (Table 18, MBSP 2014).
- **Other Natural Areas (ONAs):** Some ONAs were demarcated within the Impumelelo site, however turbines are permissible in ONAs under certain conditions subject to the appropriate authorisations (MBSP 2014).
- **Freshwater Ecosystem Priority Area (FEPA):** Although the entire site is classified as an upstream management area, the site assessment of the vegetation and the application of a sensitivity model rated the vegetation occurring in most of the river FEPA area as being of low to medium sensitivity, with only the drainage lines having a high sensitivity.
- **Mpumalanga Highveld wetlands:** These wetlands were largely incorporated into the delineation of the CBAs (refer to aquatic specialist report for wetlands).

Ecological processes, function and drivers:

- Overall, it is unlikely that the development will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.
- The disturbance caused by the construction of the WEF will inevitably create conditions favourable for invasion by alien species.
- Fire is an important driver of vegetation dynamics in the Grassland Biome and can occur when the fuel load is high. To avoid damage to the infrastructure, fire will have to be suppressed. If the grass layer is regularly mowed/brush cut, it should prevent grasses from becoming moribund in the absence of fire although mowing or brushcutting would reduce seed set.

Significance of environmental impacts:

Overall the significance of the environmental impacts was rated as low to medium. In summary:

- Since the development footprint is relatively small and spread across the site, the loss of prime habitat within the Soweto Highveld Grassland vegetation type can be constrained by well-planned positioning of the turbines.

- **From an ecological point of view**, large portions of the site have been heavily modified (compare CBA map) and not prime examples of the Soweto Highveld Grassland. If the development is thus contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered in the allocation of a vulnerable status.
- The vegetation in the wetland habitat (Habitat 7) was rated as highly sensitive and Habitats 1 and 3 were rated as medium sensitive in the current assessment. Substation 1 (SS1, Figure 15) is located in a habitat with a vegetation sensitivity of medium and also fall in a CBA1 and should be relocated or microsited.
- Most of the habitats covered by the proposed infrastructure were rated as having a low vegetation sensitivity in the current assessment.
- Except for Sensitive species 691 no other SCC highlighted by the Screening Tool were encountered on site, thus if all mitigation measures are applied the impact on populations of Screening Tool species could be minimised.
- Depending on the type of fencing to be erected at some of the infrastructure, the WEF will contribute minimally to obstruction of animal movement.

Key environmental mitigation and management actions proposed

- Ensure that the placing of infrastructure takes the CBAs, ESAs and the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on species and habitats of conservation concern.
- Demarcate all infrastructure sites clearly to avoid unnecessary clearance of the vegetation.
- Avoid or minimise impacts that could potentially affect animal behaviour.
- Trenches should not be left open for long periods of time. Trenches should be inspected regularly for the presence of trapped animals.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.
- Speed limits should be strictly adhered to.
- Dust control measures should be implemented.
- Permits have to be obtained for the removal of Mpumalanga protected species.
- Implement a monitoring program for the early detection of alien invasive plant species.
- Employ a control program to combat declared alien invasive plant species.

Preferred infrastructure locations

Access route:
The site can be accessed by the R547 and R23 roads and Boschmansfontein Rd. in the east.

Wind turbines:

- Nine of the 28 turbines are located in CBA1s (Figure 18). These sites must be re-located or micro-sited prior to approval of final layout.
- A further 4 turbines are located in CBA2s and one turbine in an ESA. The turbines in CBA2s should preferably be relocated or micro-sited. However, turbines in CBA2s and ESAs are permissible under certain conditions (MBSP 2014).
- No turbines were located in Mpumalanga Highveld Wetlands (Figure 19).
- The current layout of the wind turbines avoided the habitats where the vegetation sensitivity was rated medium and high (Figure 20).

On-site substations (SS1 & SS2):

- The two optional on-site substations fall within (or partly within) CBAs (Figure 18).
- The two optional on-site substations avoid wetlands (Figure 19).
- Substation 1 (SS1) falls within an area of medium sensitivity (Figure 20).

Construction sites:

- Construction site 1 falls in a CBA1 (Figure 18).
- Construction site 2 falls in a CBA2 (Figure 18).
- Construction site 3 falls in a CBA2 (Figure 18).
- Construction site 4 falls in an ONA and partly in a CBA1 (Figure 18).
- Construction site 5 fall in a moderately modified area (Figure 18).
- All construction sites avoid wetlands (Figure 19).
- All construction sites fall in habitats with low sensitivity (Figure 20).

Internal roads on site:

- The road network within CBA1s should be minimised.

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APPENDIX A

SYNOPTIC TABLE OF THE HABITATS (PLANT COMMUNITIES)

Plant community/Habitat	1	2	3	4	5	6	7		
							7a	7b	7c
Species group 1									
Euryops laxus	5				1				
Microchloa caffra	5			1	1				
Dipcadi ciliare	5			1					
Euphorbia inaequilatera	5			1					
Panicum repens	5			1	1		1	3	
Jamesbrittenia stricta	5								
Tragus berteronianus	4								3
Hermannia cf coccocarpa	4			1	1				
Colchicum striatum	3								
Oropetium capense	3								
Trachyandra saltii	3								
Gladiolus robertsoniae	2								
Huernia hystrix	2								
Sporobolus discosporus	2								
Albuca sp. 1	2								
Cotula sp.	2								
Species group 2									
Kohautia amatymbica		3							
Melinis repens		3							
Pellaea calomelanos		2							
Species group 3									
Cyperus rupestris	4	3		1					
Aristida diffusa	3	5		1					
Tulbaghia acutiloba	3	2							
Euphorbia clavarioides	2	2		1	1				
Species group 4									
Diospyros lycioides		2	3						
Ajuga ophrydis			3						
Tephrosia capensis			3	1					
Acalypha angustata			3		1				
Indigofera hilaris			2	1					
Aloe ecklonis			2	1					
Tristachya biseriata			3						
Erythrina zeyheri			2	1					
Turbina oblongata			3						
Afrosciadium magalismontanum			3						
Eucomis autumnalis			2						
Polygala hottentotta			2						
Artemisia afra			2						
Ledebouria graminifolia			2						
Oxalis obliquifolia			2						
Species group 5									
Searsia rigida		2	2						
Ziziphus zeyheriana		2	1						
Senecio othonniflorus		2	3	1	1				
Euphorbia striata		2	3	1				2	
Species group 6									
Cymbopogon pospischilii	2	4	1	2	1				
Cyperus semitrifidus	4	3		1	1				
Felicia muricata	2	5		1	1				
Chaetacanthus costatus	2			1					
Heteropogon contortus	1	2	1	1					

Gazania krebsiana	1	2	1	2					
Species group 7									
Hibiscus microcarpus			2	2					
Hypoxis acuminata			1	2	1				
Hibiscus aethiopicus			2	1					
Asclepias sp.			1	1	1				
Rhynchosia adenodes			2	1	1				
Species group 8									
Dianthus mooiensis		4	3	2	1				
Hermannia depressa		4	3	2	1				
Eragrostis capensis		3	3	2					
Eragrostis racemosa		5		1	1				
Cynodon incompletus		2	1	1	1				
Helichrysum nudifolium		2	2	1	1				
Species group 9									
Scabiosa columbaria		3	3	4	2			3	3
Elionurus muticus	1	5	2	3	2				
Indigofera hedyantha		3	2	3	2				
Nemesia cf. umbonata		2	3	3	1		1		
Helichrysum pilosellum		2		4	1				
Hilliardiella elaeagnoides		4	3	2	1				
Abildgaardia ovata	1		1	3	1				
Kyllinga erecta			3	2	1				
Crabbea acaulis			1	2	1				
Polygala amatymbica			2	1	1				
Hypoxis hemerocallidea			1	1	1				
Gladiolus crassifolius			1	1	1				
Species group 10									
Berkheya setifera	1	4	5	4	3		1		
Helichrysum rugulosum	1	5	5	4	3	2	1		
Ipomoea crassipes	3	3	3	5	2		1		
Brachiaria serrata	2	4	4	5	1				
Commelina africana	4	3	5	2	2				
Hypoxis rigidula	1	2	3	4	1				
Crassula lanceolata	1	2	3	1	2		1		
Cyanotis speciosa	3	3	3	2	1			2	
Geigeria burkei	3	2		2	1				
Sonchus oleraceus	1		2	1	2	2	1		
Eragrostis planiculmis				3	1				
Gomphrena celosioides	1	2	1	1	1	2			
Bulbine abyssinica	2	2		1	1				
Setaria pumila	1	3		1	1				
Hermannia grandistipula	1	2	3	1	1				
Monsonia angustifolia	3			1	1		1		
Selago densiflora		2	2	2	1				
Species group 11									
Eragrostis chloromelas	5	5	5	5	5	4			
Hyparrhenia hirta	1	3	3	4	4	3			
Digitaria eriantha	3		1	1	1	4			
Setaria sphacelata	1	2	3	2	2	3		2	
Aristida bipartita	1		1	1	1	3			
Species group 12									
Ischaemum fasciculatum							3	3	
Andropogon appendiculatus							2	4	
Fingerhuthia sesleriiformis					1		2	2	
Trifolium pratense		2	3	1	1		2	4	
Galium capense			2	1	1		3	4	
Salix babylonica							1	2	
Schizoglossum bidens							1	3	
Species group 13									
Setaria incrassata	2	2	5	4	4	3		3	
Asclepias stellifera	1	3	4	4	3	2		3	
Chlorophytum fasciculatum	3	3	2	5	3			4	
Jamesbrittenia aurantiaca	2		2	4	3		1	2	
Salvia sp.	1	2	3	2	2		1	2	
Ledebouria cf. revoluta	3		2	2	2			3	
Hypoxis argentea	3		2	1	2		1	2	
Species group 14									
Typha capensis							1		5
Phragmites australis									5

Carex glomerabilis									3
Mentha longifolia									3
Species group 15									
Dimorphotheca caulescens			1	1	1			4	3
Schoenoplectus cf. muricinux								3	5
Potamogeton thunbergii								2	3
Species group 16									
Cirsium vulgare				1	1		5	4	5
Plantago lanceolata				1	1		3	5	5
Bromus catharticus				1	1	2	4	3	3
Trisetopsis imberbis					1		5	4	3
Rumex crispus				1	1		5	3	3
Crinum bulbispermum	1				1		2	4	5
Leersia hexandra							4	3	3
Cyperus longus							2	3	3
Persicaria lapathifolia							3		3
Species group 17									
Oenothera rosea		2		3	3	2	5	5	5
Paspalum dilatatum	1			1	3	4	5	2	5
Cyperus esculentus				1	2	2	3		5
Bidens pilosa		2		2	2	2	2	3	
Verbena brasiliensis				1	2		2	3	3
Sisymbrium thellungii	1			2	2		2	2	5
Verbena bonariensis				2	1		3		5
Arctotis arctotoides			1	2	1			2	3
Species group 18									
Berkheya radula		4	5	4	3		4	3	3
Senecio inaequidens		3	1	3	3	2	1	2	
Conyza podocephala		5	3	4	2	2	2	2	
Haplocarpha scaposa		5	5	2	1			5	
Species group 19									
Themeda triandra	5	5	5	5	5	2	2	3	3
Eragrostis curvula	3	4	3	4	5	5	4	2	3
Senecio erubescens	1	3	3	4	4	3	4		
Oenothera tetraptera	1	3	3	4	4		3	4	3
Hermannia erodioides	3	3	3	4	3	2	1	3	3
Setaria nigrirostris	1		3	4	3	2	3	3	5
Solanum elaeagnifolium	1	3	3	3	4	2	1	2	
Pseudognaphalium luteo-album	2		1	3	3	3	2	3	5
Schkuhria pinnata	3		3	3	3	2	2		3
Eragrostis plana	2		2	2	3	3	2	3	3
Ranunculus multifidus	1		2	2	3		2	5	5
Cynodon dactylon	2	2	3	2	3	2	1	3	3
Hibiscus trionum	4			2	3	4	2	3	
Gomphocarpus fruticosus	1	3	1	2	2		2	4	
Cosmos bipinnatus	1			1	3	4	3	2	5
Nasturtium officinale	1		1	1	3	5	2	2	3
Bidens bipinnata	3	3	3	1	2	2	1	3	
Convolvulus sagittatus	2		2	2	2	2		2	
Lepidium africanum	1	2		1	1		4	2	
Lactuca inermis			2	1	2	2	1		
Hyparrhenia tamba	1			1	1		1		
Tagetes minuta		2		1	1		2		3
Senecio inornatus		2	1	1	1	2	1		
Species group 20									
Ledebouria cf. minima	3				1		1		
Bulbostylis humilis	1			1	1		1		
Albuca sp. 2	2			1	1		1		
Gazania sp.	2				1				
Selago tenuifolia	1						1		
Aristida sp.	1					2			
Urochloa panicoides	1			1					
Boophone disticha		2			1		1		
Dipcadi viride		2		1	1				
Melolobium calycinum		2		1	1				
Asclepias cf. gibba		2		1					
Ipomoea bolusiana		2		1					
Aloe transvaalensis		2		1	1				
Raphionacme sp.		2			1				
Striga elegans		2							

Senecio coronatus		2							
Hemizygia pretoriae		2							
Lessertia stricta		2							
Leobordea divaricata			1	1	1				
Oxalis corniculata			1	1	1				
Solanum nigrum			2				1		
Trachyandra asperata			1	1		2			
Solanum campylacanthum			1	1					
Gladiolus dalenii			1	1					
Xysmalobium undulatum			1			2			
Conyza albida				1	1	2	1		
Cyclospermum leptophyllum				1	1		1	2	
Senecio sp.				1	1				
Helichrysum aureonitens				1	1				
Ruellia sp.				1	1				
Portulaca quadrifida				1	1				
Cuscuta campestris				1	1	2			
Datura ferox				1			1		3
Ruellia patula				1					
Galinsoga parviflora				1	1				
Vigna vexillata				1			1		
Senecio isatideus				1			1		
Trachyandra sp.				1	1				
Physalis viscosa				1					3
Ipomoea sp.				1	1				
Pennisetum clandestinum					1	2	2		
Amaranthus hybridus					1		1		
Wahlenbergia sp.					1				
Cyrtanthus stenanthus					1				
Ipomoea bathycolpos					1			2	
Amaranthus sp.					1				3
Guilleminea densa						2			
Harpochloa falx								2	
Veronica anagallis-aquatica								2	
Haemanthus humilis								2	
Leptochloa fusca								2	
Ascolepis sp.									3
Cheilanthes sp.	1								
Crassula sp.	1								
Crassula cf. setulosa	1								
Eriospermum flagelliforme	1								
Portulaca hereroensis	1								
Corchorus asplenifolius	1								
Lapeirousia sp.	1								
Kohautia cynanchica	1								
Ledebouria sp.	1								
Chaenostoma calycina	1								
Eriospermum sp.	1								
Portulaca kermesina	1								
Chaenostoma sp.	1								
Aristida adscensionis	1								
Eragrostis inamoena	1								
Cyperus capensis	1								
Indigofera sp.	1								
Cynoglossum hispidum			1						
Gnidia sp.			1						
Tribulus terrestris			1						
Albuca sp. 3			1						
Asparagus cooperi			1						
Berkheya pinnatifida			1						
Ledebouria cooperi			1						
Searsia magalismontana			1						
Sphenostylis angustifolium			1						
Aster harveyanus			1						
Rhynchosia monophylla			1						
Vernonia glabra			1						
Athrixia elata			1						
Cephalaria zeyheriana			1						
Opuntia ficus-indica			1						
Pelargonium alchemilloides			1						

Thesium cf. goetzeanum	1				
Tragopogon dubius	1				
Ocimum obovatum	1				
Osteospermum muricatum	1				
Cannabis sativa		1			
Cymbopogon caesius		1			
Lotononis sp.		1			
Haplocarpha lyrata		1			
Verbena rigida		1			
Rhynchosia caribaea		1			
Chamaesyce hirta		1			
Pelargonium minimum		1			
Capsella bursa-pastoris		1			
Lolium perenne		1			
Blepharis integrifolia		1			
Eragrostis superba		1			
Plectranthu cf. madagascariensis			1		
Seriphium plumosum			1		
Hemizygia sp.			1		
Becium species			1		
Echinochloa colona			1		
Panicum sp.			1		
Indigofera sp.			1		
Senecio consanguineus			1		
Senna italica			1		
Leucas sp.			1		
Nidorella hottentotica			1		
Pelargonium luridum			1		
Haemanthus sp.			1		
Panicum natalense			1		
Trifolium cf. africanum				1	
Cyperus sp.				1	
Alternanthera sessilis				1	
Schoenoplectus sp.				1	
Oxalis sp.				1	

APPENDIX B

PLANT SPECIES CHECKLIST

[1]Newposa list (SANBI)
[2]Plants observed during December 2021 site survey
[3]MBSP = Mpumalanga Biodiversity Sector Plan redlist
[4]IUCN category
[5]MBSP = Mpumalanga Biodiversity Sector Plan redlist status
[6]MNCA (1998) Schedules
[7]CITES = Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES 2023)
[9]NAT = Naturalised alien species
[10]AIS = Alien and invasive species

Family	Species	New Posa[1]	Current survey[2]	MBSP[3]	IUCN[4]	MBSP status[5]	MNCA[6]	CITES[7]	ToPS[8]	Natura-lised[9]	IAS[10]
Cyperaceae	*Abildgaardia ovata*		X		LC						
Fabaceae	*Acacia mearnsii*		X								1b
Euphorbiaceae	*Acalypha angustata*		X		LC						
Euphorbiaceae	*Acalypha caperonioides var. caperonioides*	X			DD						
Lamiaceae	*Aeollanthus buchnerianus*	X			LC						
Apiaceae	*Afrosciadium magalismontanum*		X		LC						
Asparagaceae	*Agave americana*		X				Sch 13				
Lamiaceae	*Ajuga ophrydis*	X	X		LC						
Hyacinthaceae	*Albuca sp. 1*		X								
Hyacinthaceae	*Albuca sp. 2*		X								
Hyacinthaceae	*Albuca sp. 3 geel*		X								
Hyacinthaceae	*Albuca virens subsp. virens*	X			LC						
Orobanchaceae	*Alectra orobanchoides*	X			LC						
Asphodelaceae	*Aloe ecklonis*		X		LC		Sch 11	App II			
Asphodelaceae	*Aloe transvaalensis*		X		LC		Sch 11	App II			
Amaranthaceae	*Alternanthera sessilis*		X							Nat	
Amaranthaceae	*Amaranthus hybridus*		X							Nat	
Amaranthaceae	*Amaranthus sp.*		X							Nat	
Poaceae	*Andropogon appendiculatus*		X		LC						
Poaceae	*Andropogon schirensis*	X			LC						
Rubiaceae	*Anthospermum rigidum subsp. pumilum*	X			LC						
Asteraceae	*Arctotis arctotoides*		X		LC						
Fabaceae	*Argyrolobium campicola*	X			NT						
Poaceae	*Aristida adscensionis*	X	X		LC						
Poaceae	*Aristida bipartita*	X	X		LC						
Poaceae	*Aristida diffusa*		X		LC						
Poaceae	*Aristida sp.*		X								
Asteraceae	*Artemisia afra var. afra*	X	X		LC						
Poaceae	*Arundo donax*		X				Sch 13				1b
Apocynaceae	*Asclepias albens*	X			LC						
Apocynaceae	*Asclepias gibba var. gibba*	X	X		LC						
Apocynaceae	*Asclepias multicaulis*	X			LC						
Apocynaceae	*Asclepias sp.*		X								
Apocynaceae	*Asclepias stellifera*		X		LC						
Apocynaceae	*Ascolepis sp.*		X								
Asparagaceae	*Asparagus cooperi*		X		LC						
Asparagaceae	*Asparagus setaceus*	X			LC						
Apocynaceae	*Aspidoglossum lamellatum*	X			LC						
Aspleniaceae	*Asplenium adiantum-nigrum var. solidum*	X			LC						

Aspleniaceae	*Asplenium aethiopicum*	X			LC						
Asteraceae	*Aster harveyanus*		X		LC						
Asteraceae	*Athrixia elata*		X		LC						
Lamiaceae	*Becium obovatum*		X		LC						
Lamiaceae	*Becium sp.*		X								
Asteraceae	*Berkheya pinnatifida*		X		LC						
Asteraceae	*Berkheya radula*		X		LC						
Asteraceae	*Berkheya setifera*		X		LC						
Asteraceae	*Bidens bipinnata*		X							Nat	
Asteraceae	*Bidens pilosa*	X	X				Sch 13			Nat	
Acanthaceae	*Blepharis integrifolia*		X		LC						
Orchidaceae	*Bonatea porrecta*	X			LC		Sch 11	App II			
Amaryllidaceae	*Boophone disticha*		X	X	LC	Dec	Sch 11				
Poaceae	*Brachiaria advena*	X								Nat	
Poaceae	*Brachiaria eruciformis*	X			LC						
Poaceae	*Brachiaria serrata*		X		LC						
Apocynaceae	*Brachystelma foetidum*	X			LC		Sch 11				
Poaceae	*Bromus catharticus*		X							Nat	
Asphodelaceae	*Bulbine abyssinica*		X		LC						
Asphodelaceae	*Bulbine capitata*	X			LC						
Cyperaceae	*Bulbostylis humilis*		X		LC						
Cannabaceae	*Cannabis sativa*		X							Nat	
Brassicaceae	*Capsella bursa-pastoris*		X							Nat	
Cyperaceae	*Carex glomerabilis*	X	X		LC						
Poaceae	*Catalepis gracilis*	X			LC						
Dipsacaceae	*Cephalaria zeyheriana*		X		LC						
Cactaceae	*Cereus jamacaru*		X				Sch 13				1b
Scrophulariaceae	*Chaenostoma calycina*		X		LC						
Scrophulariaceae	*Chaenostoma patrioticum*	X			LC						
Scrophulariaceae	*Chaenostoma sp.*		X								
Acanthaceae	*Chaetacanthus costatus*		X		LC						
Fabaceae	*Chamaecrista mimosoides*		X		LC						
Euphorbiaceae	*Chamaesyce hirta*		X		LC						
Pteridaceae	*Cheilanthes sp.*		X								
Poaceae	*Chloris virgata*	X			LC						
Agavaceae	*Chlorophytum cooperi*	X			LC						
Agavaceae	*Chlorophytum fasciculatum*		X		LC						
Asteraceae	*Cineraria geraniifolia*	X			LC						
Asteraceae	*Cirsium vulgare*		X				Sch 13				1b
Peraceae	*Clutia pulchella var. pulchella*	X			LC						
Colchicaceae	*Colchicum striatum*	X	X		LC						
Commelinaceae	*Commelina africana var. africana*	X	X		LC						
Convolvulaceae	*Convolvulus multifidus*	X			LC						
Convolvulaceae	*Convolvulus sagittatus*	X	X		LC						
Asteraceae	*Conyza albida*		X							Nat	
Asteraceae	*Conyza podocephala*		X		LC						
Malvaceae	*Corchorus asplenifolius*		X		LC						
Apocynaceae	*Cordylogyne globosa*	X			LC						
Asteraceae	*Cosmos bipinnatus*	X	X							Nat	
Asteraceae	*Cotula sp.*		X								
Acanthaceae	*Crabbea acaulis*		X		LC						
Crassulaceae	*Crassula cf. setulosa*		X		LC						
Crassulaceae	*Crassula lanceolata*		X		LC						
Crassulaceae	*Crassula sp.*		X								
Amaryllidaceae	*Crinum bulbispermum*		X	X	LC	DEC	Sch 11				
Amaryllidaceae	*Crinum graminicola*	X			LC		Sch 11				
Amaryllidaceae	*Crinum lugardiae*	X			LC		Sch 11				
Cucurbitaceae	*Cucumis hirsutus*	X			LC						
Cucurbitaceae	*Cucumis zeyheri*	X			LC						
Convolvulaceae	*Cuscuta campestris*		X				Sch 13				1b
Commelinaceae	*Cyanotis speciosa*		X		LC						

Apiaceae	*Cyclospermum leptophyllum*		X						Nat		
Poaceae	*Cymbopogon caesius*	X	X		LC						
Poaceae	*Cymbopogon pospischilii*		X		LC						
Poaceae	*Cynodon dactylon*		X		LC						
Poaceae	*Cynodon incompletus*		X		LC						
Boraginaceae	*Cynoglossum hispidum*		X		LC						
Cyperaceae	*Cyperus albostriatus*	X			LC						
Cyperaceae	*Cyperus capensis*		X		LC						
Cyperaceae	*Cyperus esculentus var. esculentus*	X	X		LC						
Cyperaceae	*Cyperus longus var. tenuiflorus*	X	X		NE						
Cyperaceae	*Cyperus marginatus*	X			LC						
Cyperaceae	*Cyperus rupestris*		X		LC						
Cyperaceae	*Cyperus semitrifidus*		X		LC						
Cyperaceae	*Cyperus sp.*		X								
Amaryllidaceae	*Cyrtanthus stenanthus*		X				Sch 11				
Solanacaea	*Datura ferox*		X				Sch 13				1b
Caryophyllaceae	*Dianthus basuticus subsp. basuticus var. basuticus*	X			NE						
Caryophyllaceae	*Dianthus mooiensis*		X		LC						
Scrophulariaceae	*Diclis rotundifolia*	X			LC						
Poaceae	*Digitaria eriantha*	X	X		LC						
Asteraceae	*Dimorphotheca caulescens*	X	X		LC						
Ebenaceae	*Diospyros lycioides*		X		LC						
Hyacinthaceae	*Dipcadi ciliare*		X		LC						
Hyacinthaceae	*Dipcadi viride*	X	X		LC						
Orchidaceae	*Disa aconitoides subsp. aconitoides*	X			LC		Sch 11	App II			
Orchidaceae	*Disa cooperi*	X			LC		Sch 11	App II			
Fabaceae	*Dolichos falciformis*	X			LC						
Fabaceae	*Dolichos linearis*	X			LC						
Hyacinthaceae	*Drimia depressa*	X			LC						
Hyacinthaceae	*Drimia intricata*	X			LC						
Hyacinthaceae	*Drimia pauciflora*	X			LC						
Amaranthaceae	*Dysphania pumilio*	X							Nat		
Poaceae	*Echinochloa colona*		X		LC						
Cyperaceae	*Eleocharis dregeana*	X			LC						
Cyperaceae	*Eleocharis limosa*	X			LC						
Poaceae	*Eleusine coracana subsp. africana*	X			LC						
Poaceae	*Elionurus muticus*	X	X		LC						
Poaceae	*Eragrostis capensis*		X		LC						
Poaceae	*Eragrostis chloromelas*	X	X		LC						
Poaceae	*Eragrostis cilianensis*	X			LC						
Poaceae	*Eragrostis curvula*	X	X		LC						
Poaceae	*Eragrostis inamoena*		X		LC						
Poaceae	*Eragrostis plana*		X		LC						
Poaceae	*Eragrostis planiculmis*	X	X		LC						
Poaceae	*Eragrostis racemosa*		X		LC						
Poaceae	*Eragrostis superba*		X		LC						
Fabaceae	*Eriosema salignum*	X			LC						
Ruscaceae	*Eriospermum flagelliforme*		X		LC						
Ruscaceae	*Eriospermum sp.*		X								
Fabaceae	*Erythrina zeyheri*	X	X		LC						
Myrtaceae	*Eucalyptus cf. camaldulensis*		X				Sch 13				2
Hyacinthaceae	*Eucomis autumnalis*		X	X	LC	Dec	Sch 11				
Orchidaceae	*Eulophia hians var. inaequalis*	X			LC		Sch 11	App II			
Orchidaceae	*Eulophia hians var. nutans*	X			LC		Sch 11	App II			
Euphorbiaceae	*Euphorbia clavarioides*		X					App II			
Euphorbiaceae	*Euphorbia inaequilatera*		X		LC						
Euphorbiaceae	*Euphorbia striata*		X		LC						
Asteraceae	*Euryops laxus*	X	X		LC						
Asteraceae	*Euryops transvaalensis subsp. transvaalensis*	X			LC						
Asteraceae	*Felicia muricata*		X		LC						
Cyperaceae	*Fimbristylis complanata*	X			LC						

Poaceae	*Fingerhuthia sesleriiformis*		X		LC				
Asteraceae	*Galinsoga parviflora*		X						Nat
Rubiaceae	*Galium capense*		X		LC				
Asteraceae	*Garuleum woodii*	X			LC				
Asteraceae	*Gazania krebsiana*		X		LC				
Asteraceae	*Gazania sp.*		X						
Asteraceae	*Geigeria burkei*		X		LC				
Asteraceae	*Geigeria burkei subsp. burkei var. burkei*	X			NE				
Asteraceae	*Geigeria burkei subsp. burkei var. zeyheri*	X			NE				
Iridaceae	*Gladiolus crassifolius*	X	X		LC		Sch 11		
Iridaceae	*Gladiolus dalenii*		X		LC		Sch 11		
Iridaceae	*Gladiolus elliotii*	X			LC		Sch 11		
Iridaceae	*Gladiolus longicollis subsp. longicollis*	X			LC		Sch 11		
Iridaceae	*Gladiolus robertsoniae*	X	X	*x*	NT	NT	Sch 11		
Thymelaeaceae	*Gnidia gymnostachya*	X			LC				
Thymelaeaceae	*Gnidia sp.*		X						
Apocynaceae	*Gomphocarpus fruticosus subsp. fruticosus*	X	X		LC				
Apocynaceae	*Gomphocarpus rivularis*	X			LC				
Amaranthaceae	*Gomphrena celosioides*		X						Nat
Malvaceae	*Grewia flava*	X			LC				
Amaranthaceae	*Guilleminea densa*		X						Nat
Orchidaceae	*Habenaria barbertoni*	X		*x*	NT	NT	Sch 11	App II	
Orchidaceae	*Habenaria epipactidea*	X			LC		Sch 11	App II	
Amaryllidaceae	*Haemanthus humilis*		X		LC		Sch 11		
Amaryllidaceae	*Haemanthus montanus*	X			LC		Sch 11		
Amaryllidaceae	*Haemanthus sp.*		X				Sch 11		
Asteraceae	*Haplocarpha lyrata*	X	X		LC				
Asteraceae	*Haplocarpha scaposa*		X		LC				
Poaceae	*Harpochloa falx*	X	X		LC				
Asteraceae	*Helichrysum aureonitens*		X		LC				
Asteraceae	*Helichrysum lepidissimum*	X			LC				
Asteraceae	*Helichrysum nudifolium*		X		LC				
Asteraceae	*Helichrysum pilosellum*		X		LC				
Asteraceae	*Helichrysum rugulosum*		X		LC				
Poaceae	*Trisetopsis imberbis*		X		LC				
Lamiaceae	*Hemizygia pretoriae*		X		LC				
Lamiaceae	*Hemizygia sp.*		X						
Malvaceae	*Hermannia coccocarpa*	X	X		LC				
Malvaceae	*Hermannia cristata*	X			LC				
Malvaceae	*Hermannia depressa*		X		LC				
Malvaceae	*Hermannia erodioides*		X		LC				
Malvaceae	*Hermannia grandistipula*		X		LC				
Poaceae	*Heteropogon contortus*		X		LC				
Malvaceae	*Hibiscus aethiopicus*		X		LC				
Malvaceae	*Hibiscus microcarpus*		X		LC				
Malvaceae	*Hibiscus trionum*	X	X						Nat
Asteraceae	*Hilliardiella elaeagnoides*		X		LC				
Apocynaceae	*Huernia hystrix*		X		LC		Sch 11		
Poaceae	*Hyparrhenia anamesa*	X			LC				
Poaceae	*Hyparrhenia hirta*		X		LC				
Poaceae	*Hyparrhenia tamba*		X		LC				
Hypoxidaceae	*Hypoxis acuminata*	X	X		LC				
Hypoxidaceae	*Hypoxis argentea*		X		LC				
Hypoxidaceae	*Hypoxis hemerocallidea*		X	X	LC	DEC			
Hypoxidaceae	*Hypoxis rigidula*		X		LC				
Hypoxidaceae	*Hypoxis rigidula var. rigidula*	X			LC				
Poaceae	*Imperata cylindrica*		X		LC				
Fabaceae	*Indigofera dregeana*	X			LC				
Fabaceae	*Indigofera hedyantha*	X	X		LC				
Fabaceae	*Indigofera hilaris*		X		LC				
Fabaceae	*Indigofera sp.*		X						

Fabaceae	*Indigofera sp.*		X							
Convolvulaceae	*Ipomoea bathycolpos*		X		LC					
Convolvulaceae	*Ipomoea bolusiana*		X		LC					
Convolvulaceae	*Ipomoea crassipes*		X		LC					
Convolvulaceae	*Ipomoea oblongata*	X			LC					
Convolvulaceae	*Ipomoea sp.*		X							
Poaceae	*Ischaemum fasciculatum*		X		LC					
Scrophulariaceae	*Jamesbrittenia aurantiaca*		X		LC					
Scrophulariaceae	*Jamesbrittenia stricta*		X		LC					
Aizoaceae	*Khadia beswickii*			X	VU	VU				
Asphodelaceae	*Kniphofia typhoides*			X	NT	NT	Sch 11			
Poaceae	*Koeleria capensis*	X			LC					
Rubiaceae	*Kohautia amatymbica*		X		LC					
Rubiaceae	*Kohautia cynanchica*		X		LC					
Cyperaceae	*Kyllinga erecta*		X		LC					
Asteraceae	*Lactuca inermis*		X						Nat	
Iridaceae	*Lapeirousia sp.*		X							
Asteraceae	*Launaea rarifolia var. rarifolia*	X			LC					
Hyacinthaceae	*Ledebouria burkei subsp. burkei*	X			LC					
Hyacinthaceae	*Ledebouria cf. minima*		X		LC					
Hyacinthaceae	*Ledebouria cf. revoluta*		X		LC					
Hyacinthaceae	*Ledebouria cooperi*		X		LC					
Hyacinthaceae	*Ledebouria graminifolia*		X		LC					
Hyacinthaceae	*Ledebouria sp.*		X							
Poaceae	*Leersia hexandra*		X		LC					
Fabaceae	*Leobordea divaricata*	X	X		LC					
Fabaceae	*Leobordea mucronata*	X			LC					
Brassicaceae	*Lepidium africanum*		X		LC					
Poaceae	*Leptochloa fusca*		X		LC					
Fabaceae	*Lessertia stricta*		X		LC					
Lamiaceae	*Leucas sp.*		X		LC					
Poaceae	*Lolium perenne*		X						Nat	
Fabaceae	*Lotononis sp.*		X							
Fabaceae	*Medicago laciniata var. laciniata*	X			NE				Nat	
Poaceae	*Melinis nerviglumis*	X			LC					
Poaceae	*Melinis repens*		X		LC					
Fabaceae	*Melolobium calycinum*	X	X		LC					
Lamiaceae	*Mentha longifolia*		X		LC					
Poaceae	*Microchloa caffra*		X		LC					
Geraniaceae	*Monsonia angustifolia*		X		LC					
Brassicaceae	*Nasturtium officinale*		X						Nat	
Scrophulariaceae	*Nemesia cf. umbonata*		X		LC					
Amaryllidaceae	*Nerine graciiis*			X	VU	VU				
Amaryllidaceae	*Nerine krigei*	X			LC					
Asteraceae	*Nidorella hottentotica*		X		LC					
Asteraceae	*Nidorella resedifolia subsp. resedifolia*	X			LC					
Asteraceae	*Nolletia jeanettae*	X			LC					
Onagraceae	*Oenothera rosea*		X						Nat	
Onagraceae	*Oenothera tetraptera*	X	X						Nat	
Cactaceae	*Opuntia ficus-indica*		X				Sch 13			1b
Apocynaceae	*Orbea cooperi*	X			LC		Sch 11			
Poaceae	*Oropetium capense*		X		LC					
Orchidaceae	*Orthochilus leontoglossus*	X			LC		Sch 11	App II		
Asteraceae	*Osteospermum muricatum*		X		LC					
Oxalidaceae	*Oxalis corniculata*		X						Nat	
Oxalidaceae	*Oxalis obliquifolia*		X		LC					
Oxalidaceae	*Oxalis sp.*		X							
Poaceae	*Panicum natalense*		X		LC					
Poaceae	*Panicum repens*		X		LC					
Poaceae	*Panicum sp.*		X							
Poaceae	*Paspalum dilatatum*		X		LC					

Poaceae	*Paspalum distichum*	X		LC			Nat
Geraniaceae	*Pelargonium alchemilloides*		X	LC			
Geraniaceae	*Pelargonium luridum*	X	X	LC			
Geraniaceae	*Pelargonium minimum*		X	LC			
Pteridaceae	*Pellaea calomelanos*		X	LC			
Poaceae	*Pennisetum clandestinum*		X	LC			
Polygonaceae	*Persicaria lapathifolia*		X				Nat
Poaceae	*Phragmites australis*		X	LC			
Phyllanthaceae	*Phyllanthus parvulus var. garipensis*	X		LC			
Solanaceae	*Physalis viscosa*		X				Nat
Plantaginaceae	*Plantago lanceolata*		X	LC			
Lamiaceae	*Plectranthus cf. madagascariensis*		X	LC			
Lamiaceae	*Plectranthus ramosior*	X		LC			
Polygalaceae	*Polygala amatymbica*		X	LC			
Polygalaceae	*Polygala hottentotta*		X	LC			
Poaceae	*Polypogon viridis*	X					Nat
Portulacaceae	*Portulaca hereroensis*		X	LC			
Portulacaceae	*Portulaca kermesina*		X	LC			
Portulacaceae	*Portulaca quadrifida*		X	LC			
Potamogetonaceae	*Potamogeton thunbergii*		X	LC			
Rosaceae	*Prunus persica*		X				Alien
Molluginaceae	*Psammotropha myriantha*	X		LC			
Asteraceae	*Pseudognaphalium luteo-album*		X	LC			
Orchidaceae	*Pterygodium nigrescens*	X		LC	Sch 11	App II	
Cyperaceae	*Pycreus cooperi*	X		LC			
Ranunculaceae	*Ranunculus multifidus*		X	LC			
Apocynaceae	*Raphionacme sp.*		X				
Fabaceae	*Rhynchosia adenodes*		X	LC			
Fabaceae	*Rhynchosia caribaea*		X	LC			
Fabaceae	*Rhynchosia monophylla*		X	LC			
Acanthaceae	*Ruellia patula*		X	LC			
Acanthaceae	*Ruellia sp.*		X				
Polygonaceae	*Rumex crispus*		X				Nat
Polygonaceae	*Rumex lanceolatus*	X		LC			
Salicaceae	*Salix babylonica*		X				Alien
Lamiaceae	*Salvia sp.*		X				
Orchidaceae	*Satyrium stenopetalum subsp. brevicalcaratum*	X		LC	Sch 11	App II	
Caprifoliaceae	*Scabiosa columbaria*		X	LC			
Hyacinthaceae	*Schizocarphus nervosus*	X		LC			
Apocynaceae	*Schizoglossum bidens*		X	LC			
Asteraceae	*Schkuhria pinnata*	X	X				Nat
Cyperaceae	*Schoenoplectus cf. muricinux*		X	LC			
Cyperaceae	*Schoenoplectus decipiens*	X		LC			
Cyperaceae	*Schoenoplectus sp.*		X				
Anacardiaceae	*Searsia discolor*	X		LC			
Anacardiaceae	*Searsia lancea*		X	LC			
Anacardiaceae	*Searsia magalismontana*		X				
Anacardiaceae	*Searsia rigida*		X	LC			
Gentianaceae	*Sebaea leiostyla*	X		LC			
Selaginellaceae	*Selaginella caffrorum var. caffrorum*	X		LC			
Scrophulariaceae	*Selago densiflora*		X	LC			
Scrophulariaceae	*Selago tenuifolia*		X	LC			
Asteraceae	*Senecio consanguineus*		X	LC			
Asteraceae	*Senecio coronatus*		X	LC			
Asteraceae	*Senecio erubescens*		X	LC			
Asteraceae	*Senecio inaequidens*		X	LC			
Asteraceae	*Senecio inornatus*		X	LC			
Asteraceae	*Senecio isatideus*		X	LC			
Asteraceae	*Senecio othonniflorus*		X	LC			
Asteraceae	*Senecio sp.*		X	LC			
Fabaceae	*Senna italica*		X	LC			

Asteraceae	*Seriphium plumosum*	X	X	LC				
Poaceae	*Setaria incrassata*		X	LC				
Poaceae	*Setaria nigrirostris*	X	X	LC				
Poaceae	*Setaria pumila*		X	LC				
Poaceae	*Setaria sphacelata*		X	LC				
Poaceae	*Setaria sphacelata var. sericea*	X		LC				
Poaceae	*Setaria sphacelata var. sphacelata*	X		LC				
Brassicaceae	*Erucastrum austroafricanum*		X				Nat	
Solanaceae	*Solanum campylacanthum*		X	LC				
Solanaceae	*Solanum elaeagnifolium*		X					1b
Solanaceae	*Solanum nigrum*		X				Nat	
Asteraceae	*Sonchus oleraceus*		X				Nat	
Fabaceae	*Sphenostylis angustifolium*		X	LC				
Poaceae	*Sporobolus africanus*	X		LC				
Poaceae	*Sporobolus discosporus*		X	LC				
Apocynaceae	*Stenostelma periglossoides*	X		LC				
Apocynaceae	*Stenostelma umbelluliferum*	X		NT				
Orobanchaceae	*Striga elegans*		X	LC				
Lamiaceae	*Syncolostemon canescens*	X		LC				
Asteraceae	*Tagetes minuta*	X	X				Nat	
Fabaceae	*Tephrosia capensis*	X	X	LC				
Poaceae	*Themeda triandra*	X	X	LC				
Santalaceae	*Thesium cf. goetzeanum*		X	LC				
Asphodelaceae	*Trachyandra asperata*		X	LC				
Asphodelaceae	*Trachyandra erythrorrhiza*	X		LC	NT			
Asphodelaceae	*Trachyandra saltii var. saltii*	X	X	LC				
Asphodelaceae	*Trachyandra sp.*		X					
Asteraceae	*Tragopogon dubius*		X				Nat	
Poaceae	*Tragus berteronianus*	X	X	LC				
Zygophyllaceae	*Tribulus terrestris*		X	LC				
Fabaceae	*Trifolium cf. africanum*		X					
Fabaceae	*Trifolium pratense*		X				Nat	
Poaceae	*Tristachya biseriata*		X	LC				
Poaceae	*Tristachya leucothrix*	X		LC				
Alliaceae	*Tulbaghia acutiloba*	X	X	LC				
Alliaceae	*Tulbaghia leucantha*	X		LC				
Convolvulaceae	*Turbina oblongata*		X	LC				
Typhaceae	*Typha capensis*		X	LC				
Poaceae	*Urochloa panicoides*		X	LC				
Fabaceae	*Vachellia karroo*		X	LC				
Verbenaceae	*Verbena bonariensis*		X					1b
Verbenaceae	*Verbena brasiliensis*		X					1b
Verbenaceae	*Verbena rigida*		X				Nat	
Asteraceae	*Vernonia glabra*		X	LC				
Plantaginaceae	*Veronica anagallis-aquatica*		X	LC				
Fabaceae	*Vigna vexillata*		X	LC				
Campanulaceae	*Wahlenbergia sp.*		X	LC				
Asteraceae	*Xanthium spinosum*		X		Sch 13			1b
Apocynaceae	*Xysmalobium undulatum*		X	LC				
Rhamnaceae	*Ziziphus zeyheriana*		X	LC				

APPENDIX C

FAUNA CHECKLISTS (ADU DATABASE)

[1]ADU Database = Animal Demography Unit, University of Cape Town
[2]Landowners reporting
[3]Current survey
[4]IUCN red list category
[5]MNCA (1998) Schedules
[6]MBSP = Mpumalanga Biodiversity Sector Plan redlist
[7]NEMBA (ToPS) - Threatened or Protected Species
[8]CITES = Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES 2023)

Mammals

Family	Scientific name	Common name	ADU[1]	Impumelelo[2]	Current survey[3]	IUCN[4]	MNCA[5] 1998	MBSP[6] 2629CB	ToPS[7]	CITES[8]
Bathyergidae	*Cryptomys hottentotus*	Southern African Mole-rat	x			LC				
Bathyergidae	*Cryptomys hottentotus pretoriae*	Highveld mole-rat	x			NE				
Bovidae	*Antidorcas marsupialis*	Springbok	x	X	X	LC	Sch 3	Sch 3 LC		
Bovidae	*Connochaetes gnou*	Black Wildebeest	x			LC	Sch 2	Sch 2 LC	Prot	
Bovidae	*Connochaetes taurinus*	Blue Wildebeest	x			LC	Sch 3			
Bovidae	*Damaliscus pygargus phillipsi*	Blesbok	x	X	X	LC	Sch 3	Sch 3 LC		
Bovidae	*Oryx gazella*	Gemsbok	x			LC	Sch 3			
Bovidae	*Ourebia ourebi*	Oribi	x			EN	Sch 2		EN	
Bovidae	*Raphicerus campestris*	Steenbok	x	X	X	LC	Sch 2			
Bovidae	*Taurotragus oryx*	Cape Eland	x			LC	Sch 2			
Bovidae	*Alcelaphus buselaphus*	Red hartebeest	x			LC	Sch 3	Sch 3 LC		
Bovidae	*Kobus ellipsiprymnus*	Waterbuck	x			LC	Sch 2	Sch 2 LC		
Canidae	*Canis mesomelas*	Black-backed Jackal	x	X	X	LC	Sch 8			
Canidae	*Vulpes chama*	Cape Fox	x			LC	Sch 5		Prot	
Canidae	*Panthera pardus*	Leopard	x			VU	X Sch 4	Sch 4 VU	VU	App I
Chrysochloridae	*Amblysomus septentrionalis*	Highveld Golden Mole	x			NT				
Equidae	*Equus quagga*	Plains Zebra	x			LC	Sch 3	Sch 3 LC		
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	x	X		NT	Sch 2		Prot	
Felidae	*Caracal caracal*	Caracal	x			LC	Sch 8			App II
Felidae	*Felis catus*	Domestic Cat	x	X	X	Introd				
Felidae	*Felis nigripes*	Black-footed Cat	x			VU			Prot	App I
Felidae	*Felis silvestris*	African Wildcat	x			LC	Sch 5			
Felidae	*Leptailurus serval*	Serval	x	X		NT	Sch 5		Prot	App II
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	x	X	X	LC	Sch 5			
Herpestidae	*Herpestes ichneumon*	Egyptian Mongoose	x			LC	Sch 5			
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	x			LC	Sch 5			
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose	x			LC	Sch 5			
Herpestidae	*Suricata suricatta*	Meerkat	x	X	X	LC	Sch 5			
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	x	X	X	LC				
Leporidae	*Lepus capensis*	Cape Hare	x			LC	Sch 3			
Leporidae	*Lepus saxatilis*	Scrub Hare	x	X	X	LC	Sch 3			
Muridae	*Gerbilliscus brantsii*	Highveld Gerbil	x			LC				
Muridae	*Mastomys natalensis*	Natal Mastomys	x			LC				
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	x			LC				
Muridae	*Mus musculus musculus*	House mouse	x	X	X	LC				
Muridae	*Otomys angoniensis*	Angoni Vlei Rat	x			LC				
Muridae	*Otomys auratus*	Southern African Vlei Rat (Grassland type)	x	X		NT				

Muridae	*Rattus rattus*	Roof Rat	x	X			LC				
Muridae	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	x				LC				
Mustelidae	*Aonyx capensis*	African Clawless Otter	x				NT	Sch 2		Prot	App II
Mustelidae	*Ictonyx striatus*	Striped Polecat	x				LC				
Mustelidae	*Poecilogale albinucha*	African Striped Weasel	x				NT		NT		
Nesomyidae	*Dendromus melanotis*	Gray African Climbing Mouse	x				LC				
Nesomyidae	*Dendromus mystacalis*	Chestnut African Climbing Mouse	x				LC				
Pedetidae	*Pedetes capensis*	South African Spring Hare	x				LC	Sch 5			
Sciuridae	*Xerus inauris*	South African Ground Squirrel	x	X		X	LC				
Soricidae	*Crocidura mariquensis*	Swamp Musk Shrew	x				NT				
Suidae	*Phacochoerus africanus*	Warthog	x				LC	Sch 5			
Vespertilionidae	*Neoromicia capensis*	Cape Serotine	x				LC				
Viverridae	*Civettictis civetta*	African Civet	x				LC	Sch 5			
Viverridae	*Genetta genetta*	Common Genet	x	X			LC	Sch 5			
Viverridae	*Genetta tigrina*	Cape Genet (Cape Large-spotted Genet)	x				LC	Sch 5			

Reptiles

Family	Scientific name	Common name	Red list	MNCA 1998	Mpu Redlist 2629CB	ToPS	CITES
Agamidae	*Agama aculeata distanti*	Distant's Ground Agama	LC	Sch 2	LC		
Agamidae	*Agama atra*	Southern Rock Agama	LC	Sch 2			
Chamaeleonidae	*Bradypodion ventrale*	Eastern Cape Dwarf Chameleon	LC	Sch 2			
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	LC	Sch 5	LC		
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	LC	Sch 5			
Cordylidae	*Chamaesaura aenea*	Coppery Grass Lizard	NT	Sch 2			
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard	LC	Sch 2			X
Cordylidae	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	LC	Sch 2			
Cordylidae	*Smaug giganteus*	Giant Girdled Lizard	VU	Sch 2		EN	X
Elapidae	*Hemachatus haemachatus*	Rinkhals	LC	Sch 5	LC (on site Impumelelo)		
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	LC	Sch 2			
Gekkonidae	*Pachydactylus vansoni*	Van Son's Gecko	LC	Sch 2			
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC	Sch 2			
Lamprophiidae	*Amplorhinus multimaculatus*	Many-spotted Snake	LC	Sch 5			
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	LC	Sch 5			
Lamprophiidae	*Duberria lutrix lutrix*	South African Slug-eater	LC	Sch 5			
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	LC	Sch 5			
Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	LC	Sch 5			
Lamprophiidae	*Lycodonomorphus rufulus*	Brown Water Snake	LC	Sch 5			
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	LC	Sch 5			
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	LC	Sch 5			
Lamprophiidae	*Psammophylax tritaeniatus*	Striped Grass Snake	LC	Sch 5			
Leptotyphlopidae	*Leptotyphlops scutifrons conjunctus*	Eastern Thread Snake		Sch 5	LC		
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake		Sch 5	LC		
Leptotyphlopidae	*Leptotyphlops incognitus*	Incognito Worm Snake		Sch 5	LC		
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	LC	Sch 2			
Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	LC	Sch 2			
Scincidae	*Trachylepis capensis*	Cape Skink	LC	Sch 2			
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	LC	Sch 2	X		
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	LC	Sch 2	X		
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	LC	Sch 5	LC		
Varanidae	*Varanus niloticus*	Water Monitor	LC	Sch 5	LC		

Frogs

Family	Scientific name	Common name	Red list	MNCA (1998)	Mpu Redlist 2629CB	ToPS	CITES
Bufonidae	*Poyntonophrynus vertebralis*	Southern Pygmy Toad	LC				
Bufonidae	*Sclerophrys capensis*	Raucous Toad	LC		LC		
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	LC		LC		
Bufonidae	*Sclerophrys pusilla*	Flatbacked Toad	LC				
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	LC		LC		
Hyperoliidae	*Semnodactylus wealii*	Rattling Frog	LC		LC		
Phrynobatrachidae	*Phrynobatrachus natalensis*	Snoring Puddle Frog	LC				
Pipidae	*Xenopus laevis*	Common Platanna	LC		LC		
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	LC				
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog	LC		LC		
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	LC		LC		
Pyxicephalidae	*Strongylopus fasciatus*	Striped Stream Frog	LC				
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	LC		LC		
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog	LC		LC		

Lepidoptera

Family	Scientific name	Common name	Red list
HESPERIIDAE	*Afrogegenes letterstedti*	Brown dodger	LC
HESPERIIDAE	*Andronymus neander neander*	Nomad dart	LC
HESPERIIDAE	*Eretis umbra umbra*	Small marbled elf	LC
HESPERIIDAE	*Kedestes barberae barberae*	Freckled ranger	LC
HESPERIIDAE	*Metisella meninx*	Marsh sylph	LC
HESPERIIDAE	*Spialia asterodia*	Star sandman	LC
HESPERIIDAE	*Spialia ferax*	Striped sandman	LC
HESPERIIDAE	*Spialia mafa mafa*	Mafa sandman	LC
HESPERIIDAE	*Spialia spio*	Mountain sandman	LC
HESPERIIDAE	*Tsitana tsita*	Dismal sylph	LC
LYCAENIDAE	*Actizera lucida*	Rayed blue	LC
LYCAENIDAE	*Aloeides aranda*	Yellow russet	LC
LYCAENIDAE	*Aloeides dentatis maseruna*	Maluti toothed russet	LC
LYCAENIDAE	*Aloeides henningi*	Hillside russet	LC
LYCAENIDAE	*Aloeides molomo molomo*	Mottled russet	LC
LYCAENIDAE	*Aloeides trimeni trimeni*	Brown russet	LC
LYCAENIDAE	*Azanus jesous*	Topaz babul blue	LC
LYCAENIDAE	*Azanus ubaldus*	Velvet-spotted babul blue	LC
LYCAENIDAE	*Cacyreus marshalli*	Common geranium bronze	LC
LYCAENIDAE	*Chilades trochylus*	Grass jewel blue	LC
LYCAENIDAE	*Chrysoritis aureus*	Golden opal	EN
LYCAENIDAE	*Chrysoritis chrysaor*	Burnished opal	LC
LYCAENIDAE	*Chrysoritis lycegenes*	Mooi river opal	LC
LYCAENIDAE	*Cigaritis mozambica*	Mozambique silverline	LC
LYCAENIDAE	*Cupidopsis cissus cissus*	Meadow blue	LC
LYCAENIDAE	*Eicochrysops messapus mahallakoaena*	Cupreous ash blue	LC
LYCAENIDAE	*Lampides boeticus*	Pea blue	LC
LYCAENIDAE	*Lepidochrysops ketsi ketsi*	Ketsi giant cupid	LC
LYCAENIDAE	*Lepidochrysops letsea*	Free State giant cupid	LC
LYCAENIDAE	*Lepidochrysops patricia*	Patrician giant cupid	LC
LYCAENIDAE	*Lepidochrysops variabilis*	Variable giant cupid	LC
LYCAENIDAE	*Leptomyrina henningi henningi*	Plain black-eye	LC
LYCAENIDAE	*Leptotes pirithous pirithous*	Common zebra blue	LC
LYCAENIDAE	*Lycaena clarki*	Eastern sorrel copper	LC

LYCAENIDAE	*Orachrysops lacrimosa*	Restless cupid	LC
LYCAENIDAE	*Tarucus sybaris sybaris*	Dotted pierrot	LC
LYCAENIDAE	*Thestor basutus basutus*	Basuto skolly	LC
LYCAENIDAE	*Zizeeria knysna knysna*	African grass blue	LC
LYCAENIDAE	*Zizula hylax*	Tiny grass blue	LC
NYMPHALIDAE	*Acraea horta*	Garden acraea	LC
NYMPHALIDAE	*Acraea neobule neobule*	Wandering donkey acraea	LC
NYMPHALIDAE	*Aeropetes tulbaghia*	Table mountain beauty	LC
NYMPHALIDAE	*Byblia ilithyia*	Spotted joker	LC
NYMPHALIDAE	*Catacroptera cloanthe cloanthe*	Pirate	LC
NYMPHALIDAE	*Danaus chrysippus orientis*	African plain tiger	LC
NYMPHALIDAE	*Hypolimnas misippus*	Common diadem	LC
NYMPHALIDAE	*Junonia hierta cebrene*	Yellow pansy	LC
NYMPHALIDAE	*Junonia oenone oenone*	Dark blue pansy	LC
NYMPHALIDAE	*Junonia orithya madagascariensis*	African blue pansy	LC
NYMPHALIDAE	*Precis archesia archesia*	Garden inspector	LC
NYMPHALIDAE	*Stygionympha wichgrafi wichgrafi*	Wichgraf's hillside brown	LC
NYMPHALIDAE	*Telchinia rahira rahira*	Marsh telchinia	LC
NYMPHALIDAE	*Vanessa cardui*	Painted lady	LC
PAPILIONIDAE	*Papilio demodocus demodocus*	Citrus swallowtail	LC
PIERIDAE	*Belenois aurota*	Pioneer caper white	LC
PIERIDAE	*Catopsilia florella*	African migrant	LC
PIERIDAE	*Colias electo electo*	African clouded yellow	LC
PIERIDAE	*Eurema brigitta brigitta*	Broad-bordered grass yellow	LC
PIERIDAE	*Pontia helice helice*	Southern meadow white	LC
SPHINGIDAE	*Basiothia medea*		Not listed

Spiders

Family	Scientific name	Common name	Red list	MNCA 1998	ToPS
Sparassidae	FAMILY Sparassidae	Huntsman spiders			
Theraphosidae	*Brachionopus sp.*				
Theraphosidae	*Harpactira hamiltoni*	Baboon spider		Sch 7	Prot

Scorpion

Family	Scientific name	Common name	Red list	MNCA 1998	ToPS
BUTHIDAE	*Uroplectes triangulifer*	Highveld Lesser-Thicktail scorpion	LC		

APPENDIX D

SITE SENSITIVITY VERIFICATION

Prior to commencing with the Terrestrial Biodiversity Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was 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).

The details of the site sensitivity verification are noted below:

Date of site visit	January 2021 and December 2021
Specialist name	Dr Noel van Rooyen; Prof. Gretel van Rooyen
Professional registration number	401430/83 Botanical Science (NvR); 400509/14 Ecological Science (GvR)
Specialist affiliation / company	Ekotrust cc

The site sensitivity verification was undertaken using the following means:

- desk top analysis using satellite imagery;
- consulting geological, land type and vegetation type maps of the region;
- consulting provincial datasets on the latest versions of the mapping of CBAs, ESAs, ONAs, NPAES and PAs;
- checking distribution ranges of IUCN red-listed species and species highlighted by the screening tool;
- compiling plant and animal species checklist for the region; and
- on-site inspection.

To verify the site sensitivity of the screening tool, Google satellite images were studied beforehand and the site stratified into relatively homogenous physiographic-physionomic units or habitats. Sites were then selected to represent these habitats. During the field survey, 20 sampling sites were surveyed at the proposed Impumelelo development. However, a further 60 sample plots were surveyed on the Vhuvhili and Impumelelo sites in the vicinity and the total of 80 sample plots were used to improve the identification and description of habitat types in the area.

Plant Species Theme

Screening tool: The screening tool rated the sensitivity of the Plant Species Theme as High and provided the following list of plant SCC.

Sensitivity	Feature(s)
High	Sensitive species 691
Medium	Sensitive species 1252
Medium	Khadia beswickii
Medium	Sensitive species 691
Medium	Sensitive species 1248

Site verification:

Our field survey and application of a sensitivity model indicated that most of the habitats (plant communities) on site had a **low** sensitivity.

- One of the SCC highlighted by the screening tool were recorded on site, i.e. Sensitive species 691.
- The endangered vegetation type or ecosystem highlighted in the Screening Tool refers to the Tsakane Clay Highveld, which covers only about one hectare in the far west of the Impumelelo site and no infrastructure is planned for that area.
- The Soweto Highveld Grassland is classified as a Vulnerable vegetation type. However, relatively large portions of the site have been heavily or moderately modified (compare CBA map, Figure 18) and not prime examples of the Soweto Highveld Grassland. If the development is thus contained within the heavily or moderately modified areas it would not affect the status of the vegetation type since these modified area were already considered as lost for the allocation of a vulnerable status of the vegetation type.
- Sensitive species 691 occurs in damp depressions in shallow soil over rock sheets (Habitat 1, Figure 6). The species was recorded at one location on site (MBSP 2022) but not within 240 m of any of the proposed turbine locations. This habitat should be avoided by the development.
- The habitats on site do not present suitable habitat for sensitive species 1252 and 1248 because of a lack of suitable wooded habitat. Moreover, the rocky outcrops on hilly terrain with a sparse woody cover were avoided by the development. Neither of these species were listed for the region on the NewPosa database nor in the MTPA database for the farms in the immediate vicinity of the Impumelelo site (data provided by MTPA; MBSP 2022).
- *Khadia beswickii* occurs in rocky habitats on shallow soil (sheetrock) (see Habitat 1 in Figure 6), but was not recorded on site. One location for *Khadia beswickii* was indicated in the region to the south of the site (data provided by MTPA). Furthermore, the rocky habitats (Habitats 1, 2 & 3) were avoided in the layout of the infrastructure on the Impumelelo site.

Based on the information provided above, we would rate the sensitivity of the Plant Species Theme as **Medium.**

Animal Species Theme

Screening tool: The screening tool rated the sensitivity of the Animal Species Theme as **high** and listed the following species as being SCC**.**

Sensitivity	Feature(s)
High	Aves-*Circus ranivorus*
High	Aves-*Eupodotis senegalensis*
High	Aves-*Hydroprogne caspia*
High	Aves-*Polemaetus bellicosus*
High	Aves-*Sagittarius serpentarius*
High	Aves-*Mycteria ibis*
Medium	Aves-*Tyto capensis*
Medium	Aves-*Circus ranivorus*
Medium	Aves-*Hydroprogne caspia*
Medium	Aves-*Eupodotis senegalensis*
Medium	Insecta-*Lepidochrysops procera*
Medium	Mammalia-*Crocidura maquassiensis*
Medium	Mammalia-*Hydrictis maculicollis*
Medium	Mammalia-*Ourebia ourebi ourebi*

Site verification:

Note - the avifaunal and bat component will be addressed by the avifaunal and bat specialists.

- The Screening Tool listed *Lepidochrysops procera* (Lepidoptera) as a SCC for the site. However, it was not listed in the ADU database, the MNCA (1998) provincial species lists or the NEMBA (2007c) ToPS lists. *Lepidochrysops*

procera was not recorded on site and is unlikely to occur there because its host plant (*Ocimum obovatum*) was scarce and only recorded in one location.

- The oribi *Ourebia ourebi* is found in patchy distributions in open and wooded mesic grassland. The Impumeleo site falls marginally within the distribution range of *Ourebia ourebi ourebi.* Its habitat is largely fragmented due to human socio-economic activities including agriculture, forestry and mining. It was not recorded during the survey or mentioned by the landowners on site.
- The Maquassie Musk Shrew *Crocidura maquassiensis* was not listed for the region in the ADU mammal species list or the MNCA (1998) lists for the Mpumalanga province. It was not recorded on site during the survey. The Maquassie Musk Shrew depends on wetlands as suitable habitat in savanna and grasslands. Although it has a wide inferred extent of occurrence, it appears to be patchily distributed. The main threats to shrews are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. *Crocidura maquassiensis* has not been reported from Mpumalanga Province post-1999 and thus there is a very low probability for it to occur on site.
- The spotted-necked otter *Hydrictis maculicollis* was not listed for the region in the ADU mammal species list but was included in the MNCA (1998) lists for the Mpumalanga province. It was not recorded on site during the survey. Marginally suitable habitat for the spotted-necked otter is available on site. It occurs widespread, but it is restricted to areas of permanent fresh water offering good shoreline cover and an abundant prey base. The proposed WEF will not encroach into any drainage lines.
- What the screening tool did not highlight was the possible presence of the giant girdled lizard, a species with a Vulnerable IUCN status. However, the species was not recorded on site nor listed in the MTPA database for the farms in the immediate vicinity of the Impumelelo site. Furthermore, according to Bates *et al*. (2014), the distribution of the giant girdled lizard does not include the Impumelo site.
- The screening did also not highlight the presence of three Near Threatened species, viz. the Southern African hedgehog (*Atelerix frontalis*), serval (*Leptailurus serval*) and Southern African vlei rat (*Otomys auratus*) which have been reported for the Impumelelo site. It is unlikely that the development will affect the Southern African vlei rat, since the vlei habitat should be avoided. During construction the serval will avoid the area, but it could return during the operational phase. Construction workers should be made aware of not harming the Southern African hedgehog, however due to its size most individuals will go unnoticed.

Based on the information provided above, we would rate the sensitivity of the Animal Theme as **Medium**. However, if the suggested mitigation measures are followed the animal SCC should not be negatively affected.

Relative Terrestrial Biodiversity Theme

Screening tool: The screening tool rated the sensitivity of the Relative Terrestrial Biodiversity theme as **Very High** and listed the following features of concern:

Sensitivity	Feature(s)
Very high	Critical Biodiversity Area 1
Very high	Critical Biodiversity Area 2
Very high	Ecological support area: landscape corridor
Very high	Ecological support area: local corridor
Very high	Endangered ecosystem
Very high	Vulnerable ecosystem
Very high	Protected Areas Expansion Strategy

Site verification:

- This theme considers the presence of protected areas, National Protected Area Expansion Strategy (NPAES), CBAs, ESAs and National Freshwater Ecosystem Priority Area (FEPAs).

- The study area is not located in a protected area.
- The study area falls in the NPAES (NPAES 2018). The mapped units include CBA1 (or CBA irreplaceable), CBA2 (or CBA optimal) and ESAs (Landscape and Local corridors). A substantial number of turbines (16) are located within the 'Priority Focus Areas', thus those turbines falling in CBAs and ESAs.
- The impumelelo site does form part of the 5-year and 20 year plan of the Mpumalanga PAES (MPAES data supplied by MTPA). The MPAES 20-year plan corresponds to the NPAES (2018) map. As in the case of NPAES, a substantial number of turbines are located within the MPAES, i.e. those turbines falling in CBAs and ESAs.
- Our background study confirms that the Soweto Highveld Grassland vegetation type on site is listed as 'Vulnerable'. The Tsakane Clay Highveld, an 'Endangered' vegetation type, covers only about one hectare in the far west of the Impumelelo site and will not be impacted by the WEF.
- Our background study indicated that although there are CBAs and ESAs present on site, our sensitivity analysis rated most of these areas as being of low sensitivity except for the wetlands (Habitat 7), which have a high sensitivity. Sensitivity of Habitats 1 and 3 was rated as moderate, but the development has not encroached onto these habitats. Nevertheless, wherever possible, wind turbines should preferably not be located within areas demarcated as CBAs and micrositing of one or two turbines might be necessary.
- There are ESA Landscape corridors and ESA Local corridors indicated on site, but the presence of the WEF would not impact negatively on them.
- Freshwater Ecosystem Priority Areas (FEPAs) or water catchments were not flagged by the screening tool. Based on the site assessment of the vegetation most of the area mapped as upstream river FEPA was rated as having a low or medium sensitivity, with only the drainage lines having a high sensitivity. Several Mgumalanga Highveld wetlands are present on site (see aquatic specialist report), but these were also not highlighted by the Screening Tool.
- **The recommendations of the aquatic specialist should be followed when observing buffers around drainage lines as well as for Mpumalange Highveld Wetlands.**

Outcome of the site sensitivity verification:

- We suggest that the Plant Species Theme's site sensitivity is changed to **Medium.**
- We would suggest the Animal Species Theme's site sensitivity to be rated as **Medium**.
- Unfortunately, the screening tool limits the sensitivity of the Relative Terrestrial Biodiversity Theme to either Very High or Low. This is an issue which should be revisited by DFFE, since it does not give a proper representation of the site conditions. Although we agree with the presence of the CBAs, ESAs, NPAES, MPAES and Vulnerable ecosystem, the entire site does not qualify as having a 'Very High Sensitivity', since a large proportion of the site (approximately 32%) is degraded and moderately and heavily modified.

APPENDIX E

COMPLIANCE WITH THE TERRESTRIAL BIODIVERSITY PROTOCOL (GN 320, 20 MARCH 2020)

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity	***Section where this has been addressed in the Specialist Report***
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 will impact these;*	*Chapters 9, Section 9.6; Chapter 17*
2.3.2. ecological functioning and ecological processes (e.g. fire, migration, pollination, etc.) that operate within the preferred site;	*Chapter 9, Section 9.6*
2.3.3. the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;	*Chapter 9, Sections 9.4 & 9.6*
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;	*Chapters 4 – 9*
2.3.5. a description of terrestrial biodiversity and ecosystems on the preferred site, including: *a) main vegetation types;* *b) threatened ecosystems, including listed 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;*	*(a) Chapter 5* *(b) Chapters 5 & 9* *(c) Chapters 5 & 9* *(d) Chapters 5 – 9; Appendix A, B & C*
2.3.6. the assessment must identify any 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	*Chapter 12*
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 the 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;*	*(a) Chapter 9, Appendix D* *(b) Chapter 9; Section 9.4* *(c) Chapter 12, 13 & 17* *(d) Chapter 17* *(e) n.a.* *(f) Chapters 12 & 13* *(g) Chapters 12 & 13*
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;*	*(a) Chapter 9* *(b) Chapter 9* *(c) Chapter 9*
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;*	*n.a.*
2.3.7.4. priority areas for protected area expansion, including-	*n.a.*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity	***Section where this has been addressed in the Specialist Report***
a) the way in which in which the proposed development will compromise or contribute to the expansion of the protected area network;	
2.3.7.5. SWSAs including: *a) the impact(s) on the terrestrial habitat of a SWSA; and* *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 watercourses);*	*n.a. (Chapter 9 (section 9.8)*
2.3.7.6. FEPA subcatchments, including- *a) the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;*	*Chapter 9; Section 9.5*
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.*	*n.a.*
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;	*Appendix F*
3.1.2. a signed statement of independence by the specialist;	*p. viii*
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;	*Chapter 2*
3.1.4. a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	*Chapter 2*
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;	*p. xvii*
3.1.6. a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	*Chapters 9, 10, 12, 13; Figures 12 – 15 Sensitivity.kmz file*
3.1.7. additional environmental impacts expected from the proposed development;	*n.a.*
3.1.8. any direct, indirect and cumulative impacts of the proposed development;	*Chapters 12 & 13*
3.1.9. the degree to which impacts and risks can be mitigated;	*Chapters 12 & 13*
3.1.10. the degree to which the impacts and risks can be reversed;	*Chapters 12 & 13*
3.1.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	*Chapters 12 & 13*
3.1.12. proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	*Chapter 15*
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;	*n.a.*
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 or not; and	*Chapter 17*
3.1.15. any conditions to which this statement is subjected.	*Chapter 17*
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.	*For EAP to incorporate*
3.2.1. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	*For EAP to append* *.*

APPENDIX F

Curriculum vitae: DR NOEL VAN ROOYEN

1. Biographical information

Surname	**Van Rooyen**
First names	**Noel**
ID number	**501225 5034 084**
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Business address	**Ekotrust CC** **7 St George Street** **Lionviham 7130** **Somerset West** **South Africa**
Mobile	**082 882 0886**
e-mail	**noel@ekotrust.co.za**
Current position	**Member of Ekotrust cc**
Professional registration	**Botanical Scientist : Pr.Sci.Nat; Reg no. 401430/83**

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

2. Publications

I am the author/co-author of 128 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students. More than 350 projects were undertaken by Ekotrust cc as consultant over a period of more than 40 years.

Books

VAN ROOYEN, N. 2001. ***Flowering plants of the Kalahari dunes***. Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2019. ***Flowering plants of the southern Kalahari***. Somerset West.

Author / co-author of various chapters on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. 1996. ***Vegetation types of South Africa, Lesotho and Swaziland*****,** Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) 1999, 2006. ***The Magnificent Natural Heritage of South Africa*****.** (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bushveld.** Briza, Pretoria. (Chapter on Sour Bushveld).

Contributed to chapters on vegetation, habitat evaluation and veld management in the book:

BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2016**.** ***Game Ranch Management*****.** 5th edition**.** Van Schaik, Pretoria.

BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2021**. Wildplaasbestuur.** 5th edition**.** Van Schaik, Pretoria.

Co-editor of the book:

BOTHMA, J. du P. & VAN ROOYEN, N**.** (eds). 2005**.** ***Intensive wildlife production in southern Africa.*** Van Schaik, Pretoria.

3. Ekotrust CC: Core Services

Ekotrust CC specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, biodiversity assessments, rare species assessments, carbon pool assessments and alien plant management.

4. Examples of projects previously undertaken

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (BAs & EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note is the Kgalagadi Transfrontier Park; iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserve).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project; Namaqualand and Kruger Park Rivers Ecosystem research programme.

5. Selected references of other projects done by Ekotrust CC

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLäNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report: Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. 1999 & 2017. The vegetation types, veld condition and game of Tswalu Kalahari Desert Reserve.

VAN ROOYEN, N. 2000. Vegetation survey and mapping of the Kgalagadi Transfrontier Park. Peace Parks Foundation, Stellenbosch.

VAN ROOYEN, N, VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for wildlife and livestock - PAN TRUST Ranch, Ghanzi, Botswana.

VAN ROOYEN, N. 2004. Vegetation and wildlife of the Greater St Lucia Wetland Park, KZN.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, habitat evaluation and wildlife management of the proposed Royal Big Six Nsubane-Pongola Transfrontier Park, Swaziland. Ekotrust cc.

VAN ROOYEN, N., VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011. The vegetation of the NECSA Vaalputs site. Report to NECSA.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2014. Ecological evaluation and wildlife management on Ndzalama Nature Reserve and adjacent farms, Gravelotte, Limpopo province.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2016. Ecological evaluation of the farm Springbokoog in the Van Wyksvlei region of Northern Cape, including a habitat assessment for the introduction of black rhinoceros. Ekotrust.

VAN ROOYEN, M.W. & VAN ROOYEN, N. & VAN DEN BERG, H. 2016. Kathu Bushveld study: Research offset for first development phase of Adams Solor Energy Facility. Project conducted for Department of Environment and Nature Conservation Northern Cape (DENC) and the Department of Agriculture, Forestry and Fisheries (DAFF).

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Environmental screening study for the proposed essential oils and Moringa oil enterprise on Ferndale farm, Bathurst, Eastern Cape. Ekotrust cc, Somerset West.

VAN ROOYEN, M.W., GAUGRIS, J.Y. & VAN ROOYEN, N. 2018. Dish Mountain gold project, Republic of Ethiopia: Natural resource use evaluation - baseline report. FFMES, Report to SRK Consulting.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Report on the terrestrial ecology (flora & fauna). Basic assessment report for the proposed development of the 325 MW Kudusberg Wind Energy Facility in the Northern and Western Cape. Ekotrust cc, Somerset West.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2019. Proposed amendments to the Ishwati Emoyeni Wind Energy Facility (WEF) of Special Energy Project (PTY) LTD, a subsidiary of Windlab Systems (PTY) LTD. Ekotrust cc, Somerset West.

6. Selected peer-reviewed research publications

VAN ROOYEN, N. 1978. A supplementary list of plant species for the Kruger National Park from the Pafuri area. *Koedoe* 21: 37 - 46.

VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1981. A floristic description and structural analysis of the plant communities of the Punda Milia - Pafuri - Wambiya area in the Kruger National Park, Republic of South Africa. 2. The sandveld communities. *Jl S. Afr. Bot.* 47: 405 - 449.

VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1986. The vegetation of the Roodeplaat Dam Nature Reserve. 4. Phenology and climate. *S. Afr. J. Bot*. 52: 159 - 166.

VAN ROOYEN, N. 1989. Phenology and water relations of two savanna tree species. *S. Afr. J. Sci*. 85: 736 - 740.

VAN ROOYEN, N., BREDENKAMP, G.J. & THERON, G.K. 1991. Kalahari vegetation: Veld condition trends and ecological status of species. *Koedoe* 34: 61 - 72.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1992. The ephemerals of Namaqualand: effect of germination date on development of three species. *J. Arid. Environ*. 22: 51 - 66.

VAN ROOYEN, N. BREDENKAMP, G.J., THERON, G.K., BOTHMA, J. DU P. & LE RICHE, E.A.N. 1994. Vegetational gradients around artificial watering points in the Kalahari Gemsbok National Park. *J. Arid Environ*. 26: 349-361.

STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996. The phenology of Namaqualand ephemeral species: the effect of sowing date. *J. Arid Environ*. 32: 407 - 420.

JELTSCH, F., MILTON, S.J., DEAN, W.R.J. & VAN ROOYEN, N. 1997. Analyzing shrub encroachment in the southern Kalahari: a grid-based modelling approach. *Journal of Applied Ecology* 34 (6): 1497 - 1509.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 1998. Vegetation of the south-western arid Kalahari: an overview. *Trans. Roy. Soc. S. Afr*. 53: 113 -140.

DE VILLIERS, A.J., VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1999. Vegetation diversity of the Brand-se-Baai coastal dune area, West Coast, South Africa: a pre-mining benchmark survey for rehabilitation. *Land Degradation & Development* 10: 207 - 224.

VAN ESSEN, L.D., BOTHMA, J. DU P., VAN ROOYEN, N. & TROLLOPE, W.S.W. 2002. Assessment of the woody vegetation of Ol Choro Oiroua, Masai Mara, Kenya. *Afr. J. Ecol.* 40: 76 - 83.

MATTHEWS, W.S., VAN WYK, A.E., VAN ROOYEN, N. & BOTHA, G.A. 2003. Vegetation of the Tembe Elephant Park, Maputaland, South Africa. *South African Journal of Botany* 67: 573-594.

BOTHMA, J. DU P., VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Using diet and plant resources to set wildlife stocking densities in African savannas. *Wildlife Society Bulletin* 32 (3): 840-851.

VAN ROOYEN, M.W., THERON, G.K., VAN ROOYEN, N., JANKOWITZ, W.J. & MATTHEWS, W.S. 2004. Mysterious circles in the Namib Desert: review of hypotheses on their origin. *Journal of Arid Environments* 57: 467-48.

STEENKAMP, J.C. VOGEL, A., VAN ROOYEN, N., & VAN ROOYEN, M.W. 2008. Age determination of *Acacia erioloba* trees in the Kalahari. *Journal of Arid Environments* 72: 302 - 313.

VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa Part 2. Succulent Karoo Biome-related vegetation. *Koedoe* 50: 160-183.

VAN ROOYEN, M.W., VAN ROOYEN, N. & BOTHMA, J. DU P. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. *Koedoe:* 50: 32-41.

VAN ROOYEN, M.W., HENSTOCK, R., VAN ROOYEN. N. & VAN DER MERWE, H. 2010. Plant diversity and flowering displays on old fields in the arid Namaqua National Park, South Africa. *Koedoe* 52: Art. #1004, 7 pages. DOI: 10.4102/koedoe.v52i1.1004.

VAN ROOYEN, M.W., LE ROUX, A., GELDENHUYS, C., VAN ROOYEN, N., BROODRYK, N. & VAN DER MERWE, H. 2015. Long-term vegetation dynamics (40 yr) in the Succulent Karoo South Africa: effects of rainfall and grazing. *Applied Vegetation Science* 18: 311-322.

VAN ROOYEN, M.W., VAN ROOYEN, N., ORBAN, B., GAUGRIS, B., MOUTSAMBOTÉ, J.M., NSONGOLA, G. & MIABANGANA, E.S. 2016. Floristic composition, diversity and stand structure of the forest communities in the Kouilou Département, Republic of Congo. *Tropical Ecology*: 54: 805-824.

VAN ROOYEN, M.W., VAN ROOYEN, N., MIABANGANA, E.S., NSONGOLA, G., GAUGRIS, V. & GAUGRIS, J.Y. 2019. Floristic composition, diversity and structure of the rainforest in the Mayoko District, Republic of Congo. *Open Journal of Forestry* 9: 16-69. https://doi.org/10.4236/ojf.2019.91002.

VAN DER MERWE, H., VAN ROOYEN, N., BEZUIDENHOUT, H., BOTHMA, J. DU P. VAN ROOYEN, M.W. 2019. *Vachellia erioloba* dynamics over 38 years in the Kalahari Gemsbok National Park, South Africa. *Koedoe* a1534. https://doi.org/ 10.4102/koedoe.v61i1.1534

VAN DER MERWE, H., VAN ROOYEN, N., BEZUIDENHOUT, H., BOTHMA, J. DU P. & VAN ROOYEN, M.W. 2020. Woody vegetation change over more than 30 years in the interior duneveld of the Kalahari Gemsbok National Park. *Bothalia* 50 (1), a2 http://dx.doi.org/10.38201/btha.abc.v50.i1.2

Curriculum vitae

PROF GRETEL VAN ROOYEN

1. Biographical information

Surname	**Van Rooyen**
First names	**Margaretha Wilhelmine**
ID number	**5004130033084**
Home address	**7 St George Street** **Lionviham 7130** **Somerset West** **South Africa**
Mobile	**072 025 3386**
e-mail	**Gretel@ekotrust.co.za**
Current position	**Professor in Plant Ecology** **Scientific advisor - Ekotrust**
Academic qualifications	**BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)**

2. Publications

I am author / co-author of more than 100 peer reviewed research publications and have presented / co-presented more than 100 posters or papers at international and national conferences. Five PhD-students and 29 Masters students have completed their studies under my supervision / co-supervision. I have co-authored a book as part of a series on the Adaptations of Desert Organisms by Springer Verlag (Van Rheede van Oudtshoorn, K. & Van Rooyen, M.W. 1999. ***Dispersal biology of desert plants.*** Springer Verlag, Berlin) and two wildflower guides (Van Rooyen, G., Steyn, H. & De Villiers, R. 1999. ***Cederberg, Clanwilliam and Biedouw Valley*****.** Wild Flower Guide of South Africa no 10. Botanical Society of South Africa, Kirstenbosch, and Van der Merwe, H. & Van Rooyen, G. **Wild flowers of the Roggeveld and Tanqua**). I have also contributed to six chapters in the following books: (i) Dean, W.R.J. & Milton, S.J. (Eds) *The Karoo: Ecological patterns and processes*. Cambridge University Press, Cambridge. pp. 107-122; (ii) Knobel, J. (ed.) *The magnificent heritage of South Africa.* Sunbird Publishing, Llandudno. pp. 94-107; (iii)Hoffman, M.T., Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 3: Implications for landuse and management*: pp. 109–150, Klaus Hess Publishers, Göttingen & Windhoek; (iv) Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 2: Patterns and processes at regional scale: pp.* 222-232, Klaus Hess Publishers, Göttingen & Windhoek; (v) Stoffberg, H., Hindes, C. & Muller, L. South African Landscape Architecture: A Compendium and A Reader. Chapter 10, pp. 129 – 140; and (vi) Stoffberg, H., Hindes, C. & Muller, L. South African Landscape Architecture: A Compendium and A Reader. Chapter 11, pp. 141 – 146.

3. Research interests

My primary research interests lie in population biology and vegetation dynamics. The main aim of the research is to gain an understanding of ecosystem dynamics and to use this understanding to develop strategies to conserve, manage, use sustainably or restore ecosystems. Geographically the focus of the studies has been primarily in Namaqualand (Northern Cape Province, South Africa; classified as Succulent Karoo) and the Kalahari although several studies were conducted in Maputaland (Northern KwaZulu-Natal) and Namibia.

4. Selected project references

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