

Appendix G.14

BUTTERFLY HABITAT
SENSITIVITY **ASSESSMENT**



BUTTERFLY HABITAT SENSITIVITY EIA REPORT FOR THE PROPOSED ABO UVEMVANE WIND ENERGY FACILITY 1 THAT WILL BE SITUATED SOUTHEAST OF HEIDELBERG AND WEST OF BALFOUR IN THE MPUMALANGA AND GAUTENG PROVINCES OF SOUTH AFRICA

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1 EXECUTIVE SUMMARY

ABO Uvemvane Wind Energy Facility 1 (Pty) Ltd (the Applicant) proposes the development of ABO Uvemvane Wind Energy Facility 1 (WEF 1), a commercial wind energy generation facility that will comprise up to 20 turbines as well as associated infrastructure, and with a total generation capacity of up to 170 MWac. The proposed WEF would be located approximately 9 km west of the town of Balfour (Mpumalanga Province, Gert Sibande District Municipality, Dipaleseng Local Municipality), and approximately 14 km south-east of Heidelberg (Gauteng Province, Sedibeng District Municipality, Lesedi & Midvaal Local Municipalities). It is anticipated that the proposed WEF would have a total development footprint of up to 67.2 ha, which is approximately 1.12 % of the total site area (i.e., affected properties).

Sensitivities associated with certain threatened and sensitive butterfly species were identified by the DFFE's National Environmental Screening Tool. To provide the applicant with a realistic assessment of butterfly habitat sensitivity within the receiving environment, Anthene Ecological cc undertook an initial scoping-level assessment. This EIA report builds on that assessment by providing a quantitative evaluation of the anticipated and likely impacts of the proposed project on butterfly habitat sensitivity. The assessment also takes into consideration the current project layout, which has been refined through an iterative design process to avoid, as far as practicable, the majority of areas initially identified as having high butterfly sensitivity.

The following key results were obtained from the study:

- ⇒ An appraisal of available information indicates that an estimated diversity of 83 butterfly species may occur within the project area, reflecting a diverse butterfly composition that includes threatened and range-restricted species.
- ⇒ Topography of the site is varied and complex, comprising rugged rocky ridges (particularly in the central parts), low mountains that are embedded in gentle slopes on surrounding plains, valleys that are situated between some of the ridges, as well as extensive riparian zones and wetland habitat types along the lower parts of the landscape.
- ⇒ Natural (regional) ecosystems of the region (Andesite Mountain Bushveld (LC), Gold Reef Mountain Bushveld (LC), Soweto Highveld Grassland (VU), and Tsakane Clay Grassland (EN) ecological types) comprise a mosaic of relatively natural, degraded and transformed habitats, including areas that are presently cultivated or have been cultivated in the past (fallow fields).
- ⇒ In addition, stands of exotic and alien invasive tree species occur sporadically throughout the project area. Alien invasive herbaceous weed species are also conspicuous at disturbed areas.
- ⇒ Typical infrastructure associated with farming such as homesteads, roads and fences contribute to the extent of transformed and deteriorated habitat types. The network of transformed areas and (formal and informal) roads results in a fragmented landscape where natural habitat remains as isolated portions in the plains. Topographically complex areas are generally characterized by higher levels of ecological integrity and functionality.



- ⇒ The following broad-scale habitat types within the project area are considered relevant to sensitive butterfly constituents of the area:
- Alien tree stands;
 - Cultivated fields;
 - Mountain bushveld, which generally relates to untransformed portions of the Andesite Mountains Bushveld ecological type;
 - Natural Grassland, which generally relates to grassy plains areas between mountainous areas where deeper soils prevail;
 - Rocky shrubland, which generally relates to untransformed portions of the Gold Reef Mountain Bushveld ecological type;
 - Secondary grassland, which generally relates to grassland habitats that exhibit a moderate level of deterioration, e.g., pastures and fallow cultivated fields that have attained a secondary climax status;
 - Transformed areas;
 - Watercourses; and
 - Wetlands.
- ⇒ Ecological sensitivities pertaining to threatened and priority butterfly species were indicated by the National Environmental Screening Tool (DFFE) as part of the Animal Species Theme Sensitivities. Notably, an estimated Medium Sensitivity was indicated for the following butterfly species:
- *Chrysoritis aureus* (Golden Opal/Heidelberg Copper, EN) is associated with areas where its larval host plant, *Clutia pulchella*, occurs. However, the distribution of *C. aureus* appears to be more restricted than that of its host plant (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). The species is also highly dependent on the presence of the specific host ant *Crematogaster liengmei*, which occurs beneath surface rocks in close proximity to *C. pulchella*. In addition to these biotic requirements, suitable habitat is associated with rocky ridges, typically characterised by steep slopes and a southern aspect, while an appropriate fire regime is considered important for maintaining suitable habitat (Terblanche, Morgenthal & Cilliers 2003). The assessment considered the results of the field survey, desktop assessment and supporting observation records provided by the Mpumalanga Tourism and Parks Agency (MTPA)¹. These records identified specific areas of potential concern within the broader project area. Medium Sensitivity areas identified by the Environmental Screening Report correspond primarily with untransformed portions of Andesite Mountain Bushveld and Tsakane Clay Grassland. Subsequent habitat assessment and iterative layout refinement indicate that the proposed project layout has avoided most areas considered potentially suitable for *C. aureus*. Minor micro-siting recommendations are nevertheless proposed for selected towers to further reduce the potential for habitat disturbance. As a precautionary measure, all areas considered conceivably suitable for *C. aureus*—specifically, areas where *C. pulchella* was recorded in association with rocky ridges—were conservatively classified as Highly Sensitive. The proposed layout largely avoids these areas. On this

¹ [1] MTPA (Mr. M. Lotter) requested that the precise geographic coordinates of *C. aureus* observation localities be treated as confidential and not disclosed, published or otherwise disseminated in the public domain. In accordance with this request, the precise observation localities have not been mapped in this report. Instead, the assessment identifies and maps areas of suitable habitat without disclosing the confidential locality information.



basis, and provided that the recommended mitigation and micro-siting measures are implemented, significant impacts on *C. aureus* and its associated habitat are not anticipated.

- *Lepidochrysops procera* (Potchefstroom Blue, LC, Rare Habitat Specialist). Extensive parts of the project area are categorised as Medium Sensitivity for this species; these areas generally relate to untransformed portions of the Andesite Mountain Bushveld and the Soweto Highveld Grassland, providing a broad understanding of the habitat preferences of this species. More detailed habitat information indicates that it is mostly restricted to areas where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Terblanche, PhD, in prep.), although it is worth noting that the distribution of this butterfly species appears to be more restricted compared to the wider distribution of the host plant. Suitable habitat for this species includes rocky grassland areas with few trees. Correlation of the proposed project area in terms of the anticipated sensitivities for this species indicates that the project layout will mostly avoid these Medium Sensitivity areas. Furthermore, no habitat was observed during the survey period that could be considered highly suitable within the project area, and the presence of *Lepidochrysops procera* within the project area is considered unlikely. As such, no significant impacts on this species are expected.
- *Orachrysops mijburghi* (Heilbron Blue/Heilbron Cupid, EN). This species exhibits a preference for grassland depressions where specific Indigofera (Fabaceae) host plant species occur (Terblanche & Edge 2007). Within the project area untransformed parts of the Andesite Mountain Bushveld and Soweto Highveld Grassland are highlighted as being of Medium Sensitivity. Notably, only areas west of the N3 highway have been highlighted, which may indicate limitations in the habitat modelling undertaken by the National Environmental Screening Tool, and highlighting a lack of more specific habitat and distributional knowledge of this species. While the likelihood of *Orachrysops mijburghi* occurring in suitable parts of the project area cannot be excluded entirely. Wetland habitats observed within the site do not appear to correspond closely with the known habitat requirements of the species; no individuals of this species were observed during the initial survey period. Additionally, no area that could be considered highly suitable for *Orachrysops mijburghi* was found within the site, and the Likelihood of Occurrence of *Orachrysops mijburghi* within the site is considered unlikely. Study results and a review of available data suggest that the proposed project layout will largely avoid untransformed habitat types, providing precautionary protection against significant impacts.

⇒ Despite not being highlighted in the Environmental Screening Report, *Metisella meninx* (Marsh Sylph) is considered a likely inhabitant of selected parts of the area such as wetland margins and grass-dominated (*Leersia hexandra*) marsh edges. *Metisella meninx* was previously assessed as Vulnerable, but subsequent information indicated a wider distribution, which resulted in its reassessment as Near Threatened (Mecenero et al., 2020) and therefore remains a localised habitat specialist of conservation concern that is dependent on wetlands with suitable patches of grass along the fringes (Terblanche, in prep.). Ideal habitat for *Metisella meninx* conforms to treeless, marshy areas, where the larval host plant *Leersia hexandra* (Rice Grass) is abundant (Terblanche, in prep.), (G.A. Henning & Roos, 2001). Several such patches were noted within riparian zone and wetland zones of the project area. As these parts of the landscape have already been included in High Sensitivity areas, it is considered unlikely that



significant threats to *Metisella meninx* will result if appropriate conservation and preservation actions are implemented along wetland corridors.

The following conclusions were obtained from the study:

- ⇒ Natural grassland and savanna that have not been subjected to transformative or disruptive impacts ultimately represent the most important natural attribute when considering butterfly habitat sensitivity in the wider landscape.
- ⇒ Watercourses and associated riparian and wetland zones exhibit attributes of 'High Sensitivity', mainly because of the importance as conservation corridors for insects, or the likelihood that the Near Threatened *Metisella meninx* could persist at some of these wetland/riparian areas.
- ⇒ Rocky ridges and other areas of complex topography often exhibit high butterfly diversity and serve as important corridors or 'stepping stones' that are often embedded in transformed areas. The sensitivity of these areas (where no threatened species were observed) is therefore categorised as 'High Sensitivity'.
- ⇒ Remaining untransformed terrestrial habitat of the site is assessed to be of 'Medium Sensitivity' for butterflies.
- ⇒ Cultivated, modified, or transformed areas do not exhibit any sensitivity; a 'Low Sensitivity' is ascribed to these parts.
- ⇒ Elevated habitat sensitivities (High or Very High) are often associated with habitat that exhibit specific attributes, e.g., the presence of certain host plant/animal species, high rockiness, topographically complex, wetland and mesic types, etc.
- ⇒ The presence of threatened or sensitive butterflies from these 'special' habitat types cannot be excluded entirely and High or Very High Sensitivities were ascribed to these parts.
- ⇒ The proposed development plan does provide consideration of these areas and most of these areas are effectively avoided.
- ⇒ Some conflict areas have been identified during earlier phases of the project, and the proposed layout is considerate of the recommendations. For example, the position of turbine WT-14 has been indicated to be situated in high sensitivity areas; the position was adjusted to be in lower sensitivity areas that are also outside CBA habitat according to the Mpumalanga BPS (2014).
- ⇒ Some potential conflict areas were identified where proposed project infrastructure overlaps with High Sensitivity areas. While these are generally not regarded to be major impacts (note quantified impacts), it should nonetheless be considered with caution. Potential conflict areas were noted with the following infrastructure:
 - Wind Turbine 8, Wind Turbine 20;
 - Selected portions of proposed 33 kV Powerline
 - Selected portions of proposed Alternative 33 kV Powerline; and
 - Selected portions of proposed Maintenance and Reticulation Roads.
- ⇒ Apart from some impacts from potential impact areas, there appears to be no significant threat to threatened or sensitive butterfly species.



The following table provides a summary of the quantified assessment of the impacts identified as relevant to the proposed development. It presents the significance ratings assigned to each impact based on the assessment criteria and, where applicable, reflects the anticipated significance before and after the implementation of the recommended mitigation measures.

Impact Description	WEF (1)	
	Without Mitigation	With mitigation
1. Direct Impact - Direct losses of sensitive species (Threatened, Near Threatened, Rare, Declining or Protected species) during the construction phase.	54 (High)	33 (Medium)
2. Direct Impact - Loss of habitat/areas that are considered suitable/highly suitable for sensitive butterfly species, including habitat losses occurring as a result of the removal of vegetation within development footprints, access and maintenance roads, underneath powerlines, within tower footprints, etc.	68 (High)	28 (Low)
3. Indirect Impact - Persistent and exacerbated deterioration of sensitive, natural, range restricted, or untransformed habitat that may be present in the immediate or near vicinity to the development footprints, road fringes (fringe effects), specifically relating to habitat types considered suitable/highly suitable for sensitive butterfly species. This also refers to effects such as increased dust (e.g. loss of nectar sources), and contamination of water and soils through rubble, petroleum fuels, pollutants, etc.	60 (High)	27 (Low)
4. Indirect Impact - Disruption of ecological processes, services, ecological functionality (including fire regimes, exacerbated erosion, increase /introduction of invasive species) within surrounding natural habitat.	42 (Medium)	20 (Low)
5. Indirect Impact - Increased disruption of local movement/migration patterns, ecological interaction, and ecological processes that may affect diversity patterns through loss of connectivity (increased fragmentation, barrier effects), and conservation corridor networks in the landscape.	42 (Medium)	10 (Low)
6. Cumulative Impact - Cumulative losses of species and habitat considered from a wider geographic perspective from similar types of developments, including elevated regional fragmentation and isolation levels.	60 (High)	28 (Low)
7. Cumulative Impact - Threshold considerations; the elevation of the conservation status of protected and/or other threatened species through cumulative losses of species and habitat from a wider geographic perspective.	68 (High)	20 (Low)

Concluding Statement & Specialist Recommendation

The specialist recommendation is based on the following conclusions:

- ⇒ A high diversity of butterfly species is known from the project area;
- ⇒ The confirmed presence of a limited number of threatened butterfly species has been recorded within the wider region;
- ⇒ Certain habitat types within the project area have been identified as providing high suitability for threatened and/or protected butterfly species;
- ⇒ The proposed project layout has, through iterative refinement since the scoping phase, largely excluded areas that were identified as highly sensitive for particular butterfly species, with most Very High and High Sensitivity areas avoided;
- ⇒ While certain impacts on butterfly habitat and associated species are reasonably anticipated, implementation of the recommended mitigation measures is expected to reduce the significance of these impacts to acceptable levels; and



⇒ Although the unmitigated significance of cumulative impacts is considered significant at both the local and regional scales, the post-mitigation ratings represent some residual contribution of the proposed WEF to cumulative regional impacts following implementation of project-specific avoidance, minimisation, rehabilitation and monitoring measures. These ratings should not be interpreted as indicating that cumulative impacts arising from other developments within the broader region will be eliminated or reduced solely through implementation of the mitigation measures associated with the proposed project.

Based on the findings of this butterfly habitat sensitivity assessment, the proposed development can be supported in its current form and in accordance with the project layout assessed in this report. This conclusion is conditional upon the timely, comprehensive and effective implementation of all recommended mitigation measures, with appropriate adherence and monitoring throughout all phases of the development, including construction, operation and decommissioning.

The conclusion should therefore be understood as being contingent on the continued avoidance of identified sensitive butterfly habitat, implementation of the recommended mitigation and micro-siting measures, and appropriate monitoring to ensure that the anticipated residual impacts remain within the levels assessed in this report.



2 ADMINISTRATIVE INFORMATION

2.1 REPORT DETAILS

Table 1: Project details

Client	ABO Energy South Africa (Pty) Ltd
Report name	Butterfly Habitat Sensitivity EIA Report for the proposed ABO Uvemvane Wind Energy Facility 1 that will be situated southeast of Heidelberg and west of Balfour in the Mpumalanga and Gauteng Provinces of South Africa
Reference number	WSP – UBS – 2026/11
Report version	2026.10.21.06
Report status	FINAL REPORT
Report compiled by:	Reinier F. Terblanche (Pr.Sci.Nat.)
Report reviewed by:	Riaan A. J. Robbeson (Pr.Sci.Nat.)

2.2 CITATION

When used as a reference, or included as an addendum, this report should be cited as:

Anthene Ecological cc (2026). Butterfly Habitat Sensitivity EIA Report for the proposed ABO Uvemvane Wind Energy Facility 1 that will be situated southeast of Heidelberg and west of Balfour in the Mpumalanga and Gauteng Provinces of South Africa. Reference Number: WSP – UBS – 2026/11. Version: 2026.10.21.06.

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3 DECLARATION OF INDEPENDENCE

I, Reinier F. Terblanche, as the independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that:

- ⇒ I acted as an independent specialist during this assessment;
- ⇒ I performed all work relating to the project and application in an objective manner, with the understanding that it could result in views and findings that are not favourable to the applicant;
- ⇒ I regard all information contained in this report, as it relates to my specialist input/study, to be true and correct. I do not, and will not, have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- ⇒ I declare that there are no circumstances that may compromise my objectivity in performing such work;
- ⇒ I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- ⇒ I will comply with the Act, Regulations and all other applicable legislation;
- ⇒ I have no, and will not, engage in conflicting interests in the undertaking of the activity;
- ⇒ I have no vested interest in the proposed activity proceeding;
- ⇒ I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has, or may have, the potential of influencing any decision to be taken with respect to the application by the competent authority, and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- ⇒ I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- ⇒ I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application, where applicable;
- ⇒ all particulars furnished by me in this specialist input/study are true and correct; and
- ⇒ I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24 of the Act.

Reinier F. Terblanche (Pr.Sci.Nat.)
21 October 2026



4 SPECIALIST REQUIREMENTS AND DETAILS

4.1 SOUTH AFRICAN COUNCIL FOR NATURAL SCIENTIFIC PROFESSIONS

It is a legal requirement for specialists who conduct biological surveys and compile reports to be suitably registered at SACNASP in the relevant field(s) for the assessment. In terms of the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003), it is illegal to practice in a professional consulting capacity without appropriate SACNASP registration. Registration with SACNASP further ensures adherence to their code of conduct.

The Natural Scientific Professions Act (South Africa, No. 27 of 2003) aims to ‘provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith’.

Quoting the South African Council for Natural Scientific Professions Act revised (2019), specialists must:

- “5 Only undertake natural scientific work which their education, experience and background have rendered them competent to perform; and
- 8 Not knowingly misrepresent or permit misrepresentation of their own or their associates’ academic or professional qualifications, neither exaggerate their own degree of responsibility for any work of a natural scientific nature.”

Furthermore, the Natural Scientific Professions Act of 2003 also states that ‘Only a registered person may practice in a consulting capacity’ (20(1) – pg. 14). SACNASP registration details and professional affiliations of specialists who contributed to this project are presented in **Table 2**.

Table 2: Biodiversity specialists for this project

Invertebrate Specialist:	Reinier F. Terblanche (Pr.Sci.Nat.)*
Qualification:	M.Sc. (Conservation Biology), North West University (Potchefstroom)
Affiliation:	South African Council for Natural Scientific Professions
Registration Number:	400244/05
Professional Natural Scientist:	Ecological Scientist
Report Review:	Riaan Robbeson (Pr.Sci.Nat.)
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions (SACNASP)
Registration Number:	400005/03
Professional Natural Scientist:	Botanical Scientist & Ecological Scientist (Pr.Sci.Nat.)
Certified Natural Scientist:	Zoological Scientist (Cert.Nat.Sci.)

* A synoptic CV of the invertebrate specialist is presented in **Appendix 1**.



4.2 ECOSYSTEM ENVIRONMENTAL ASSESSMENT GUIDELINES AND PROCEDURES

The National Environmental Screening Tool² is a geographically based, web-enabled application that allows the screening of a proposed site for potential environmental sensitivity. The National Environmental Screening Tool allows for the generation of the Environmental Screening Report, which is referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014 (as amended), whereby the Environmental Screening Report is required to accompany any application that requires Environmental Authorisation.

Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes, including Sections 24(5)(a), 24(5)(h) and 44 of the National Environmental Management Act (1998), when applying for Environmental Authorisation, have been gazetted (Gn. R 320 of 20 March 2020). In terms of the Act, these procedures prescribe general requirements for undertaking site sensitivity verification, requirements, protocols for the assessments, and minimum report content requirements of environmental impacts for environmental themes for activities requiring Environmental Authorisation. When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under Sections 24(5)(a), 24(5)(h) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements.

This EIA assessment is required to adhere (with certain adaptations) to the following protocol to comply with provincial and national legislation, including Sections 24(5)(a), 24(5)(h) and 44 of the National Environmental Management Act (1998):

- ⇒ Section 3(c) – Protocol for the assessment and reporting of environmental impacts on terrestrial animal species (GN 1150 of 2020).

Furthermore, Section 9.1 of the DFFE Species Environmental Assessment Guidelines (2022) indicates the following:

- ⇒ SACNASP registration in the relevant (specialist) field is mandatory;
- ⇒ Previous experience for specific taxa (as indicated in the Environmental Screening Report) is required and is also to be highlighted in the report; and
- ⇒ Specialists are not allowed to act in a specialist capacity for more than two of the six recognised biodiversity disciplines for the same environmental authorisation project that triggers an EIA process.

² <https://screening.environment.gov.za/screeningtool/>



5 RELEVANT PROJECT DETAILS

ABO Uvemvane Wind Energy Facility 1 (Pty) Ltd (the Applicant) proposes the development of ABO Uvemvane Wind Energy Facility 1 (WEF 1), a commercial wind energy generation facility comprising up to 20 turbines and with a total generation capacity of up to 170 MWac, as well as associated infrastructure. The proposed WEF would be located approximately 9 km west of the town of Balfour (Mpumalanga Province, Gert Sibande District Municipality, Dipaleseng Local Municipality), and approximately 14 km south-east of Heidelberg (Gauteng Province, Sedibeng District Municipality, Lesedi & Midvaal Local Municipalities). It is anticipated that the proposed WEF would have a total development footprint of up to 67.2 ha, which is approximately 1.12 % of the total site area (i.e., affected properties³).

The development area (i.e., the full extent of the affected properties as well as beyond, where appropriate, or hereafter termed the Project Area in this report) has been identified for the proposed development. Within this identified development/project area, development footprints have been defined in a manner that took environmental sensitivities into account and intentionally remains outside of highly sensitive areas. Affected properties in their entirety have been considered in this S&EIA process (which includes independent specialists' assessments that were undertaken hereunder) and assessed in terms of the suitability from an environmental and social perspective. The location of the proposed project and siting of project infrastructure within the assessed project area has been informed by recommendations of specialists following their field assessments, where relevant.

It is important to note at the outset that the exact specifications of the proposed project components will be determined during the detailed engineering design phase prior to construction (subsequent to the issuing of an EA, should such an authorisation be granted), but that the information provided below considered the maximum development scenario for the proposed development.

The proposed facility would comprise the following (to be located within the proposed development footprint) (refer **Figure 1** for a schematic layout of the project area and relevant project components):

- ⇒ Up to 20 turbines, with the following maximum specifications:
 - Maximum hub height 180 m;
 - Maximum blade length 100 m;
 - Maximum rotor diameter 200 m;
 - Maximum capacity per turbine 10 MW;
 - A transformer at the base of each turbine;
 - Concrete turbine foundations up to 1 ha each; and
 - Turbine, crane, and blade hardstands (included in the abovementioned 1 ha).
- ⇒ Primary/main access roads as well as internal road reticulation (note that existing roads/disturbed areas would be used as far as possible, and for the proposed roads, a corridor of up to 12 m wide may be temporarily impacted upon during construction and be rehabilitated to up to 10 m wide after construction), inclusive of stormwater infrastructure where relevant;

³ For more details regarding affected properties the reader is referred to the main document.



- ⇒ Four (4) temporary laydown areas/construction compounds (includes concrete batching), totalling up to 15 ha, that will be fenced with access control; and/or
- ⇒ Battery Energy Storage System (BESS) to be located within the electrical infrastructure hub described under 'associated infrastructure' below.

Associated infrastructure would include the following (to be located within the proposed development footprint):

- ⇒ Associated internal electrical reticulation/cabling (i.e., low- and medium voltage powerlines), underground as far as is feasible, and to run within the proposed road footprint/route as far as possible;
- ⇒ A 33 kV overhead/underground line to connect the northern and southern portions of the facility; and
- ⇒ On-site electrical infrastructure hub up to 7 ha in extent (note that three (3) locations will be assessed as alternatives; however, only one will ultimately be developed), which will consist of:
 - On-site substation and associated infrastructure;
 - Additional step-up/transformation/collector/switchyard infrastructure;
 - Auxiliary buildings (including, but not limited to, Operation and Maintenance (O&M) building/s, admin building/s, workshop/s, gatehouse/s, security building/s, control centre/s, office/s, visitor centre/s, warehouse/s, etc.);
 - May include the installation of a communications tower and lighting mast on site with a maximum height of 32 m and 25m respectively; and/or
 - BESS.

Five (5) access points are proposed; four of these are off existing unnamed farm roads (originating from the D1220 and P243/1), and one is off Lagerspoort Road from Heidelberg – Balfour Road (R23). Details of access points would be as per the recommendations in the Transport Impact Assessment. Access roads would be developed both to the site and within the site (i.e., between project components).

The project grid connection could occur via a new loop-in-loop-out connection or via a direct connection to one of the nearby substations. It is worth noting that, while the EGI component of the WEFs will be subject to separate environmental impact assessments, impacts caused by the potential grid connection scenarios have been addressed in this process from a cumulative perspective (which also adopts a precautionary approach and considers all scenarios/alternatives).

5.1 PREVIOUS ASSESSMENT

This report is based on the invertebrate sensitivity scoping report that was completed for the project, namely:

Ecological Invertebrate Scoping Habitat Survey for the proposed ABO Uvemvane Wind Energy Facility 1 & 2 that will be situated west of Balfour and southeast of Heidelberg in the Mpumalanga and Gauteng Provinces. Reference Number: WSP – UBS – 2025/07. Version: 2025.11.10.02. (Anthene Ecological cc, 2026).

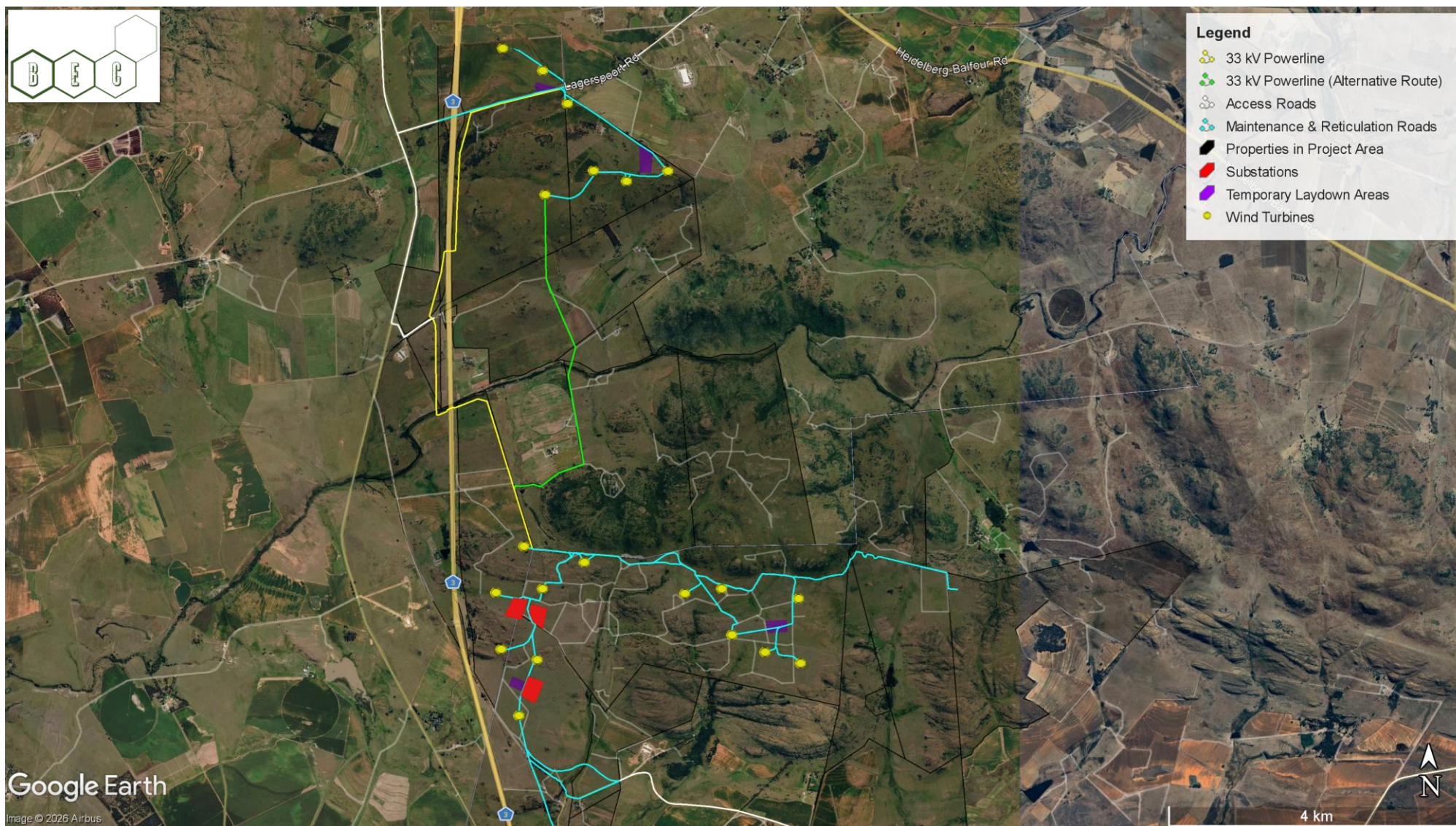


Figure 1: Schematic layout of the project area and relevant project components



6 PROJECT SCOPE AND OBJECTIVES

6.1 SCOPE OF THE EIA STUDY

The Environmental Screening Report highlighted a Medium Sensitivity pertaining to certain threatened invertebrate butterfly species in the project areas (also refer **Section 10.5.1**). These areas generally relate to remaining portions of untransformed habitat within the landscape. Anthene Ecological cc was commissioned to provide a qualitative opinion on the anticipated invertebrate (butterfly) diversity and sensitivity of the receiving environment during the initial scoping phase of the project. While particular attention was provided to butterfly species highlighted in the Environmental Screening Report, the potential presence (and sensitivity) of other butterfly species that were not specifically mentioned in the report was also considered.

The scoping assessment considered a review of available and relevant literature and information sources, and also included strategic site inspections during which the nature, status, and sensitivity of the receiving environment was assessed. The primary objective of the scoping study was to evaluate the sensitivity of the receiving environment in terms of the invertebrate (butterfly) constituents that are considered likely inhabitants of the site, and which could potentially be affected adversely by the proposed project. These tentative sensitivities were then employed to guide the project layout towards areas of lower/acceptable sensitivity.

The project layout has undergone several iterations since project inception, primarily to avoid High Sensitivity areas identified during the scoping phase. In addition to tentative scoping results, additional supporting distributional records were also provided by Mpumalanga Tourism and Parks Agency (MPTA) that were used to augment results and recommendations for the EIA report. This EIA report therefore aims to build on initial (scoping) results and focuses on providing a quantitative evaluation of anticipated impact significance on the receiving environment, specifically from the perspective of threatened butterfly species and considering the proposed layout.

6.2 EIA STUDY OBJECTIVES

- ⇒ Consider results and data obtained from the Scoping Study.
- ⇒ Present an overview of relevant biophysical and habitat attributes of the project area.
- ⇒ Highlight the anticipated and/or confirmed butterfly diversity of the project area.
- ⇒ Identify and evaluate the sensitivity of broad-scale habitat types within the project area, with special emphasis on the presence of threatened butterfly species.
- ⇒ Discuss the probability of threatened or localised butterfly species occurring within the project area, using suitable observation and data assimilation techniques, as well as a subjective evaluation of habitat suitability for these species.
- ⇒ Quantify direct, indirect, and cumulative impacts on sensitive butterfly habitat and species.
- ⇒ Develop a suitable and appropriate mitigation approach with the specific objectives to reduce or minimise impacts on sensitive butterfly species or habitat within the project area.



7 METHODS AND APPROACH

In order to present a qualified opinion on habitat diversity and sensitivity pertaining to butterflies within the project area, a desktop review of available literature and information was undertaken at the commencement of the study to identify areas of specific concern, and to augment with additional data that were obtained from the field observations.

Site inspections and surveys consisted of visits by R. F. Terblanche during January and February 2025 to note key elements of habitats within the site, with specific reference to the conservation of invertebrate fauna taxa. The main purpose of the site visits was ultimately to establish the (likely/potential) presence or absence of threatened butterfly species, also including other taxa of high conservation priority.

The following sections highlight the approach that was used to achieve the objectives of the study.

7.1 HABITAT CHARACTERISTICS AND GENERAL VEGETATION

Broad-scale habitat types were briefly investigated by noting habitat structure (rockiness, slope, plant structure/physiognomy) as well as the basic floristic composition. Voucher specimens of plant species are only taken where the taxonomy is in doubt, and where the plant specimens are considered relevant for invertebrate conservation. In this case, no plant specimens were collected as voucher specimens or sent to an herbarium for accurate identification. Available field guides and detailed works of plant identifications, ecology and conservation were available and allowed for effective identification of species.

Field guides, biogeographic works, species lists, diagnostic outlines, conservation status and detail on specific plant groups were also sourced from Boon (2010), Court (2010), Fish, Mashau, Moeaha & Nembudani (2015), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998), and Van Wyk & Van Wyk (1997).

Lists of butterfly species, species names and the conservation status of butterfly species were mainly sourced from Raimondo, von Staden, Victor, Helme, Turner, and Kamundi & Manyama (2009), as well as updated versions of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za).



7.2 BUTTERFLY OBSERVATIONS

Butterflies were noted as sight records or voucher specimens, which are mostly collected for species for which collection is warranted because of taxonomic uncertainty, or where detailed morphological evaluation is required for accurate species identification (i.e., visual identification in the veld may be incorrect). Many butterflies utilise only one specific plant species (or a limited number) as host plants for their larvae. Myrmecophilous (ant-loving) butterflies, such as the *Aloeides*, *Chrysoritis*, *Erikssonia*, *Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plant species of butterflies were therefore also recorded throughout the field surveys.

After the visits to the site and the collection of butterfly information, the list of species was further augmented to include other species that were either observed during the site inspection or considered to be likely inhabitants of the area. This Likelihood of Occurrence (LoO) was based on an interpretation of the presence of suitable habitat of these species and the life habits and requirements of the respective species. The emphasis of the initial scoping assessment was to conduct a high-level survey of available habitat types in the project area with the main objective to identify and highlight areas of particular risk that should be considered (avoided) during the planning phase of the development.

7.3 DISTRIBUTIONAL RECORDS

Spatial distributional records were provided by MTPA (2026) to inform sensitivities, augment results and recommendations presented in the EIA report.

7.4 PROJECT LIMITATIONS

- ⇒ Significant and persistent rains received during the 2024/5 season limited the execution of early seasonal surveys. Surveys were therefore delayed to more favourable periods later in the season.
- ⇒ Site surveys were conducted during January and February 2025, which is considered an optimal period to assess habitat sensitive butterfly species and species of conservation priority.
- ⇒ Climatic and seasonal conditions at the time of the surveys were considered favourable to record fauna and flora diversity within the site. The primary focus of the survey remains a habitat survey that assesses the possibility of species of conservation priority occurring on the site. Results obtained from site visits are considered sufficient to achieve the objectives of this study.
- ⇒ These (qualitative) site inspections did not consider repetitive surveys conducted across different seasonal periods⁴, or detailed and species-specific survey and collection methods (quantitative surveys).

⁴ Biodiversity surveys should ideally consider different seasonal sampling efforts to obtain a comprehensive understanding of the biological diversity of an area, with specific reference to species of conservation concern that may occur outside the typical austral summer period. This assessment, despite conducted as a single-season and habitat-based survey, concluded that most species were identifiable, and the overall confidence in the accuracy of results and findings is therefore considered good.



- ⇒ High-level biological surveys that typically form part of EIA studies are always limited in scope, funding and available time, and collected information can by no means be considered exhaustive or complete.
- ⇒ Available GIS information allowed for a suitable evaluation of background information pertaining to regional and local sensitivities.
- ⇒ To allow for minor information gaps pertaining to certain species, a brief appraisal of habitat types and status was done and subjectively assessed against the known habitat preferences and life-history requirements of butterfly SCC.
- ⇒ The collection of live faunal data (e.g., by means of trapping) was not considered necessary for this project.
- ⇒ Sufficient and adequate (site-specific and background/literature) information was obtained for this assessment to present a reasoned and considered opinion.
- ⇒ While it is assumed that third-party information is correct at the time of this report, scale-related inaccuracies and incomplete data can reasonably be expected from many information sources. This is typically the result of interrogation or interpretation of data that was collected from a wide geographic scale, and therefore not always entirely appropriate for fine-scale application and evaluations. Where noted, this was stated and suitable allowances made.
- ⇒ Faunal distributional data for a specific geographic area (quarter degree grid) was previously accessed from the <https://www.vmus.adu.org.za> website. This website was however recently discontinued, and data can no longer be accessed. The indication is that the database will eventually be migrated to <https://www.inaturalist.org/>, but existing contractual agreements preclude transferring the observations to third parties. The dataset was originally also available on GBIF, but as the data are now archived, that right falls away. The <https://www.gbif.org/> website therefore only supplies the more recent information provided by the <https://www.inaturalist.org/> website. The accuracy and completeness of the sources are however debatable (as much of the identifications are non-scientific) and historical records are furthermore not complete. No comprehensive and historical faunal distribution data is therefore included in this report.
- ⇒ The Precautionary Principle (IUCN, 2004) was applied in any instance where uncertainty was encountered.

Overall confidence in this broad-scale butterfly habitat sensitivity assessment and associated conclusions is considered high, although confidence in species-specific occurrence assessments is necessarily lower where comprehensive historical and multi-season survey data are unavailable.



8 SITE LOCATION

Province:	Gauteng and Mpumalanga Provinces
District Municipalities:	Gert Sibande District Municipality (Mpumalanga Province) and Sedibeng District Municipality (Gauteng Province)
Local Municipalities:	Lesedi and Midvaal Local Municipalities (Gauteng Province), Dipaleseng Local Municipality (Mpumalanga Province)
Nearest towns:	Balfour (situated approximately 13.7 km east) Heidelberg (situated approximately 9.1 km north, northwest)

An indication of the regional location is provided in **Figure 2**.

The project area comprises numerous smaller land parcels and portions of farm properties. The reader is referred to the main EIA report for an indication of the property descriptions and landowner details.

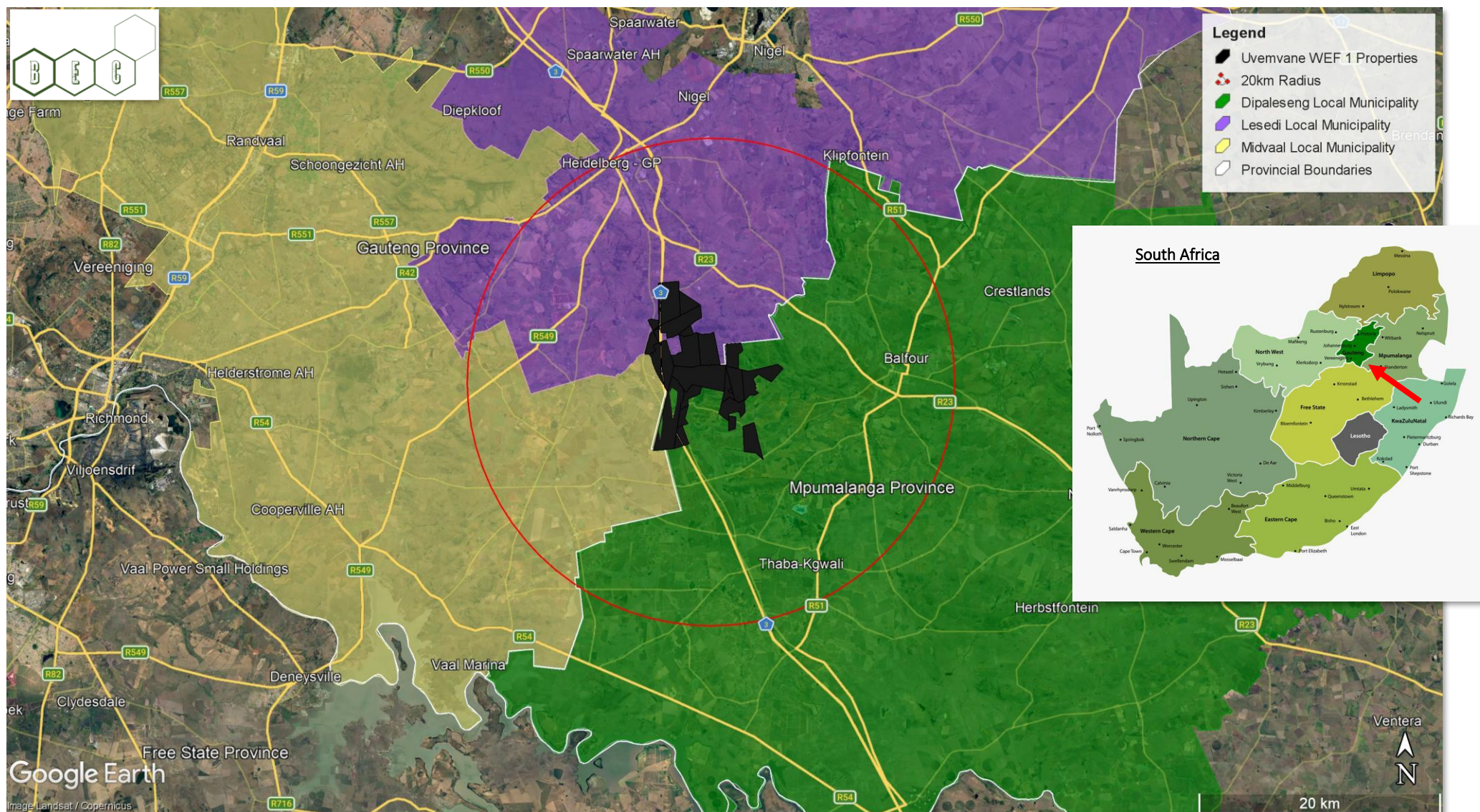


Figure 2: Regional location of the project area

imagery courtesy of Google Earth© (2023), note insert and arrow for approximate site location within the Gauteng and Mpumalanga Provinces



9 BIOPHYSICAL ATTRIBUTES

9.1 REGIONAL ECOLOGY

A biome is broadly defined as a distinct geographical region that is characterised by specific climatic, vegetation and faunal patterns and attributes and represents the largest land community unit recognized at a continental or subcontinental level Odum (1971). South Africa comprises none recognised biomes; the project area is spatially situated across parts of the Savanna and Grassland Biomes (refer **Figure 3**). The Savanna Biome represents the largest biome in southern Africa, covering about 46 % of its area. The term savanna generally describes vegetation with a well-developed grassy layer, but with a dominant upper layer of woody plants. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny (Knobel, 1999), although microphyllous species are encroaching in many areas due to inappropriate management and over-exploitation (*pers. obs.*).

The Grassland Biome represents the second largest biome in South Africa, encompassing ~28 % of the land area, and supporting several ecosystems that are inhabited by diverse vertebrate and invertebrate communities (Mucina & Rutherford 2006; Carbutt et al. 2011). It is limited to the summer rainfall areas with a mean annual rainfall mostly between 400 and 2,000 mm per annum. Characteristic attributes of the Grassland Biome include flat or rolling topography, also including the escarpment, altitudinal ranges from sea level to 2,850 m, and the floristic dominance of the graminoid component, a poorly represented tree component and abundant and diverse herbaceous and geophytic components. The floristic status of the Grassland Biome is generally maintained by frost, fire and a grazing component that prevents the establishment of a prominent woody component.

Biomes are further divided into bioregions, which is defined as a composite spatial terrestrial unit that is characterised by similar biotic and physical features and processes at a regional scale. It represents a level intermediate between a biome and vegetation units. Ultimately, these bioregions are classified into vegetation types, which represent units that are recognized on a local scale, and which are characterized by a uniform floristic composition, structure as well as delineating environmental features. The following vegetation types are recognised in the project area (refer **Figure 4**):

- ⇒ Andesite Mountain Bushveld (SVcb11);
- ⇒ Gold Reef Mountain Bushveld (SVcb9);
- ⇒ Soweto Highveld Grassland (Gm8); and
- ⇒ Tsakane Clay Grassland (Gm9).

A review of the Red List of Ecosystems (RLE) for terrestrial realm for South Africa (Remnants, SANBI 2021) (refer **Figure 5**) indicates the transformed and deteriorated nature of the wider region. Remaining portions of untransformed habitat are generally restricted to topographically heterogenous areas, while plains and undulating areas have historically been subjected to significant transformative and disruptive activities, notably commercial agriculture and urban developments. Remaining areas of untransformed habitat, with a high ecological intactness and connectivity are considered critical for conservation purposes on a local and wider scale, while the conservation of fragmented and small portions of threatened ecosystems should be prioritised.



Figure 6 illustrates the conservation status of the regional ecological types, indicating that the largest extent of the project area comprises habitat types that are well represented in the wider region (Least Concern). However, the northern and southern extents of the project area are Vulnerable and Endangered habitat types that are highly fragmented, although only small portions are likely to be affected by the proposed development.

9.1.1 ANDESITE MOUNTAIN BUSHVELD (SVCB11)⁵

The Andesite Mountain Bushveld occurs mainly on the Bronberg Ridge in eastern Pretoria, extending to Welbekend, and from Hartebeesthoek in the west along the valley between the two parallel ranges of hills to Atteridgeville. It is also encountered on hills in southern Johannesburg, encompassing Nigel, Willemsdal, Coalbrook and Suikerbosrand (in part), and the outer ring of ridges of the Vredefort Dome and some hills to the northwest around Potchefstroom. The flora conforms to a dense, medium-tall thorny bushveld with a well-developed grass layer on hill slopes, and some valleys with undulating landscape.

The following species are regarded as being representative of the Andesite Mountain Bushveld vegetation type:

Small Trees	<i>Vachellia (Acacia) caffra</i> , <i>V. karroo</i> , <i>Celtis africana</i> , <i>Protea caffra</i> , <i>Zanthoxylum capense</i> and <i>Ziziphus mucronata</i> .
Tall Shrubs	<i>Asparagus laricinus</i> , <i>Euclea crispa</i> subsp. <i>crispa</i> , <i>Searsia pyroides</i> , <i>Diospyros lycioides</i> , <i>Gymnosporia polyacantha</i> , <i>Lippia javanica</i> and <i>Rhamnus prinoides</i> .
Low Shrubs	<i>Asparagus suaveolens</i> , <i>Searsia rigida</i> and <i>Teucrium trifidum</i>
Soft Shrub	<i>Isoglossa grantii</i>
Woody Climber	<i>Rhoicissus tridentata</i>
Graminoids	<i>Eragrostis curvula</i> , <i>Hyparrhenia hirta</i> , <i>Setaria sphacelata</i> , <i>Themeda triandra</i> , <i>Cymbopogon pospischilii</i> , <i>Digitaria eriantha</i> , <i>Elionurus muticus</i> , <i>Eragrostis racemosa</i> , <i>E. superba</i> and <i>Panicum maximum</i> .
Herbs	<i>Commelina africana</i> , <i>Hilliardiella galpinii</i> and <i>H. oligocephala</i> .
Succulent Herb	<i>Aloe greatheadii</i> var. <i>davyana</i>

Of the original 2.107 km², an estimated 71 % is considered untransformed. Extensive portions are statutorily conserved, mainly in the Suikerbosrand Nature Reserve and Magaliesberg Nature Area. An additional 1-2 % is conserved in other reserves, mainly in the Hartbeesthoek Radio Astronomy Observatory. Some 15 % is already considered entirely transformed, primarily from cultivation although urban and built-up areas and fringes also occur in this unit. Agriculture is a key pressure to this ecosystem type, with 264 km² consisting of croplands and a further 141 km² old fields. Urban development has also become a pressure with 137 km² of the ecosystem consisting of built-up areas. Andesite Mountain Bushveld has experienced low rates of natural habitat loss and biotic disruptions, placing this ecosystem at low risk of collapse. A Least Concern conservation status is ascribed to this unit.

⁵ <https://bqis.sanbi.org/Ecosystems/home/Detail/282>



9.1.2 GOLD REEF MOUNTAIN BUSHVELD (SVCB9)⁶

This unit occurs along rocky quartzite ridges of the Magaliesberg and the parallel ridge to the south, from around Boshhoek and Koster in the west to near Bronkhorstspuit in the east, also comprising an east-west trending ridge of the Witwatersrand from around Krugersdorp in the west, through Roodepoort and Johannesburg to Bedfordview. Inner ridges of the Vredefort Dome on the Vaal River northwest of Parys and part of the Suikerbosrand and some other hills around Heidelberg are also characteristic of this unit. The altitude of this unit ranges between 1,200 and 1,750 m. The vegetation conforms to rocky hills and ridges, often with a distinct east-west trending, with more dense woody vegetation often on the south-facing slopes associated with distinct floristic differences (e.g., preponderance of *Senegalia caffra* on the southern slopes). Although the tree and shrub layers are often continuous, tree cover may be variable with a dominant grass layer.

Important taxa encountered in this unit include the following:

Small Trees	<i>Senegalia caffra</i> , <i>Combretum molle</i> , <i>Protea caffra</i> , <i>Celtis africana</i> , <i>Dombeya rotundifolia</i> , <i>Englerophytum magalismontanum</i> , <i>Ochna pretoriensis</i> , <i>Searsia leptodictya</i> , <i>Vangueria infausta</i> , <i>V. parvifolia</i> , and <i>Ziziphus mucronata</i> .
Tall Shrubs	<i>Canthium gilfillanii</i> , <i>Ehretia rigida</i> subsp. <i>rigida</i> , <i>Grewia occidentalis</i> , <i>Gymnosporia buxifolia</i> , and <i>Mystroxydon aethiopicum</i> subsp. <i>burkeanum</i> .
Low Shrubs	<i>Athrixia elata</i> , <i>Pearsonia cajanifolia</i> , <i>Searsia magalismontana</i> subsp. <i>magalismontana</i> , and <i>S. rigida</i> var. <i>rigida</i> .
Woody Climber	<i>Ancylobotrys capensis</i>
Graminoids	<i>Loudetia simplex</i> , <i>Panicum natalense</i> , <i>Schizachyrium sanguineum</i> , <i>Trachypogon spicatus</i> , <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Bewsia biflora</i> , <i>Digitaria tricholaenoides</i> , <i>Diheteropogon amplexans</i> , <i>Sporobolus pectinatus</i> , <i>Tristachya biseriata</i> , and <i>T. leucothrix</i> .
Herbs	<i>Helichrysum nudifolium</i> , <i>H. rugulosum</i> , <i>Pentanisia angustifolia</i> , <i>Senecio venosus</i> , and <i>Xerophyta retinervis</i> .
Geophytic Herbs	<i>Cheilanthes hirta</i> , <i>Hypoxis hemerocallidea</i> , and <i>Pellaea calomelanos</i> .

The endemic succulent species *Aloe peglerae* and *Frithia pulchra* also occur in this unit.

Some 22 % of this unit is statutorily conserved, mainly in the Magaliesberg Nature Area and smaller proportions in the Rustenberg, Wonderboom and Suikerbosrand Nature Reserves. Some areas are heavily infested with dense stands of the alien *Melia azedarach* (often associated with drainage lines or alluvia, azonal vegetation) occur embedded within this unit. Of the original 2,031 km², an estimated 79 % remains untransformed. Typically, agricultural activities and urban expansion patterns represent the major disruptions in this unit, although low rates of natural habitat loss and biotic disruptions are noted, placing this ecosystem at low risk of collapse. A Least Concern conservation status is ascribed to this unit.

⁶ <https://bqis.sanbi.org/Ecosystems/home/Detail/354>



9.1.3 SOWETO HIGHVELD GRASSLAND (GM8)⁷

The Soweto Highveld Grassland comprises a broad band roughly delimited by the N17 road between Ermelo and Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south. It extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State. This type comprises gently to moderately undulating landscapes on the Highveld plateau that support short to medium-high, dense, tufted grassland that is almost entirely dominated by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. In undisturbed parts, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover.

Plant species that are typically recorded in this unit include:

Graminoids	<i>Andropogon appendiculatus</i> , <i>Brachiaria serrata</i> , <i>Cymbopogon pospischilii</i> , <i>Cynodon dactylon</i> , <i>Elionurus muticus</i> , <i>Eragrostis capensis</i> , <i>E. chloromelas</i> , <i>E. curvula</i> , <i>E. plana</i> , <i>E. planiculmis</i> , <i>E. racemosa</i> , <i>Heteropogon contortus</i> , <i>Hyparrhenia hirta</i> , <i>Setaria nigrirostris</i> , <i>S. sphacelata</i> , <i>Themeda triandra</i> , <i>Tristachya leucothrix</i> , <i>Andropogon schirensis</i> , <i>Aristida adscensionis</i> , <i>A. bipartita</i> , <i>A. congesta</i> , <i>A. junciformis</i> subsp. <i>galpinii</i> , <i>Cymbopogon caesius</i> , <i>Digitaria diagonalis</i> , <i>Diheteropogon amplexans</i> , <i>Eragrostis micrantha</i> , <i>E. superba</i> , <i>Harpochloa falx</i> , <i>Microchloa caffra</i> , and <i>Paspalum dilatatum</i> .
Herbs	<i>Hermannia depressa</i> , <i>Acalypha angustata</i> , <i>Berkheya setifera</i> , <i>Dicoma anomala</i> , <i>Euryops gilfillanii</i> , <i>Geigeria aspera</i> var. <i>aspera</i> , <i>Graderia subintegra</i> , <i>Haplocarpha scaposa</i> , <i>Helichrysum miconiifolium</i> , <i>H. nudifolium</i> var. <i>nudifolium</i> , <i>H. rugulosum</i> , <i>Hibiscus pusillus</i> , <i>Justicia anagalloides</i> , <i>Lippia scaberrima</i> , <i>Rhynchosia effusa</i> , <i>Schistostephium crataegifolium</i> , <i>Selago densiflora</i> , <i>Senecio coronatus</i> , <i>Hilliardiella elaeagnoides</i> and <i>Wahlenbergia undulata</i> .
Geophytic Herbs	<i>Haemanthus humilis</i> subsp. <i>hirsutus</i> and <i>H. montanus</i> .
Herbaceous Climber	<i>Rhynchosia totta</i>
Low Shrubs	<i>Anthospermum hispidulum</i> , <i>A. rigidum</i> subsp. <i>pumilum</i> , <i>Berkheya annectens</i> , <i>Felicia muricata</i> and <i>Ziziphus zeyheriana</i> .

Of the original 14,537 km², only approximately 39 % remains untransformed. Agriculture is a key pressure on this ecosystem type, with 5,248 km² of the ecosystem consisting of croplands and a further 1,916 km² of old fields. Urban and road development, as well as dam construction are also pressures, with 1,263 km² of the ecosystem consisting of built-up areas, and 185 km² of artificial water bodies. Additionally, mining has impacted 131 km² of Soweto Highveld Grassland (Mucina et al. 2006). A Vulnerable conservation status is ascribed to this unit.

⁷ <https://bqis.sanbi.org/Ecosystems/home/Detail/213>



9.1.4 **TSAKANE CLAY GRASSLAND⁸**

The Tsakane Clay Grassland vegetation conforms to short, dense grassland that is dominated by a mixture of common highveld grasses such as *Themeda triandra*, *Heteropogon contortus*, *Elionurus muticus* and a number of *Eragrostis* species. Most prominent forbs are of the families Asteraceae, Rubiaceae, Malvaceae, Lamiaceae and Fabaceae. Disturbance leads to an increase in the abundance of the grasses *Hyparrhenia hirta* and *Eragrostis chloromelas*.

The following species are regarded representative of the Gold Reef Mountain Bushveld vegetation type:

Graminoids	<i>Brachiaria serrata</i> , <i>Cynodon dactylon</i> , <i>C. hirsutus</i> , <i>Digitaria ternata</i> , <i>Elionurus muticus</i> , <i>Eragrostis chloromelas</i> , <i>E. patentipilosa</i> , <i>E. plana</i> , <i>E. racemosa</i> , <i>Heteropogon contortus</i> , <i>Hyparrhenia hirta</i> , <i>Microchloa caffra</i> , <i>Setaria sphacelata</i> , <i>Themeda triandra</i> , <i>Trachypogon spicatus</i> , <i>Abildgaardia ovata</i> , <i>Andropogon schirensis</i> , <i>Cymbopogon caesius</i> , <i>Diheteropogon amplexans</i> , <i>Melinis nerviglumis</i> , <i>Panicum gilvum</i> and <i>Setaria nigrirostris</i> .
Herbs	<i>Acanthospermum australe</i> , <i>Ajuga ophrydis</i> , <i>Eriosema salignum</i> , <i>Euryops transvaalensis</i> , <i>Gerbera viridifolia</i> , <i>Helichrysum nudifolium</i> , <i>H. rugulosum</i> , <i>Hermannia depressa</i> , <i>Lotononis macrosepala</i> , <i>Nidorella hottentotica</i> , <i>Pentanisia prunelloides</i> , <i>Peucedanum afrum</i> , <i>Rothea hirsuta</i> , <i>Selago paniculata</i> , <i>Senecio coronatus</i> , <i>S. inornatus</i> , <i>Sonchus nanus</i> and <i>Hilliardiella oligocephala</i> .
Geophytic Herbs	<i>Aspidoglossum ovalifolium</i> and <i>Hypoxis rigidula</i> .
Semi-parasitic Herb	<i>Striga asiatica</i>
Low Shrubs	<i>Anthospermum rigidum</i> , <i>Chaetacanthus setiger</i> and <i>Tephrosia capensis</i> .
Semi-parasitic Shrub	<i>Thesium impletum</i>

This vegetation type is Endangered and only 1.5 % is conserved within statutory reserves (Suikerbosrand, Olifantsvlei, Klipriviersberg and Marievale) and a small portion within private nature reserves. This unit also contains several small pans, many of which have been disturbed, drained or are overgrazed and trampled. Of the original 13,133 km², only approximately 34 % remains untransformed. The natural habitat cover has decreased by 100 km² in the last 28 years (1990-2018), mainly due to agriculture, with croplands now covering 322 km² and a further 199 km² of old fields. Urban and road development represent secondary pressures, with 280 km² consisting of built-up areas. The Tsakane Clay Grassland is narrowly distributed with high rates of habitat loss, placing the ecosystem type at risk of collapse; an Endangered conservation status is ascribed to this unit.

9.2 TOPOGRAPHY

Figure 7 provides an illustration of the topographic changes across the wider region. It is apparent wind turbine positions are placed in comparatively flat areas, while topographic complex areas are situated more towards the eastern sections of the wider region.

⁸ <https://bqis.sanbi.org/Ecosystems/home/Detail/112>

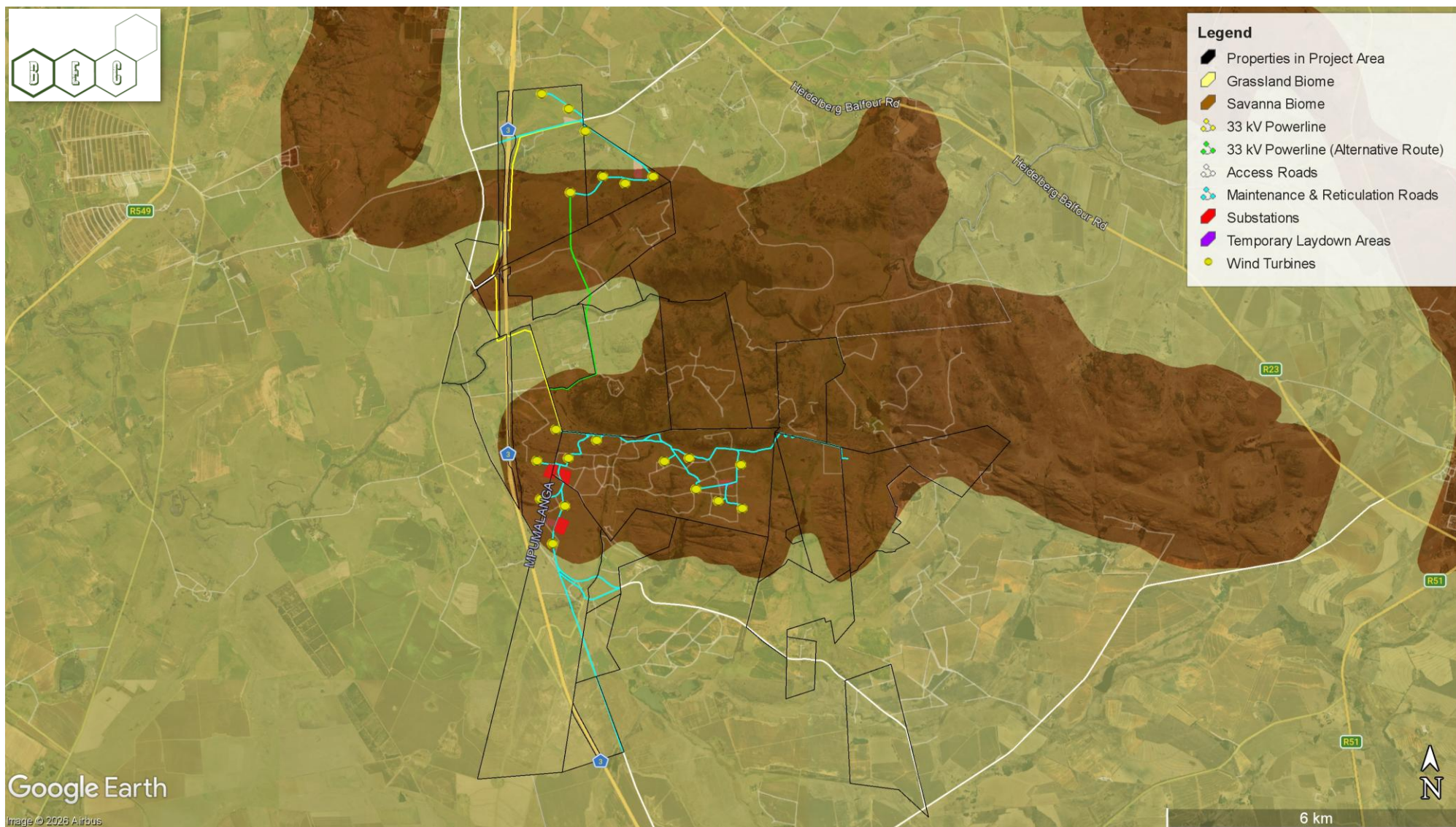


Figure 3: Biomes of the project area and wider region

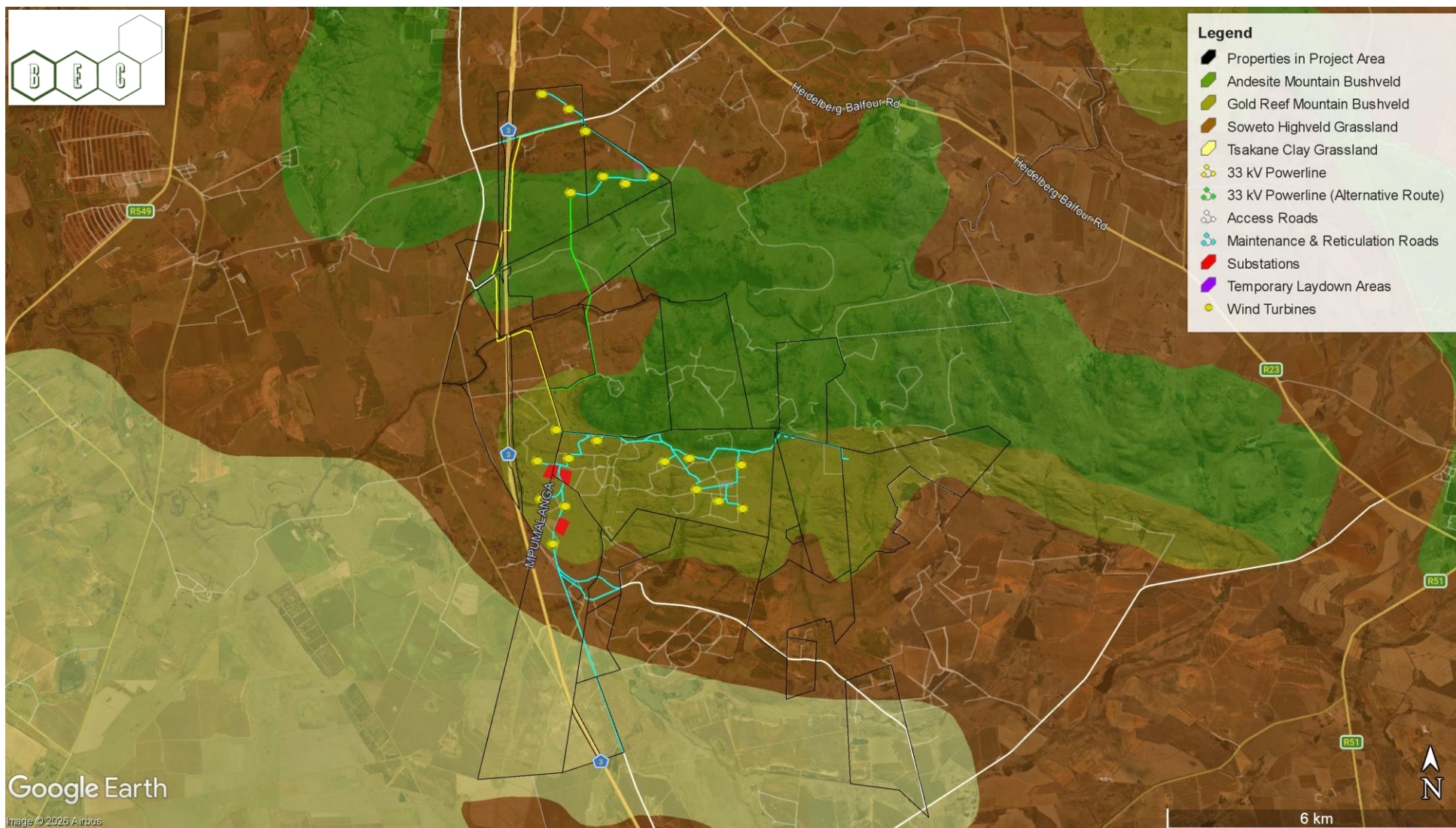


Figure 4: Vegmap ecological types of the project area and wider region



Figure 5: Remaining extent of natural habitat according to the Red List of Ecosystems (RLE) for terrestrial realm for South Africa (Remnants, SANBI 2021)



Figure 6: Conservation status of remaining portions of untransformed habitat according to the regional ecosystems (Remnants, SANBI 2021)

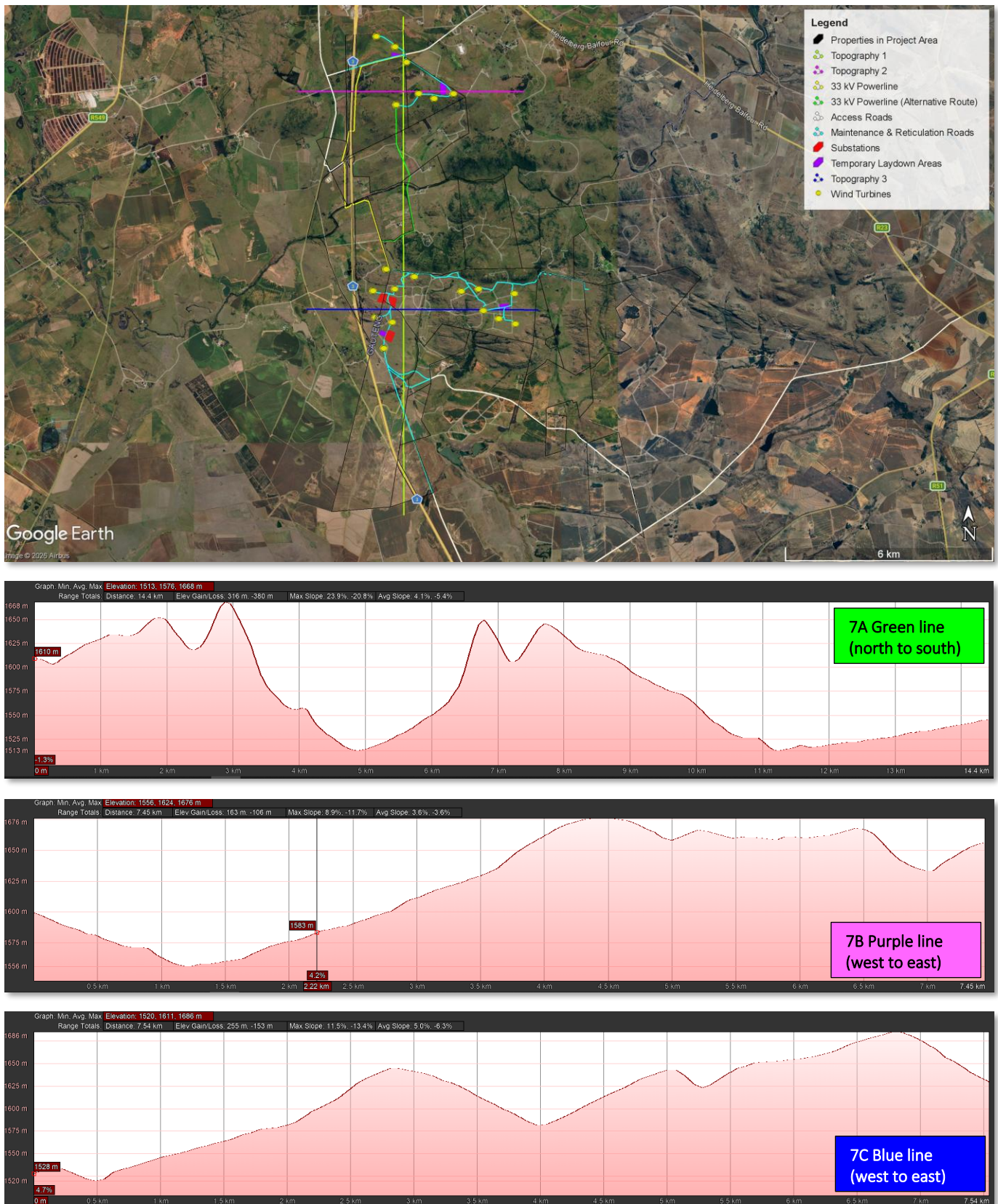


Figure 7: Elevational changes across the project area



10 RESULTS AND OBSERVATIONS

10.1 BROAD-SCALE HABITAT AND VEGETATION CHARACTERISTICS

10.1.1 BACKGROUND

For a detailed description of the broad-scale habitat types of the project area, the reader is referred to the Vegetation/Ecology report (Hawkhead Consulting cc) that was compiled independently from this assessment. The GIS layers that were produced for the ecological report has been used as an indication of the broad-scale habitat types. However, the following section provides some context to the interpretation of landscape and (vegetatal) habitat features of the project area as it relates to this invertebrate sensitivity assessment.

Vegetation has been indicated as the basis of the trophic pyramid in an ecosystem, not only acting as the primary producer and provider of energy but also providing the physical habitat in which organisms complete their lifecycles. It is therefore reasonable to expect that an understanding of the vegetation will (largely) facilitate an understanding of the ecological sensitivity. A map that produces an understanding of broad-scale habitat types (vegetation units) of an area will therefore also effectively indicate aspects such as ecological sensitivity, integrity and functionality, from the perspective of individual species or biological disciplines in general.

Vegetation develops naturally as a spatial continuum along environmental gradients and complex interactions between primary driving/developmental forces. These include climate, particularly temperature and rainfall regimes; geology and associated parent material; soil and edaphic characteristics (e.g., texture, clay and sand content, nutrient availability, mineral composition, soil depth); drainage; surface rockiness; topography, including slope, aspect and landform; and the availability and distribution of moisture. Disturbance regimes, particularly fire and herbivory, also exert important influences on vegetation composition and structure. The interaction of these factors produces heterogeneous mosaic of plant communities across a landscape, with numerous habitat types, microhabitats and ecological niches. The dynamic nature of vegetation is evident from spatial and temporal fluctuations caused by changes of the developmental forces.

Consequently, a botanical assessment of an area provides a representation of the state of the vegetation at that particular point in time, but with an understanding of the collective effects of developmental factors and biophysical conditions that determined this present status. The (recent) introduction of anthropogenic disturbances resulted in substantial and rapid departures from expected or reference conditions. These impacts range from severe and immediate transformation, including complete vegetation clearance associated with mining, infrastructure and urban developments or cultivation, to more gradual or indirect influences such as excessive livestock grazing pressure, selective utilisation, nutrient enrichment, altered fire regimes, etc.

Ecological responses to any influence vary considerably. Some impacts result in immediate and conspicuous loss of vegetation, whereas others produce gradual changes in species composition, abundance, structure and ecological functioning that may be difficult to detect, quantify and spatially delineate without the use of systematic and quantitative assessments. Vegetation communities may consequently exhibit varying degrees



of resilience, resistance and recovery in response to disturbance. Catastrophic (anthropogenic) changes to a type usually results in the depletion of natural faunal constituents or utilisers (higher trophic levels) of the vegetation, accompanying effects such as loss of species and structural diversity, ecological integrity and functionality.

Despite extensive habitat transformation and losses (notably from agriculture), extensive areas of natural vegetation remain within the wider project area. These areas of natural vegetation (including the variety of regional ecological types) provide the greatest diversity of structural habitats and ecological niches and is therefore more likely to support a higher diversity of invertebrate species, including habitat specialists and species with restricted distributions or recognised conservation significance. The conservation importance of these areas is consequently not determined solely by the regional vegetation type, but also by the condition, structural heterogeneity and availability of localised habitats within that vegetation.

Conversely, areas that have been subjected to disruptive or transformative anthropogenic disturbances often develop attributes that differ substantially from the original natural vegetation. These may include secondary, successional, ruderal, seral, or otherwise disturbance-associated communities, depending on the nature, intensity and duration of the disturbance and the subsequent trajectory of vegetation development (recovery, succession). Where persistent environmental conditions or disturbance regimes maintain a vegetation community in a relatively stable state that differs from the expected climatic climax, the resulting community may be regarded as a plagioclimax.

Transformation of natural habitat causes a cumulative reduction in the availability, extent and connectivity of specific habitat types and vegetation communities. Where previously widespread habitat becomes restricted to isolated or fragmented remnants, the associated plant communities and faunal assemblages likewise become increasingly vulnerable. Faunal species that are highly dependent on specific vegetation structures, habitat conditions or plant resources are especially susceptible to such changes. Habitat loss, degradation and fragmentation therefore cause declines in local species abundance, range contraction, and where suitable habitat is sufficiently reduced or isolated, local or regional depletion of species diversity. Vegetation transformation should therefore not be considered solely as a change in plant composition. It represents a broader alteration of the ecological structure, habitat availability, resource base and ecological functionality of the landscape, with cascading consequences for the wider biotic community.

For this invertebrate sensitivity assessment, the following factors were considered in the distinction and evaluation of habitat pertaining to invertebrate sensitivity:

Topography High topographical variability is typical of the wider landscape, particularly towards the east of the development area. These parts of the landscape include rugged rocky ridges and mountains that are embedded in gentle slopes and plains. Numerous valleys occur between some of the ridges (refer **Section 9.2, Figure 7**). Topographically complex areas are not generally conducive to agriculture and



other forms of human development, and from a landscape perspective, is characterized by lower levels of transformation and habitat loss.

Rockiness High surface rockiness is most often associated with hills, ridges, and low mountains, but does sporadically occur as low outcrops in the plains. Conversely, the flatter parts of the landscape (plains) are most often characterised by the absence of rocks; these areas are very often subjected to cultivation, transformation, resulting in highly fragmented and deteriorated (modified) habitats.

Wetlands Numerous and extensive riparian zones/wetlands associated with tributaries in the Upper Vaal Water Management Area (WMA 8) are noted across the site. The nature of these landscape features varies between endorheic pans, channelled and unchanneled valley bottoms, perennial and non-perennial streams and rivers, and mesic and hydromorphic grasslands. The nature of the predominant vegetation within these features varies between open and devoid of vegetation, reeds and bulrush stands, and graminoid and cyperoid dominated types. For a detailed description of wetlands within the project area, the reader is referred to the Wetland Ecological Assessment that was completed for this project.

Natural vegetation Terrestrial as well as riparian/wetland vegetation types characterise the site with numerous smaller variations that are formed in response to biophysical and landscape attributes, e.g., topography, edaphic characteristics, slopes, climate, geology, etc., but also as a response to transformative and disruptive anthropogenic activities. These remaining portions of natural vegetation, particularly in a landscape that is characterized by high levels of transformation and isolation, becomes increasingly sensitive and important for natural inhabitants for life and migration purposes ('stepping stones').

Levels of disturbances Extensive parts of the project area are cultivated (agricultural fields) or have been cultivated in the past (fallow fields), causing high fragmentation levels of remaining natural habitat in the wider region. These parts of the landscape are characterised by a deteriorated and modified vegetation that is dominated by a depauperate species composition of pioneer species or secondary climax (plagioclimax) species, depending on the nature of natural succession after the impact. Clumps of alien invasive tree species are particularly conspicuous at disturbed areas, e.g., along roads and fringes of transformed areas. Typical infrastructure associated with farming such as homesteads, roads and fences are present throughout the site. **Figure 5** provides an indication of regional habitat losses, while **Figure 8** specifically illustrates the presence of agricultural activities in the wider region, which confirms the high levels of habitat transformation.

Ecological connectivity at site and surrounding areas Ecological integrity and connectivity throughout the site are good, in general. Apart from areas characterised by commercial agriculture, the levels of habitat transformation and isolation is comparatively low. Watercourses occurring throughout the site represent critical movement and migration corridors and are of particular importance for butterflies. Similarly, rocky ridges and elevated mountainous areas (notably in the central part of the site), also function as corridors and are thus considered important and sensitive habitat for butterflies.



Figure 8: Agricultural activities indicating significant habitat loss and disturbance in the wider region surrounding the project area

10.1.2 *DELINEATION AND MAPPING*

The ecological report (Hawkhead Consulting cc) indicated the following broad-scale habitat types that are relevant to the invertebrate sensitivity assessment:

- ⇒ Alien tree stands;
- ⇒ Cultivated fields;
- ⇒ Mountain bushveld, which generally relates to untransformed portions of the Andesite Mountains Bushveld ecological type;
- ⇒ Natural Grassland, which generally relates to grassy plains areas between mountainous areas where deeper soils prevail;
- ⇒ Rocky shrubland, which generally relates to untransformed portions of the Gold Reef Mountain Bushveld ecological type;
- ⇒ Secondary grassland, which generally relates to grassland habitats that exhibit a moderate level of deterioration, e.g., pastures and fallow cultivated fields that have attained a secondary climax status;
- ⇒ Transformed areas;
- ⇒ Watercourses; and
- ⇒ Wetlands.

An illustration of the broad-scale habitat types according to the Hawkhead (2025) assessment is presented in Figure 9.

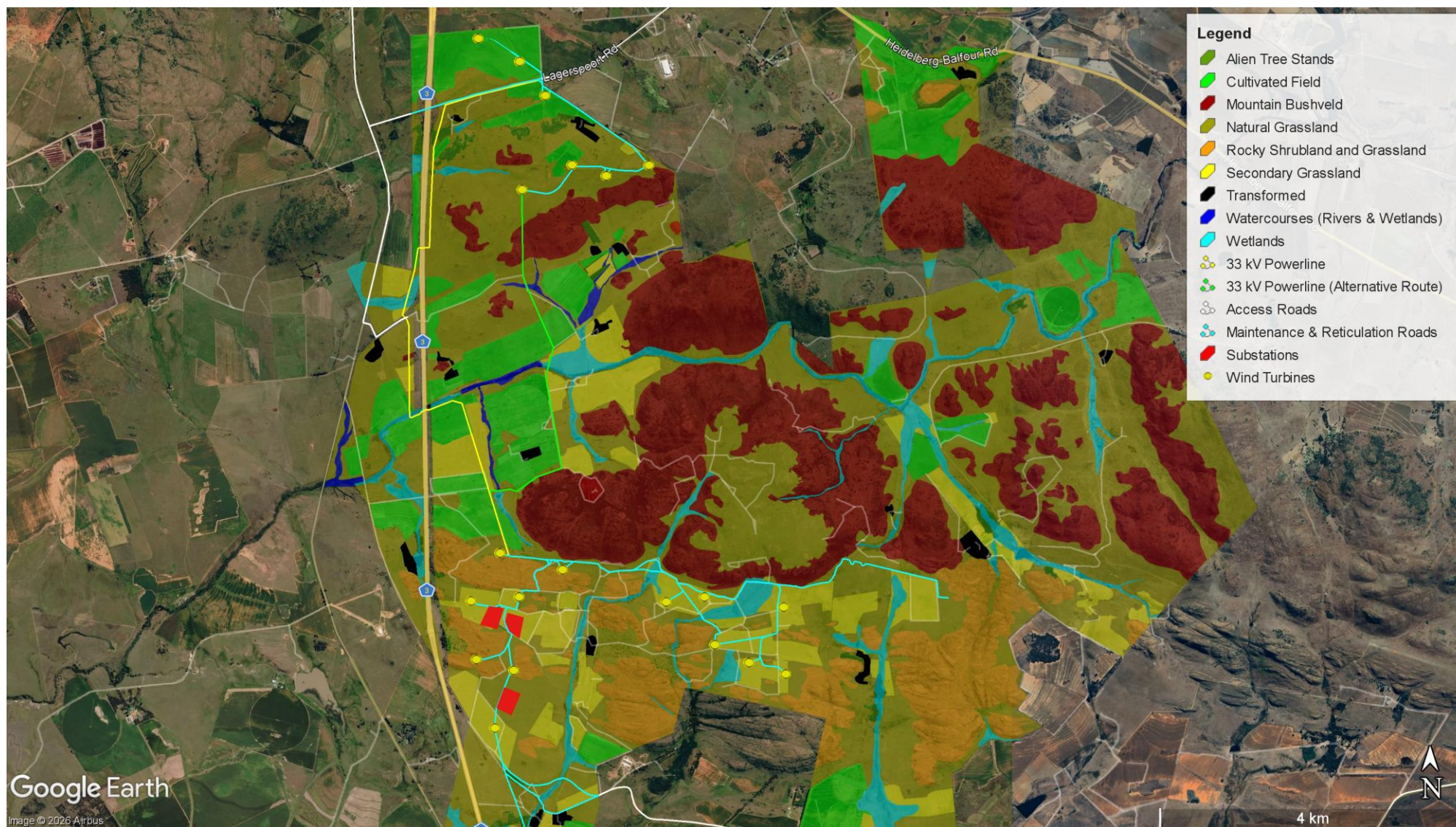


Figure 9: Broad-scale habitat types of the project area

Shapefiles courtesy of Hawkshead Consulting cc (2026), imagery courtesy of Google Earth© (2023)



10.2 RECORDED AND DOCUMENTED BUTTERFLY DIVERSITY

Table 3 indicates the anticipated butterfly diversity of the project area, including species that were recorded during the survey period and threatened species (red text) that are considered likely inhabitants of the project area, based on a review of habitat diversity and status. Annotated photographs of some species and habitat characteristics within the project area are provided in **Section 10.3**.

Table 3: Butterfly diversity of the project area and species

<i>Families, Subfamilies and Species</i>	<i>English Names</i>	<i>Conservation Status (Global status unless otherwise stated)</i>
FAMILY: PAPILIONIDAE	SWALLOWTAIL FAMILY	
SUBFAMILY: PAPILIONINAE	Swallowtails and swordtails subfamily	
<i>Papilio demodocus demodocus</i> Esper, [1798]	Citrus Swallowtail	LC
FAMILY: HESPERIIDAE	SKIPPERS	
SUBFAMILY: COELIADINAE	POLICEMEN	
<i>Coeliades forestan forestan</i> (Stoll, [1782])	Striped Policeman	LC
<i>Coeliades Pisistratus</i> (Fabricius, 1793)	Two-pip Policeman	LC
SUBFAMILY: HESPERIINAE	RANGERS AND SWIFTS	
<i>Gegenes letterstedti</i> (Wallengren, 1857)	Brown Dodger	LC
<i>Gegenes pumilio gambica</i> (Mabille, 1878)	African Dark Dodger	LC
<i>Kedestes lepenula</i> (Wallengren, 1857)	Sun-burst Ranger	LC
<i>Pelopidas mathias</i> (Fabricius, 1798)	Black-banded Swift	LC
<i>Tsitana tsita</i> (Trimen, 1870)	Dismal Sylph	LC
SUBFAMILY: HETEROPTERINAE	SYLPHS	
<i>Metisella meninx</i> (Trimen, 1873)	Marsh Sylph	Near Threatened (Rare: Habitat specialist)
SUBFAMILY: PYRGINAE	SANDMEN AND ELFINS	
<i>Agyllia asterodia</i> (Trimen, 1864)	Star Sandman	LC
<i>Eretis umbra umbra</i> (Trimen, 1862)	Shadow Elf	LC
<i>Ernsta colotes transvaaliae</i> (Trimen, 1889)	Eastern Bushveld Sandman	LC
<i>Gomalia elma elma</i> (Trimen, 1862)	Green Marbled-Sandman	LC
<i>Spialia ferax</i> (Wallengren, 1863)	Striped Sandman	LC
<i>Spialia mafa mafa</i> (Trimen, 1870)	Speckled Sandman	LC
<i>Spialia spio</i> (Linnaeus, 1764)	White-spot Sandman	LC
FAMILY: PIERIDAE	WHITES, YELLOWS, VAGRANTS AND TIPS	
SUBFAMILY: COLIADINAE	YELLOWS AND CLOUDED YELLOWS	
<i>Catopsilia florella</i> (Fabricius, 1775)	African Migrant	LC
<i>Colias electo electo</i> (Linnaeus, 1763)	African Clouded Yellow	LC
<i>Eurema brigitta brigitta</i> (Stoll, [1780])	Broad-bordered Grass Yellow	LC
SUBFAMILY: PIERINAE	WHITES AND TIPS SUBFAMILY	
<i>Belenois aurota</i> (Fabricius, 1793)	Pioneer Caper White/Brown-veined White	LC
<i>Belenois creona severina</i> (Stoll, 1781)	Southern African Caper White	LC
<i>Colotis annae annae</i> (Wallengren, 1857)	Scarlet Tip	LC
<i>Colotis antevippe gavis</i> (Wallengren, 1857)	Southern Red Tip	LC
<i>Colotis euippe omphale</i> (Godart, [1819])	Southern Round-winged Orange Tip	LC
<i>Colotis evagore Antigone</i> (Boisduval, 1836)	African Small Orange Tip	LC
<i>Colotis evenina evenina</i> (Wallengren, 1857)	African Orange Tip	LC
<i>Mylothris agathina agathina</i> (Cramer, [1779])	Eastern Dotted Border	LC
<i>Mylothris rueppellii haemus</i> (Trimen, 1879)	Southern Twin Dotted Border	LC
<i>Pinacopteryx eriphia eriphia</i> (Godart, [1819])	Zebra White	LC
<i>Pontia helice</i> (Linnaeus, 1764)	African Meadow White	LC

**Table 3: Butterfly diversity of the project area and species**

<i>Families, Subfamilies and Species</i>	<i>English Names</i>	<i>Conservation Status (Global status unless otherwise stated)</i>
<i>Teracolus subfasciatus</i> (Swainson, [1883])	Lemon Traveller	LC
FAMILY: NYMPHALIDAE	BRUSH-FOOTED BUTTERFLIES	
SUBFAMILY: BIBLIDINAE	BYBLIA SUBFAMILY	
<i>Byblia anvatarata acheloia</i> (Wallengren, 1857)	Eastern Plain Joker	LC
<i>Byblia ilithyia</i> (Drury, 1773)	Spotted Joker	LC
SUBFAMILY: CHARAXINAE	CHARAXES SUBFAMILY	
<i>Charaxes saturnus saturnus</i> Butler, 1866	Painted Emperor/Foxy Charaxes	LC
SUBFAMILY DANAINAE	MONARCH SUBFAMILY	
<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain Tiger/African Monarch	LC
SUBFAMILY: HELICONIINAE	ACRAEA SUBFAMILY	
<i>Acraea horta</i> (Linnaeus, 1764)	Garden Acraea	LC
<i>Acraea neobule</i> Doubleday, 1847	Wandering Acraea	LC
<i>Phalanta phalantha aethiopica</i> (Rothschild & Jordan, 1903)	African Leopard	LC
<i>Stephenia natalica</i> (Boisduval, 1847)	Black-based Acraea	LC
<i>Telchinia rahira rahira</i> (Boisduval, 1833)	Marsh Amber	LC
<i>Telchinia serena</i> (Fabricius, 1775)	Dancing Amber	LC
SUBFAMILY: NYMPHALINAE	PANSY SUBFAMILY	
<i>Catacroptera cloanthe cloanthe</i> (Stoll, 1781)	Pirate	LC
<i>Hypolimnas misippus</i> (Linnaeus, 1764)	Mimic Diadem	LC
<i>Junonia hierta cebrene</i> Trimen, 1870	African Yellow Pansy	LC
<i>Junonia oenone oenone</i> (Linnaeus, 1758)	Blue-spot Pansy	LC
<i>Junonia orithya madagascariensis</i> Guenée, 1865	African Blue Pansy	LC
<i>Precis archesia archesia</i> (Cramer, [1779])	Garden Commodore	LC
<i>Precis octavia sesamus</i> Trimen, 1883	Southern Gaudy Commodore	LC
<i>Vanessa cardui</i> (Linnaeus, 1758)	Painted Lady	LC
SUBFAMILY: SATYRINAE	BROWNS SUBFAMILY	
<i>Stygionympha wichgrafi wichgrafi</i> Van Son, 1955	Rocky Hillside Brown	LC
FAMILY: LYCAENIDAE	BLUES AND COPPERS	
SUBFAMILY: APHNAEINAE	OPALS, RUSSETS AND SCARLETS	
<i>Aloeides henningi</i> Tite & Dickson, 1973	Hillside Russet	LC
<i>Chrysoritis aureus</i> (van Son, 1966)	Heidelberg Golden Opal	Threatened: Endangered, presence confirmed in project area, refer Figure 10
<i>Cigaritis ella</i> (Hewitson, [1865])	Hilltop Silverline	LC
<i>Cigaritis mozambica</i> (Bertoloni, 1850)	Marmalade Silverline	LC
<i>Cigaritis natalensis</i> (Westwood, 1852)	Glitter Silverline	LC
SUBFAMILY: LYCAENINAE	SORREL-COPPERS	
<i>Lafron clarki</i> Clark & Dickson, 1971	Eastern Sorrel Copper	LC
SUBFAMILY: POLYOMMATINAE	BLUES AND HAIRTAILS	
<i>Actizera lucida</i> (Trimen, 1883)	Rayed Blue	LC
<i>Anthene amarah amarah</i> (Guérin-Méneville, 1849)	Black-striped Hairtail	LC
<i>Anthene definita definita</i> (Butler, 1899)	Grey Hairtail	LC
<i>Azanus jesous</i> (Guérin-Méneville, 1849)	Topaz Babul Blue	LC
<i>Azanus moriqua</i> (Wallengren, 1857)	Black-bordered Babul Blue	LC
<i>Azanus ubaldus</i> (Stoll, 1782)	Velvet-spotted Babul Blue	LC
<i>Cacyreus marshalli</i> Butler, 1898	Geranium Bronze	LC
<i>Cacyreus virilis</i> Stempffer, 1936	Mocker Bronze	LC
<i>Cupidopsis cissus cissus</i> (Godart, 1824)	Meadow Blue	LC
<i>Cupidopsis jobates jobates</i> (Hopffer, 1855)	Tailed Meadow Blue	LC

**Table 3: Butterfly diversity of the project area and species**

<i>Families, Subfamilies and Species</i>	<i>English Names</i>	<i>Conservation Status (Global status unless otherwise stated)</i>
<i>Eicochrysops messapus mahallakoaena</i> (Wallengren, 1857)	Pink Cupreous Ash Blue	LC
<i>Freyeria trochylus</i> (Freyer, [1843])	Brown Grass Jewel	LC
<i>Lampides boeticus</i> (Linnaeus, 1767)	Pea Blue	LC
<i>Lepidochrysops patricia</i> (Trimen, 1887)	Patrician Nimble Blue	LC
<i>Lepidochrysops plebeia plebeian</i> (Butler, 1898)	Twin-spot Nimble Blue	LC
<i>Leptomyrina henningi henningi</i> Dickson, 1976	Plain Black-eye	LC
<i>Leptotes brevidentatus</i> (Tite, 1958)	Short-toothed Zebra Blue	LC
<i>Leptotes pirithous pirithous</i> (Linnaeus, 1767)	Common Zebra Blue	LC
<i>Tarucus sybaris sybaris</i> (Hopffer, 1855)	Dotted Pierrot	LC
<i>Tuxentius melaena melaena</i> (Trimen, 1887)	Black Pie	LC
<i>Uranothauma nubifer nubifer</i> (Trimen, 1895)	Black Heart	LC
<i>Zintha hintza hintza</i> (Trimen, 1864)	Blue Pied Pierrot	LC
<i>Zizeeria knysna knysna</i> (Trimen, 1862)	Sooty Grass Blue	LC
<i>Zizula hylax</i> (Fabricius, 1775)	Tiny Grass Blue	LC
SUBFAMILY: THECLINAE	HAIRSTREAKS	
<i>Capys disjunctus disjunctus</i> Trimen, 1895	Russet Protea	LC
<i>Deudorix antalus</i> (Hopffer, 1855)	Brown Playboy	LC

* *Butterfly species and subspecies are listed alphabetically under the families and subfamilies*

10.3 ANNOTATED PHOTOGRAPHS⁹ OF RECORDED BUTTERFLY SPECIES AND HABITAT CHARACTERISTICS



Photo 1: The widespread butterfly species *Precis archesia* (Garden Commadore); this species favours rocky ridges.

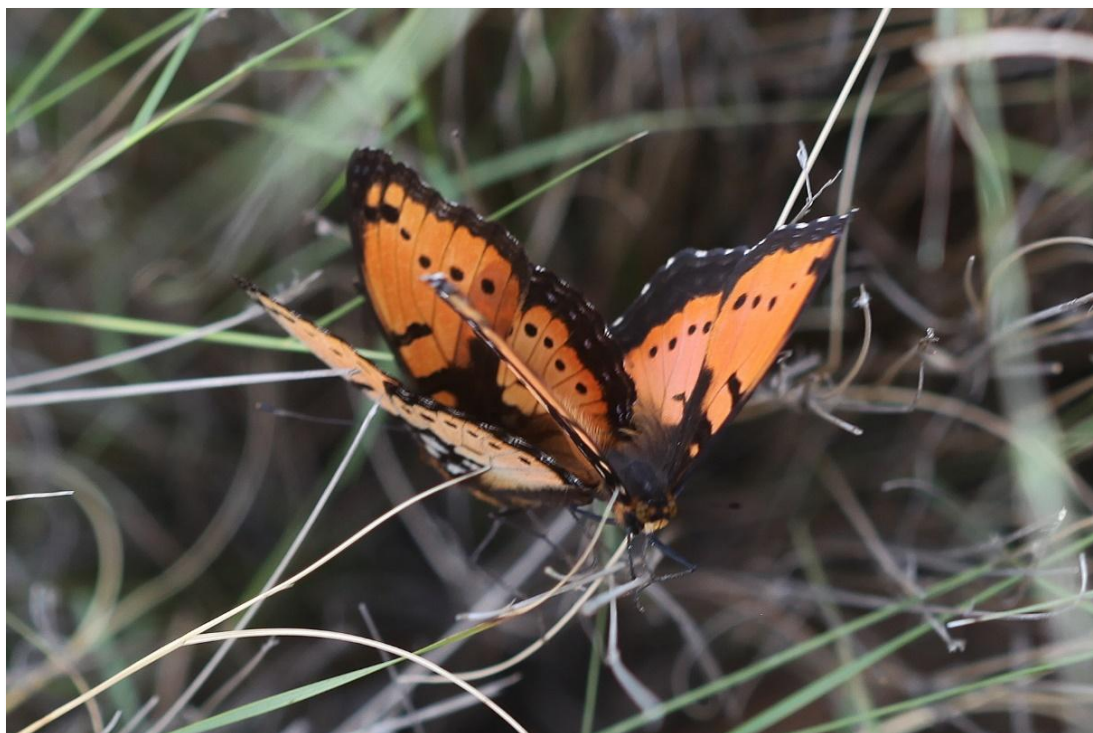


Photo 2: Mating pair of *Precis octavia sesamus* (wet season form; 'summer form'). This species is uncommon in Gauteng, and the project area appears to represent the western limit of its distribution in northern South Africa.

⁹ All photographs taken in the project area by R. F. Terblanche



Photo 3: *Catacroptera cloanthe* (Pirate butterfly).

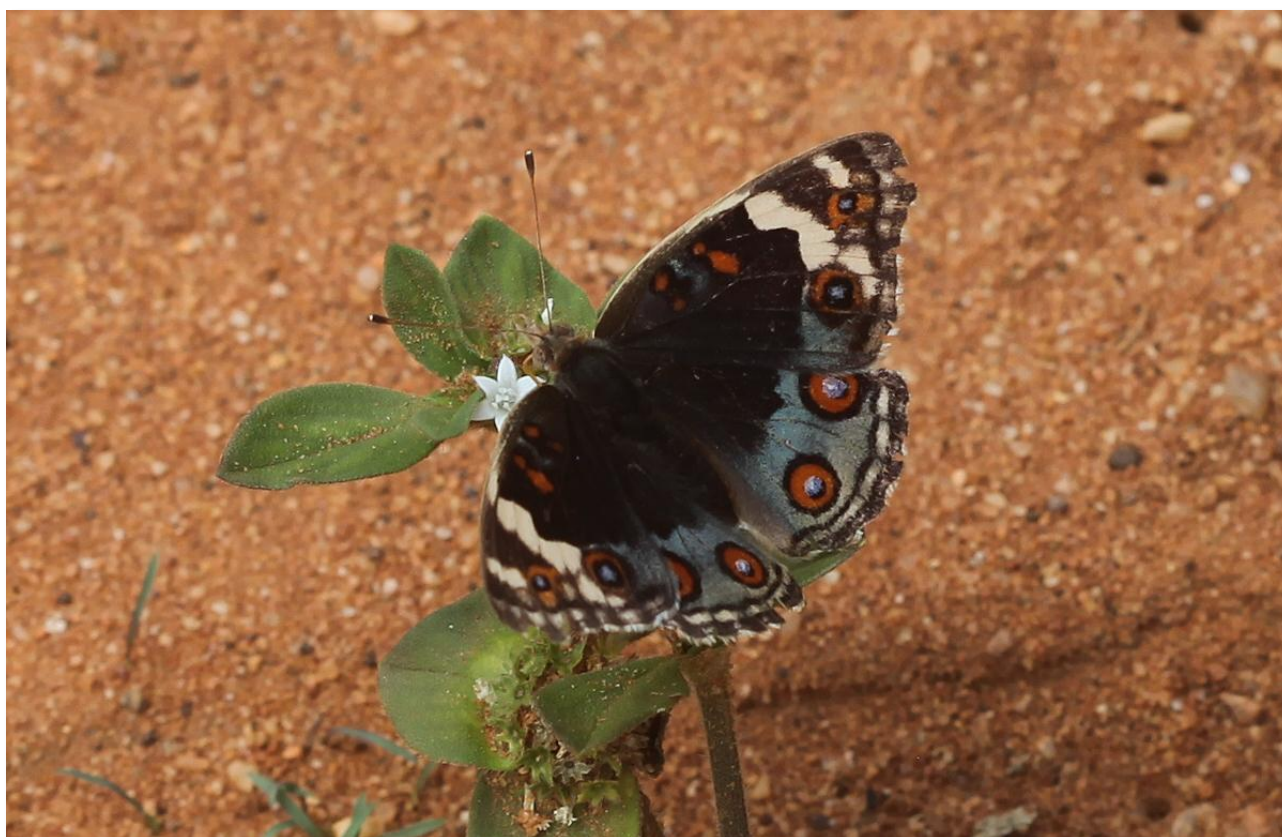


Photo 4: *Junonia orithya madagascariensis* (Blue Pansy).



Photo 5: *Acraea neobule* (Wandering Acraea).



Photo 6: *Teracolus subfasciatus* (Lemon Traveller).



Photo 7: *Belenois aurota* (Pioneer Caper White/Brown-veined White) feeding on nectar of *Cleome maculata*.



Photo 8: *Leptomyrina henningi* (Plain Black Eye) resting on a rock.



Photo 9: *Spialia ferax* (Striped Sandman) resting on a rock.



Photo 10: *Papilio demodocus* (Citrus Swallowtail) at a damp patch in the central parts of the site.



Photo 11: *Gegenes pumilio gambica* (African Dark Dodger).



Photo 12: *Cacyreus marshalli* (Geranium Bronze) feeding on an Asteraceae species.



Photo 13: *Clutia pulchella* is a widespread plant species of the highveld grassland regions and is the host plant species of the butterfly *Chrysoritis aureus*. This butterfly species not only requires the host plant to complete its life cycle, but is also associated with a specific ant species, i.e., *Crematogaster liengmei*.



Photo 14: *Clutia pulchella* and *Protea afra* at a rocky area at the western part of the site. Despite the presence of the host plant (*Clutia pulchella*), habitat appears not suitable and no *Chrysoritis aureus* was recorded at this locality.



Photo 15: *Clutia pulchella* and *Protea afra* at a rocky area at the western part of the site. Despite the presence of the host plant (*Clutia pulchella*), habitat appears not suitable and no *Chrysoritis aureus* was recorded at this locality.



Photo 16: *Zanthoxylum capense*, indigenous host plant of the butterfly *Papilio demodocus* (Citrus Swallowtail) which has a widespread distribution.



Photo 17: Indigenous woodland in the northern part of the site. This indigenous bush sustains a conspicuous butterfly diversity but is not considered suitable habitat for sensitive butterfly species such as *Chrysoritis aureus*, which persists in grassland parts of mountain bushveld (Terblanche, Morgenthal & Cilliers, 2003; Terblanche, In prep.).



Photo 18: Indigenous woodland in the northern part of the site. This indigenous bush sustains a conspicuous diversity of butterfly species but is unsuitable habitat for sensitive butterfly species such as *Chrysoritis aureus*, a butterfly species that persists in grassland parts of mountain bushveld (Terblanche, Morgenthal & Cilliers, 2003; Terblanche, In prep.).



Photo 19: Wetland that is dominated by Bulrush (*Typha capensis*) adjacent to the N3 highway at the western part of the site. The butterfly species *Orachrysops mijburghi* has not been recorded at, or near, this wetland habitat and such wetland habitats are considered unsuitable for the species.



Photo 20: Cultivated areas and clumps of exotic tree species in the foreground at the southern part of the site. Such cultivated fields and clumps of exotic trees often sustain a poor diversity of butterfly species and is regarded as of low ecological sensitivity to butterflies.



Photo 21: Flat, cultivated fields in the foreground and rocky hill in the background, at the central part of the site. Despite sustaining a moderate to high diversity of butterfly species, no threatened butterfly species, e.g., *Chrysoritis aureus*, were recorded at this rocky hill during the survey. Habitat at the rocky hill contains too much woody vegetation and is not considered suitable for the very localized threatened grassland butterfly species.



Photo 22: Beacon at elevation around 1,800 m at the central part of the site. No *Chrysoritis aureus* was recorded in this area.



Photo 23: View towards the south (south-south-east) from the top of the mountain at the central part of the site.



Photo 24: Rocky ridge vegetation at the central part of the site; no threatened butterfly species were recorded in this area.



Photo 25: Rocky ridge vegetation at the western part of the site; no threatened butterfly species were recorded in this area.



Photo 26: Rocky ridge vegetation from a nearby location outside the project area where *Chrysoritis aureus* was recorded to illustrate the nature of suitable habitat for this species. Note that a recent fire has resulted in removal of much of the vegetation (photo supplied by R Robbeson).



Photo 27: Rocky ridge vegetation from a nearby location outside the project area where *Chrysoritis aureus* was recorded to illustrate the nature of suitable habitat for this species. Note that a recent fire has resulted in removal of much of the vegetation (photo supplied by R Robbeson).

10.4 BUTTERFLY SPECIES OF CONSERVATION PRIORITY RELEVANT TO THE PROJECT AREA

Studies about the preferred vegetation and habitat of threatened butterfly species in South Africa indicate that ecosystems with a unique combination of features are often selected by localised threatened butterfly species (Deutschländer and Bredenkamp 1999; Edge 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Threatened butterfly species in South Africa are therefore regarded as effective and accurate bioindicators of rare ecosystems.

Species presented in **Table 4** to **Table 6** were considered because they were highlighted by the Screening Tool, recorded during the assessment, identified from credible regional records, or considered potentially suitable based on habitat requirements. The expected presence or absence (Likelihood of Occurrence) of these threatened butterfly species, as well as other butterfly species of conservation priority that are not currently included in threatened categories, are also indicated in **Table 4** to **Table 6**.

Species	Threatened Status	Recorded (survey)	Residential status at the site (LoO)**
<i>Aloeides barberae</i> Barberton Russet	Endangered	No	Highly unlikely
<i>Aloeides dentatis dentatis</i> Toothed Russet	Endangered	No	Could exist at some areas but were not observed during the surveys. Basic observations are recommended as part of biodiversity monitoring programme (if deemed necessary).
<i>Aloeides nubilus</i> Cloud Russet	Endangered	No	Highly unlikely
<i>Aloeides rossouwii</i> Stoffberg Russet	Critically Endangered	No	Unlikely

Table 4: Threatened butterfly species of the Mpumalanga Province and Gauteng Province combined (Mecenero *et al.* 2020)*

Species	Threatened Status	Recorded (survey)	Residential status at the site (LoO)**
<i>Chrysoritis aureus</i> Heidelberg Golden Opal/Heidelberg Copper	Endangered	No	<p>The Environmental Screening Report initially assigned a tentative 'Medium Sensitivity' to this species within the project area, indicating that suitable conditions may exist for the species to occur in the broader area. Findings of this assessment refined these initial sensitivities by identifying specific areas that may comprise highly suitable habitat for the species. Separately, supplementary observation records provided by MPTA confirmed the known occurrence of the species at specific localities within the project area. Areas that were identified as highly suitable habitat, together with confirmed localities (MPTA records), have therefore been considered highly sensitive in relation to the species. This distinction reflects both the potential for species occurrence based on habitat suitability and the greater certainty associated with areas where the species has been confirmed.</p> <p>Tower positions in proximity to these areas have been considered during successive iterations of the project layout, and the current layout, as refined since the scoping phase, largely avoids direct impacts on these highly sensitive areas. Basic monitoring surveys and appropriate habitat management measures represent some mitigation suggestions received from MPTA (M. Lotter, pers. comm.) and will be incorporated into the biodiversity monitoring programme, with any subsequent observations or potential impacts on the species recorded, assessed and appropriately addressed as they arise</p>
<i>Chrysoritis phosphor borealis</i> Scarce Scarlet Opal	Endangered	No	Highly unlikely
<i>Dingana clarki amissivallis</i> Verloren Vallei Bronze Speckled Widow	Vulnerable	No	Highly unlikely
<i>Dingana fraterna</i> Stoffberg Widow	Critically Endangered	No	Highly unlikely
<i>Lepidochrysops irvingi</i> Sabie Nimble Blue	Vulnerable	No	Highly unlikely
<i>Lepidochrysops jefferyi</i> Purple-brown Nimble Blue	Critically Endangered	No	Highly unlikely
<i>Lepidochrysops praeterita</i> Highveld Nimble Blue	Endangered	No	Unlikely
<i>Lepidochrysops swanepoeli</i> Barberton Nimble Blue	Critically Endangered	No	Highly unlikely



Table 4: Threatened butterfly species of the Mpumalanga Province and Gauteng Province combined (Mecenero *et al.* 2020)*

Species	Threatened Status	Recorded (survey)	Residential status at the site (LoO)**
<i>Orachrysops mijburghi</i> Heilbron Indigo Blue	Endangered	No	No individuals of this species were observed during the brief surveys. Considering the nature, extent and current condition of wetland habitat within the project area, the species is considered unlikely to occur in most areas of the project area. However, its potential presence cannot be entirely excluded, particularly where suitable wetland habitat persists. Avoidance of wetland habitat is therefore strongly recommended and, where implemented, is expected to substantially reduce the potential for significant impacts on <i>Orachrysops mijburghi</i> . Targeted observations should therefore be incorporated into the biodiversity monitoring programme, with particular attention given to areas of potentially suitable wetland habitat. Monitoring should be undertaken during appropriate periods when the species is most likely to be detectable, and any observations should be accurately recorded and reported. Where the species is detected, the relevant locality and associated habitat should be documented, and appropriate measures should be implemented to avoid or minimise any subsequent/potential impacts.
<i>Orachrysops violescens</i> Violescent Indigo Blue	Endangered	No	Highly unlikely

* Sources of information: Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013), Mecenero *et al.* (2020). Invertebrates such as threatened butterfly species are often highly habitat specific and residential status imply a unique ecosystem that is at stake. Species that were flagged by the DFFE National Environmental Screening Tool for the site, are also highlighted in blue.

** Residential status at the site (LoO): Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely

Table 5: Near Threatened butterfly species of the Mpumalanga Province and Gauteng Province combined (Mecenero *et al.* 2020)*

Species	Threatened Status	Recorded (survey)	Status at the site (LoO)**
<i>Dingana aladeus</i> Wakkerstroom Widow	Near Threatened	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Near Threatened	No	Considered a likely inhabitant of some wetland and riparian zones. Avoidance of wetland habitat is strongly recommended and will mitigate against significant impacts on this species. Basic observations will be recommended as part of biodiversity monitoring programme.

* Sources of information Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013), Mecenero *et al.* (2020).

** Status in the site (LoO): No = Species is unlikely to be a resident in the project area; Yes = Species is a resident in the project area



Table 6: Least Concern butterfly species of the Mpumalanga Province and Gauteng Province combined, but flagged as Rare or Critically Rare by Mecenero et al. (2020)*

Species	Threatened Status	Recorded (survey)	Status at the site (LoO)**
<i>Eriboea marieps</i> (= <i>Charaxes marieps</i>) Marieps Black Prince	Least Concern: Rare, Restricted range	No	Highly unlikely
<i>Lepidochrysops procera</i> Potchefstroom Blue/Grassland Nimble Blue	Least Concern: Rare, Habitat specialist	No	Unlikely
<i>Orachrysops warreni</i> Verloren Vallei Indigo Blue	Least Concern: Extremely Rare	No	Highly unlikely

* Sources of information Henning, Terblanche & Ball (2009), Mecenero et al. (2013), Mecenero et al. (2020). Species that were flagged by the DFFE National Environmental Screening Tool for the site, are highlighted in blue.

** Status in the site (LoO): No = Species is unlikely to be a resident in the project area; Yes = Species is a resident in the project area

10.5 REVIEW AND GROUND TRUTHING OF BUTTERFLY SPECIES HIGHLIGHTED IN THE ENVIRONMENTAL SCREENING REPORT

10.5.1 ANNOTATIONS ON THE ENVIRONMENTAL SCREENING REPORT

Updated habitat and distribution modelling was enacted in the National Environmental Screening Tool on 2026/04/13. Consequently, Environmental Screening Reports that were generated before 13 April 2026 may present different results compared to reports that generated after the update. Similarly, some taxonomic updates were also enacted in the National Environmental Screening Tool to allow for recent name changes and conservation status updates; 'Sensitive Species' numbers are therefore likely to have changed in the updated release and should not be accepted as accurate from older reports. In order to present the most recent information for the project area, a new report was generated for the project area from the National Environmental Screening Tool, with the criteria as "*Utilities Infrastructure => Electricity => Generation => Renewable => Wind*" (downloaded 2026/08/06). GIS shapefiles that accompany the report indicates that habitat modelling for butterfly species relevant to the project area and wider surrounds remained the same.

It is also worth noting that anticipated sensitivities that are allocated to the Animal Species Theme by the National Environmental Screening Tool are based on a synthesis of data that includes the known presence of species with a Threatened conservation status (CR, EN, VU) within the Aol; the National Environmental Screening Tool does not consider lower levels of conservation, such as Near Threatened, Critically Rare, Data Deficient, Rare, etc. While the appointed specialist must assess and evaluate the presence of highlighted species according to the relevant protocols, it is also a specific requirement that the following animal SCC be considered:

- 1 Other taxa with a threatened conservation status for which no collection records exist in the project area, or threatened species with collection records in proximity to the site;
- 2 Taxa with lower conservation status e.g., NT, DD, Rare, etc.; and
- 3 Taxa mentioned in any other relevant information source e.g., iNaturalist, NEWPOSA, ADU, other specialist reports, etc.



Furthermore, the National Environmental Screening Tool utilises a collection of information sources that are mapped at a national scale. As these resources were often mapped at low resolution and large scale, and also because of a paucity of accurate and relevant information and data, there ultimately may be areas where environmental sensitivities were assigned incorrectly, or missed. All sensitivities should therefore be ground-truthed and confirmed by means of broad-scale site investigations by a relevant specialist to improve the accuracy of potential inaccuracies.

Considering the Animal Species Theme, the report indicates that the project area holds 'High' and 'Medium' sensitivities for animal species. More specifically, the following sensitivities are indicated for threatened butterfly species:

- ⇒ *Chrysoritis aureus* (Heidelberg copper, EN) – High and Medium Sensitivities;
- ⇒ *Lepidochrysops procera* (Potchefstroom blue, Rare) –Medium Sensitivity; and
- ⇒ *Orachrysops mijburghi* (Mijburgh's blue, EN) –Medium Sensitivity.

The following sections provide a species-specific review of the butterfly taxa highlighted by the Environmental Screening Report, incorporating the results of field observations, habitat verification, known distributional information and the current project layout.

10.5.2 *CHRYSORITIS AUREUS (GOLDEN OPAL/HEIDELBERG COPPER)*

The proposed global red list status for *Chrysoritis aureus*, according to the most recent IUCN criteria and categories, is **Endangered** (Mecenero et al., 2020). *Chrysoritis aureus* (Golden Opal/Heidelberg Copper) is often a resident where the larval host plant *Clutia pulchella* occurs, although it is worth noting that their distribution appears to be more restricted than that of the larval host plant species (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). Specifically, one of the reasons for the localised distribution of *Chrysoritis aureus* is that a specific host ant, i.e., *Crematogaster liengmei*, must also be present at the habitat, specifically occurring underneath surface rocks in direct proximity to the host plant species (i.e., *Clutia pulchella*). Fire also appears to be an essential factor for the maintenance of suitable habitat (Terblanche, Morgenthal & Cilliers 2003). Research revealed that *Chrysoritis aureus* (Golden Opal/Heidelberg Copper) exhibits specific habitat requirements, including rocky ridges with a steep slope and a southern aspect (Terblanche, Morgenthal & Cilliers 2003) (refer Photos 26-27, p53,54). These habitat conditions and attributes were also confirmed from observational records supplied by MTPA that includes records between 2004 and 2012, as well as observations outside the project area in 2024)

The assessment indicates that Medium Sensitivity areas for this species highlighted in the Environmental Screening Report relate to untransformed portions of the Andesite Mountain Bushveld and Tsakane Clay Grassland (refer **Figure 10**). Minor portions of High Sensitivity areas are situated towards the northwest and east of the project area, and although not considered relevant to this study, it is clear that the proposed project layout avoided most of these parts of the landscape through iterative considerations of the project layout and turbine footprints.



Tentative qualitative survey observations did not highlight areas that could be considered highly suitable for this species (apart from confirmed localities) as survey results indicated suboptimal vegetation structure at most of these areas of rocky habitats (i.e., containing high incidence of trees or woody shrubs, refer Photos 13, 14, 15, 17, 18, 21, 24 & 25). As a precaution, areas that were considered suitable for this species (i.e., areas where *Clutia pulchella* was recorded on rocky ridges) were categorised as Highly Sensitive. It is also worth noting areas highlighted as 'High Sensitivity' in the Environmental Screening Report (outside the project area) likely represent habitat modelling in the National Environmental Screening Tool and not necessarily represent all available distributional information on this species, as indicated by subsequent supplementary information supplied by MTPA (refer **Figure 10**).

Figure 10 and **Figure 11** indicate that areas that have been classified as sensitive (according to the Environmental Screening Report) have largely been avoided through iterative considerations of the proposed project layout since the scoping phase. The closest turbine footprints to confirmed localities are associated with Tower 14 (approximately 210 m), Tower 17 (approximately 380 m), and Tower 18 (approximately 380 m). The species is however considered habitat-restricted (habitat specialist) and is therefore unlikely to move extensively beyond areas containing suitable habitat. The species' generally low, vegetation-associated flight behaviour further reduces the likelihood of interaction with rotating turbine blades, and turbine-related collision mortality is therefore not considered a primary impact for this species. The most likely impact is consequently considered to be direct loss or modification of suitable habitat during construction, with the potential for indirect habitat degradation during the operational phase.

Ultimately, despite the apparent proximity of turbine footprints to confirmed species localities, highly sensitive areas are largely avoided (considering a suggested buffer width of at least 200 m around confirmed localities and Very High sensitivity habitat), and together with the species' strong association with suitable habitat, the potential for significant direct impacts is considered limited. The anticipated residual impact significance is therefore acceptable but is subject to the implementation of the recommended avoidance and habitat management measures, which also were suggested mitigation measures from MPTA. Notwithstanding this assessment, uncertainty remains regarding the species' movement and dispersal patterns across the broader landscape, particularly movements between separate populations and potentially suitable habitat areas ('stepping stones'). Further investigation of these landscape-scale movement patterns could improve understanding of potential connectivity and cumulative impacts; however, such investigation falls beyond the scope of the present assessment and project.

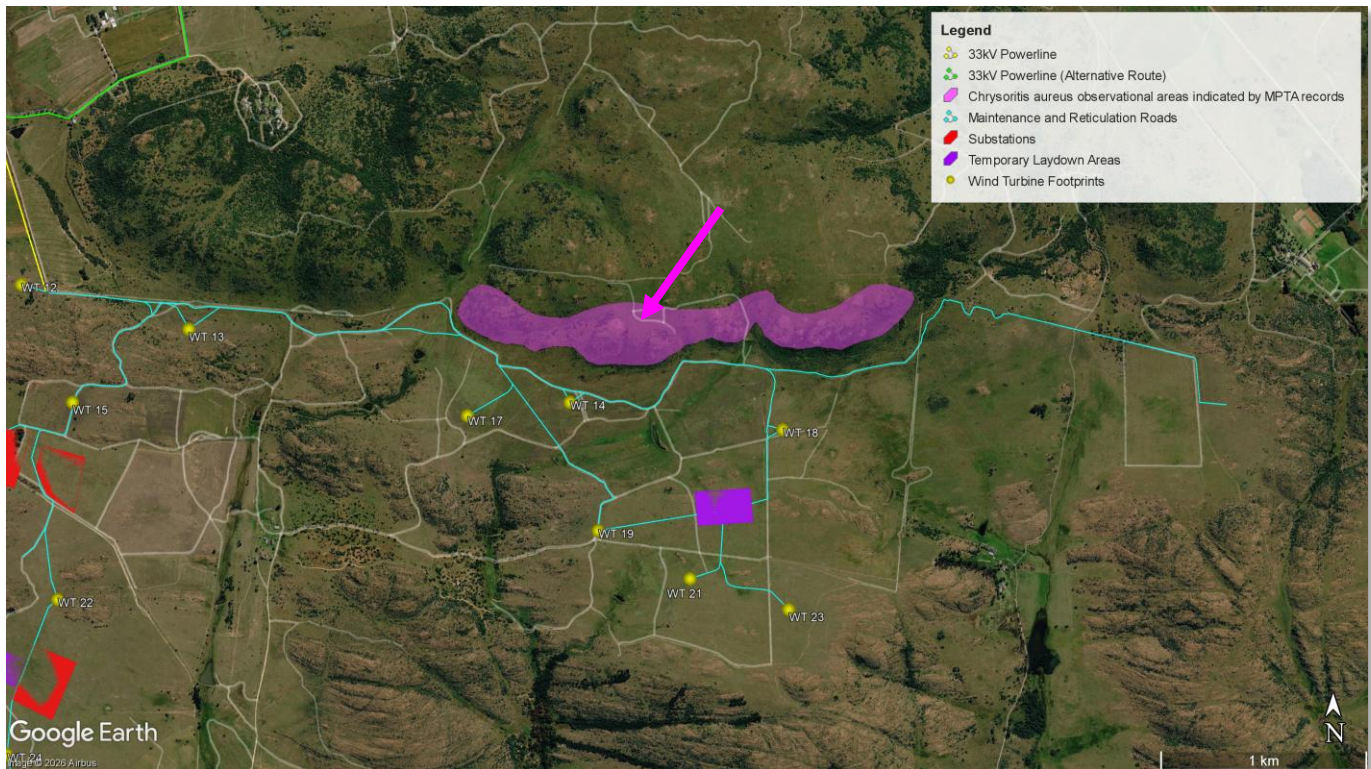


Figure 10: Habitat where MPTA observational records for Heidelberg Golden Opal (*Chrysoritis aureus*) are indicated in proximity to Turbine Towers 14, 17 & 18
Note pink arrow on Figure 11

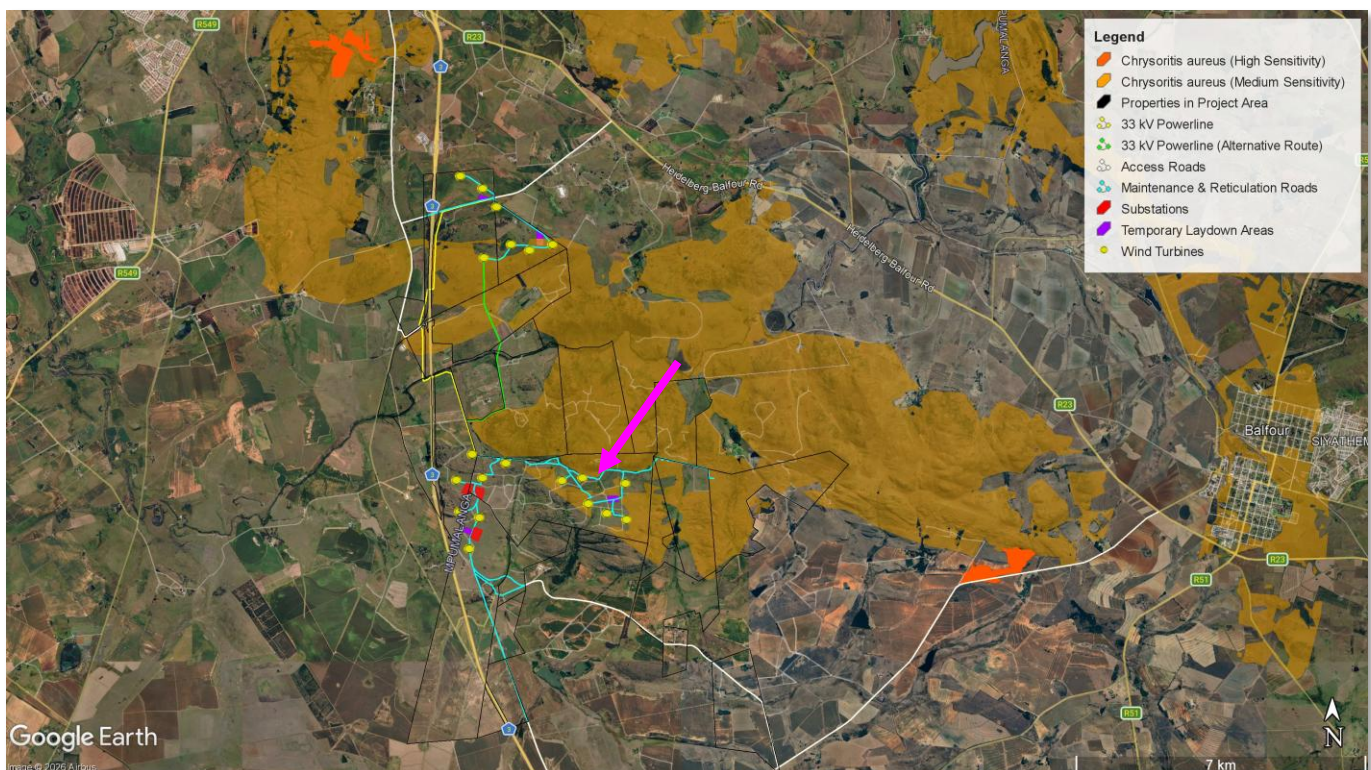


Figure 11: Anticipated sensitivity for *Chrysoritis aureus* (Heidelberg copper, EN) in the project area, as delineated in the Environmental Screening Report
Note pink arrow from Figure 10

10.5.3 *LEPIDOCHRYSOPS PROCERA* (POTCHEFSTROOM BLUE/GRASSLAND NIMBLE BLUE)

The proposed global red list status for *Lepidochrysops procera* (Potchefstroom Blue) according to the most recent IUCN criteria and categories is **Least Concern**. However, according to the National Red Listing of butterfly species of South Africa *Lepidochrysops procera* is regarded as a **Rare Habitat Specialist** (Mecenero et al., 2020). The Environmental Screening Report indicates that extensive parts of the project area are categorised as Medium Sensitivity for this species (refer **Figure 12**); these areas generally relate to untransformed portions of the Andesite Mountain Bushveld and the Soweto Highveld Grassland, providing a broad understanding of the habitat preferences of this species. More detailed habitat information indicates that it is mostly restricted to areas where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Terblanche, PhD, *in prep.*), although it is worth noting that the distribution of this butterfly species appears to be more restricted compared to the wider distribution of the host plant. *Lepidochrysops procera* is found on selected rocky slopes and rocky ridges in parts of Gauteng-, North West-, and KwaZulu-Natal provinces. Suitable habitat for this species includes rocky grassland areas with few trees.

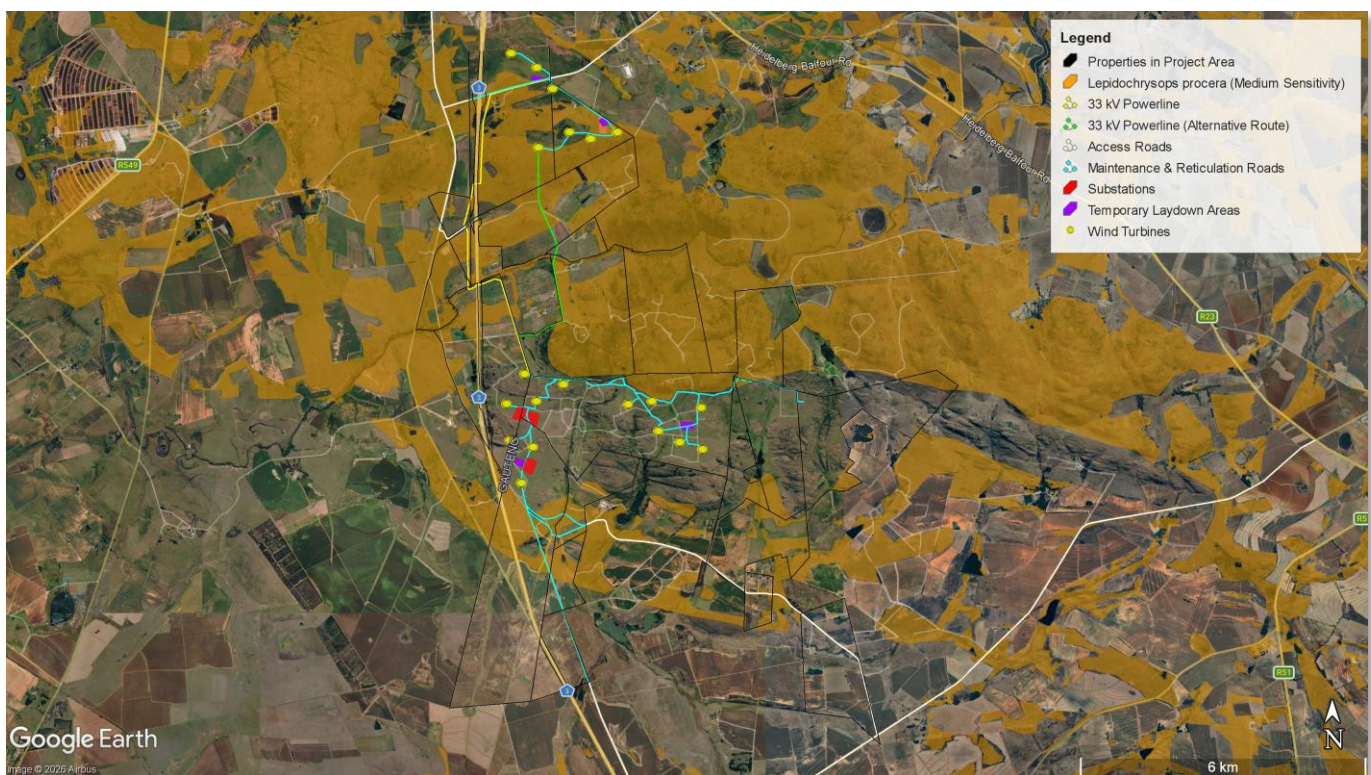


Figure 12: Anticipated sensitivity for *Lepidochrysops procera* (Potchefstroom blue, Rare) in the project area, as delineated in the Environmental Screening Report

Correlation of the proposed project area in terms of the anticipated sensitivities for this species indicates that the project layout will mostly avoid Medium Sensitivity areas. Furthermore, no habitat was observed during the survey period that could be considered highly suitable within the project area, and the presence of *Lepidochrysops procera* within the project area is considered unlikely. As such, impacts on this species, including direct and indirect impacts, are considered unlikely and impact significance is considered acceptable.

10.5.4 *ORACHRYSOPS MIJBURGHII (HEILBRON BLUE/HEILBRON CUPID)*

The proposed global red status for *Orachrysops mijburghii* according to the most recent IUCN criteria and categories is **Endangered** (Mecenero et al., 2020). This species exhibits a preference for grassland depressions where specific *Indigofera* (Fabaceae) host plant species occur (Terblanche & Edge 2007). Within the project area untransformed parts of the Andesite Mountain Bushveld and Soweto Highveld Grassland are highlighted as Medium Sensitivity. Notably, only areas west of the N3 highway have been highlighted, which seemingly indicates potential limitations in the spatial representation of suitable habitat from the National Environmental Screening Tool (refer **Figure 13**), and highlighting a lack of more specific habitat and distributional knowledge of this species.

The Heilbron population of *Orachrysops mijburghii* in the Free State utilises *Indigofera evansiana* as a larval host plant (Edge, 2005), while the Suikerbosrand population in Gauteng utilises *Indigofera dimidiata* as a larval host plant (Terblanche & Edge 2007). While the likelihood of *Orachrysops mijburghii* occurring in suitable parts of the project area cannot be excluded entirely, wetland habitats within the site do not appear to be ideal for the species; no individuals of this species were observed during the initial survey period. Additionally, no area that could be considered highly suitable for *Orachrysops mijburghii* was found within the site, and the Likelihood of Occurrence of *Orachrysops mijburghii* within the site is considered unlikely.

Study results and a review of available data suggest that the proposed project layout will largely avoid untransformed habitat types, providing precautionary protection against direct and indirect impacts, specifically in view of the lack of site-specific information.

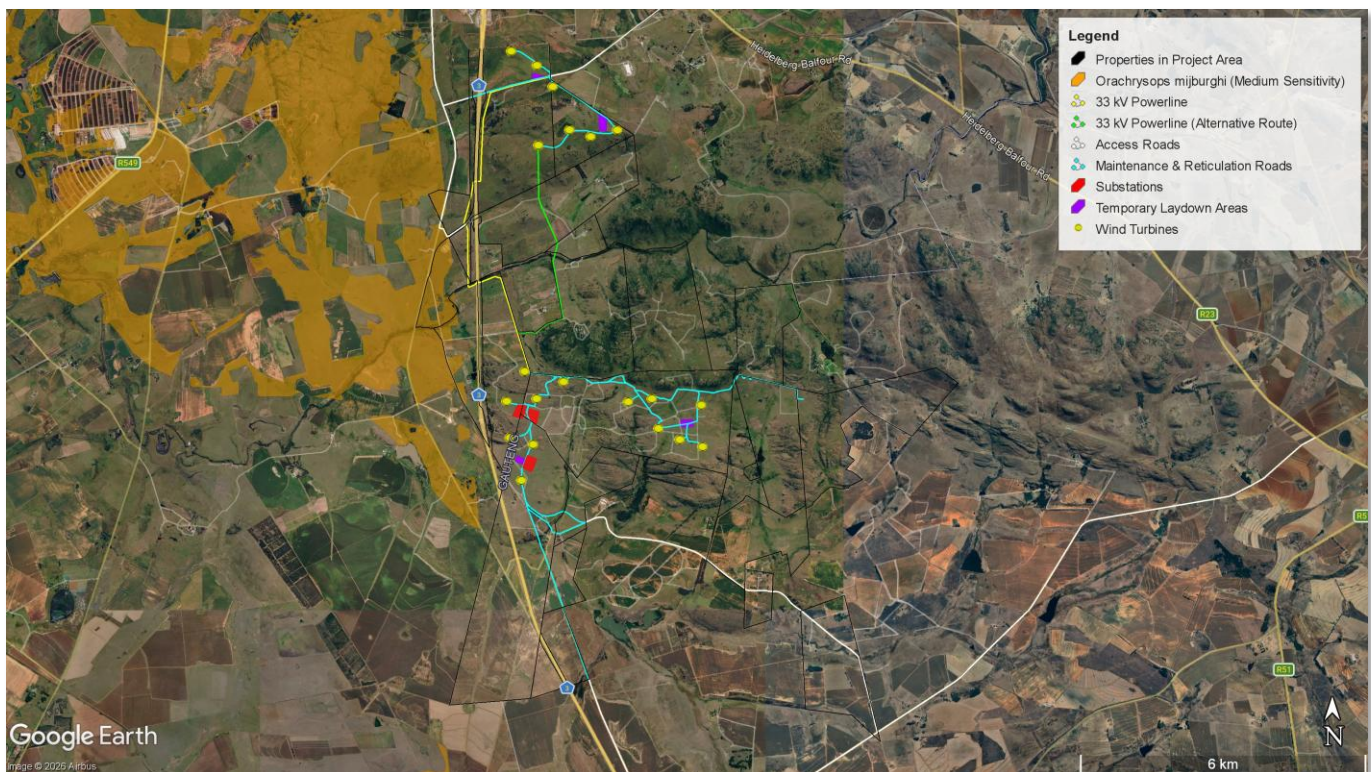


Figure 13: Anticipated sensitivity for *Orachrysops mijburghii* (Mijburgh's blue, EN) in the project area, as delineated in the Environmental Screening Report



10.6 OTHER SPECIES

10.6.1 *METISELLA MENINX (MARSH SYLPH)*

Although *Metisella meninx* was not recorded during the surveys, the occurrence of this wetland species cannot be entirely excluded. Henning and Henning (1989), in the first South African Red Data Book of Butterflies, listed *Metisella meninx* as Threatened under the former IUCN category Indeterminate. Even earlier in the 20th century, Swanepoel (1953) raised concern about vanishing wetlands leading to habitat loss and loss of populations of *Metisella meninx*. According to the second South African Red Data Book of butterflies (Henning, Terblanche & Ball, 2009), the proposed global red list status of *Metisella meninx* is considered Vulnerable. During a recent large-scale atlassing project for the Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas (Mecenero et al., 2013), it was found that more *Metisella meninx* populations are present than initially thought. Based on this valid new information, the conservation status of *Metisella meninx* is now regarded as **Near Threatened** (Mecenero et al., 2020).

Though *Metisella meninx* has a wider distribution (refer **Figure 14**) and is less threatened than initially thought, it is nonetheless regarded as a localised rare habitat specialist of conservation priority that is dependent on wetlands with suitable patches of grass along wetland margins (Terblanche, *in prep.*). It is also important to note that *Metisella meninx* represents a species complex that likely consists of at least three independent taxa (Terblanche *in prep.*, Terblanche & Henning, *in prep.*), and also that the present status is based on very recent discoveries of new taxa in the group.

Ideal habitat for *Metisella meninx* conforms to treeless, marshy areas, where the larval host plant *Leersia hexandra* (Rice Grass) is abundant (Terblanche, *in prep.*), (G.A. Henning & Roos, 2001). Several such patches were noted within riparian zone and wetland zones of the project area; these parts were included as High Sensitivity wetlands zones in the project area. Considering the latest layout, it is unlikely that significant threats to *Metisella meninx* will result if appropriate conservation and preservation actions are implemented along wetland corridors.

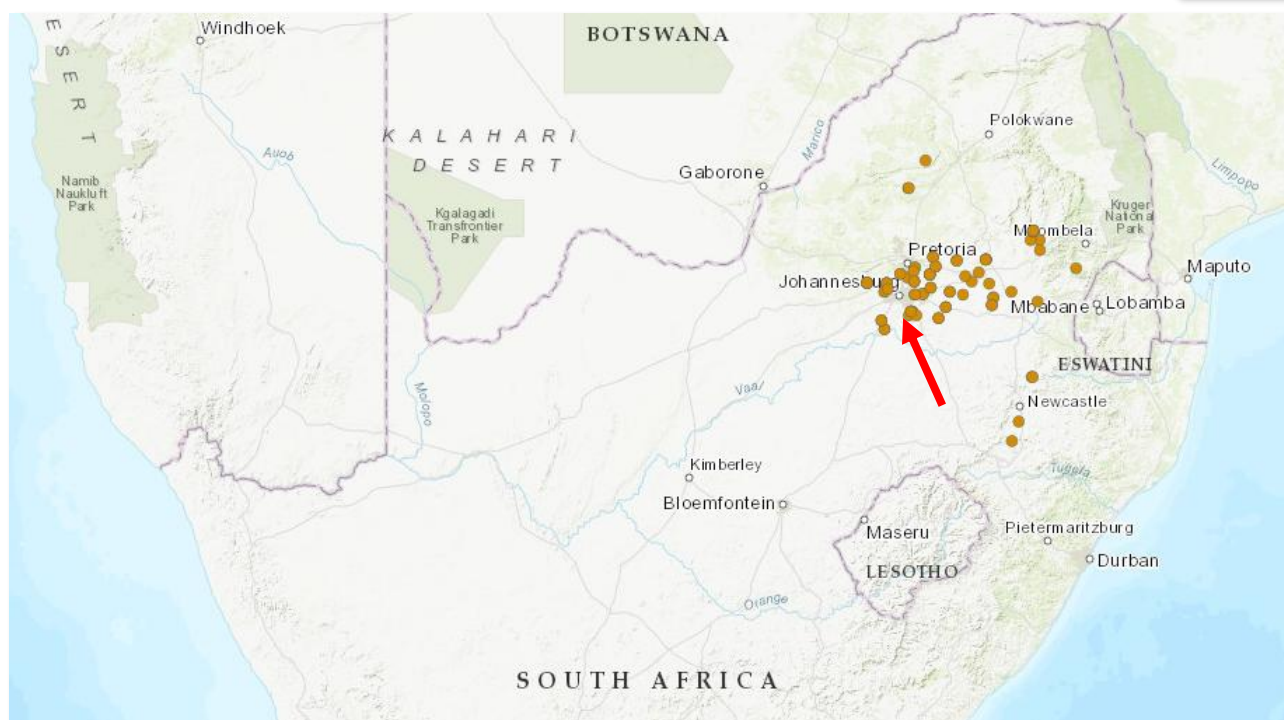


Figure 14: Extant (resident) distribution of *Metisella meninx* (Marsh Sylph) across the highveld regions of South Africa (IUCN, 2018)

* Arrow indicating approximate location of the project area

10.7 COMMENTS

Considering that the occurrence of threatened butterfly species in the project area is restricted to highly specific habitat types, the implementation of avoidance strategies and micro-siting of development components (as per the latest layout iteration) has achieved significant mitigation of potential and likely impacts. Considering the latest layout, the proposed development is unlikely to cause significant threats to any threatened butterfly species or populations and habitat associated with these species. While minor infringements into High Sensitivity areas are noted according to the latest layout (refer **Section 11.4**), the application of the recommended mitigation approach, which also includes final walkthrough of site footprints and micro-siting recommendations, will ameliorate impact significance to acceptable levels.



11 BUTTERFLY HABITAT SENSITIVITY OF THE PROJECT AREA

11.1 BACKGROUND

Pressures to develop areas for the improvement of human well-being are high in South Africa, often with a realistic risk of losing habitat for (invertebrate) conservation, particularly for those threatened species that have highly specific habitat requirements. Remaining areas of natural (untransformed, not modified) habitats in the Gauteng and Mpumalanga regions are often threatened because of urban expansion patterns (Pfab & Victor, 2002) and commercial agricultural activities (*pers. obs.* 2025). Habitat conservation is therefore a key to the effective conservation of invertebrates such as threatened butterflies (Deutschländer and Bredenkamp 1999; Edge 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008), while Pryke & Samways (2003) and Samways (2005) demonstrated the importance of migration corridors and habitat linkages (integrity) for insect conservation. The development and implementation of management plans that are considerate of these criteria should therefore be prioritised during all developments, particularly as the preservation of special ecosystems is in line with the Biodiversity Act (2004) of the Republic of South Africa.

This is also true for any detailed planning of corridors and buffer zones for invertebrates. Corridors linkages are important for ecosystems of high conservation priority, particularly as these corridors or linkages improve survival of otherwise isolated populations (Samways, 2005). Corridor width is however a dynamic and highly debated topic, highly depending on criteria such as specific conservation goals and focal species (Samways, 2005). Typically, for an African butterfly assemblage, an effective corridor width is approximately 250 m, considering the requirements for movement as well as functioning of these areas as a habitat source (Pryke and Samways 2003). Similarly, Hill (1995) suggested a buffer distance of approximately 200 m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even narrow corridors play a valuable role (Samways, 2005). Much more research is however required to determine more refined answers to the width of grassland corridors in South Africa. It is also worth noting that the corridor width is also dependent on the type of development; for instance, shade effects of multiple story buildings will be quite different from that of small houses. To summarise, in practice, and as far as developments are concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems.

11.2 IN THE CASE OF THIS STUDY

Sensitivity is not simply a measure of butterfly abundance; it represents the relative ecological importance and vulnerability of habitat to project-related disturbance. Areas of low (butterfly) sensitivity generally relate to transformed areas, including commercially cultivated fields, while fallow agricultural fields also account for significant parts that are considered 'poor habitat'. Additionally, stands of alien invasive tree species occur sporadically in some places and stands of alien invasive herbaceous weeds are conspicuous at disturbed areas. Typical infrastructure associated with farming, such as homesteads, roads and fences are present, while a major highway (i.e., the N3) runs through the site, which contributes to habitat fragmentation. These deteriorated, modified, and transformed areas are typically characterised by low butterfly diversity (or comprising only of ubiquitous species). The absence (or extremely unlikely presence) of threatened butterfly species for these parts has been noted, and a low (butterfly) sensitivity has been ascribed.



Conversely, considering the habitat and life preferences of species that are considered potential inhabitants of the region, parts of the landscape where these species are reasonably anticipated to persist were highlighted as being of elevated butterfly habitat sensitivity. For example, areas of known *Chrysoritis aureus* observations as well as parts of the landscape that exhibit attributes that correlate to habitat preferences for this species were precautionary categorised as being of 'Very High Sensitivity'. Watercourses and associated riparian and wetland zones exhibit attributes of 'High Sensitivity', mainly because of the importance as conservation corridors for insects or the likelihood that the Near Threatened *Metisella meninx* could persist at some of these wetland/riparian areas. Similarly, rocky ridges and areas of complex topography often exhibit high butterfly diversity, serving as important migration corridors or 'stepping stones' when occurring embedded in transformed areas. Although no threatened species were recorded within these parts, a tentative High Sensitivity was ascribed based on habitat suitability.]

The key to effective butterfly conservation is therefore the conservation of habitats where the preferred host plants for caterpillars of these species occur. These areas are also highly likely to represent suitable habitat for several other localized and/or threatened butterfly species in South Africa. Specifically, areas where the associated ant species (Henning, Terblanche & Ball, 2009) for *Chrysoritis aureus* occurs in association with the host plant species are considered highly sensitive.

11.3 BUTTERFLY HABITAT SENSITIVITY

Estimated butterfly ecological sensitivity categories for the project area are illustrated in **Figure 15**.

Very High butterfly habitat sensitivity:

Very High Sensitivity is indicated for any area where a Threatened butterfly species has been recorded or considered highly likely to be present as habitat at these sites is highly suited for the existence of a population of these threatened species. Specifically, *Chrysoritis aureus* (Heidelberg Golden Opal/Heidelberg Copper) is considered a species of interest in specific parts of the project area and wider region; these parts of the landscape should be protected. Despite the apparent proximity of 3 turbine footprints to confirmed localities is noted, the proposed project layout will unlikely affect these areas directly. These parts of the wider landscape generally relate to certain sections of the high mountainous parts of the Mountain Bushveld habitat type.

High butterfly habitat sensitivity:

High Sensitivity areas include parts of the landscape where the Threatened butterfly might not necessarily occur, but a conspicuous/high diversity of other butterflies is present. These areas also refer to habitat types that are considered moderately suitable for priority species, e.g., watercourses, rocky ridges, and areas that act as migration corridors for butterflies. It is worth noting that some/limited developments, e.g., inserting a wind turbine, in High Sensitivity areas are still possible under controlled and specific conditions; careful development and implementation of effective mitigation and conservation measures, as well as the implementation of effective mitigation and conservation principles could even contribute to the safeguarding ecosystems with high butterfly habitat sensitivity.



High sensitivity areas generally relate to untransformed and natural habitat types of the landscape, including the following broad-scale habitat types:

- ⇒ Mountain bushveld;
- ⇒ Natural grassland (high integrity portions);
- ⇒ Rocky shrubland; and
- ⇒ Watercourses and Wetlands.

Medium butterfly habitat sensitivity:

Medium Sensitivity areas conform to those parts where butterfly diversity is not conspicuously high, and these parts of the project area is not considered to represent a significant migration or movement corridor for butterfly species based on available information. Despite some modification of the predominant vegetation (e.g., resulting from high and persistent grazing pressure and associated deterioration patterns), extensive parts of the project area are nonetheless considered relatively natural and do not exhibit the high transformation levels associated with cultivated or fallow agricultural fields. Medium sensitivity areas generally relate to the Natural grassland broad-scale habitat, specifically parts where lower integrity or status have been recorded.

Low butterfly habitat sensitivity:

Low Sensitivity areas represent modified or extensively degraded areas. Butterfly abundance in these areas is often conspicuously poor or generally contain high numbers of ubiquitous and widespread butterfly species that have the ability to utilise 'poor' floral types (e.g., exotic and invasive species) as host plants for caterpillars. For example, butterfly abundance and diversity are typically very poor in areas where plantations of *Eucalyptus* trees dominate, exhibiting characteristics of Low Sensitivity. Low sensitivity areas generally relate to parts of the landscape that exhibit moderate to severe levels of disturbance, including:

- ⇒ Alien tree stands;
- ⇒ Cultivated fields; and
- ⇒ Transformed areas.

Table 7: Habitat types of the project area in relation to the ascribed sensitivity			
<i>Habitat type</i>	<i>Ecological condition</i>	<i>Butterfly value</i>	<i>Sensitivity</i>
Mountain bushveld	Natural	High	High
Natural grassland	Natural	High	Medium–High
Rocky shrubland	Natural	High	High
Secondary grassland	Modified	Moderate	Medium
Cultivated fields	Transformed	Low	Low
Wetlands	Natural/mesic	High	High



11.4 POTENTIAL CONFLICT AREAS

Potential conflict areas have been identified where the proposed layout overlaps with High Sensitivity areas (refer **Figure 15**) and where turbine footprints are placed in proximity to confirmed localities of threatened species (although appropriately outside a suitable buffer zone). While these are generally not regarded to be major impacts, it should nonetheless be considered with caution. Potential conflict areas are mentioned in **Table 8** below.

Table 8: Potential conflict areas according to the proposed layout			
<i>Infrastructure</i>	<i>Sensitivity overlap</i>	<i>Nature of conflict</i>	<i>Recommended action</i>
WT-8	High	Localised footprint overlap	Micro-site
WT-20	High	Localised footprint overlap	Micro-site
33 kV line	High	Linear crossing	Route adjustment
Alternative 33 kV line	High	Linear crossing	Avoid where practicable
Roads	High	Localised habitat loss	Re-route/micro-site

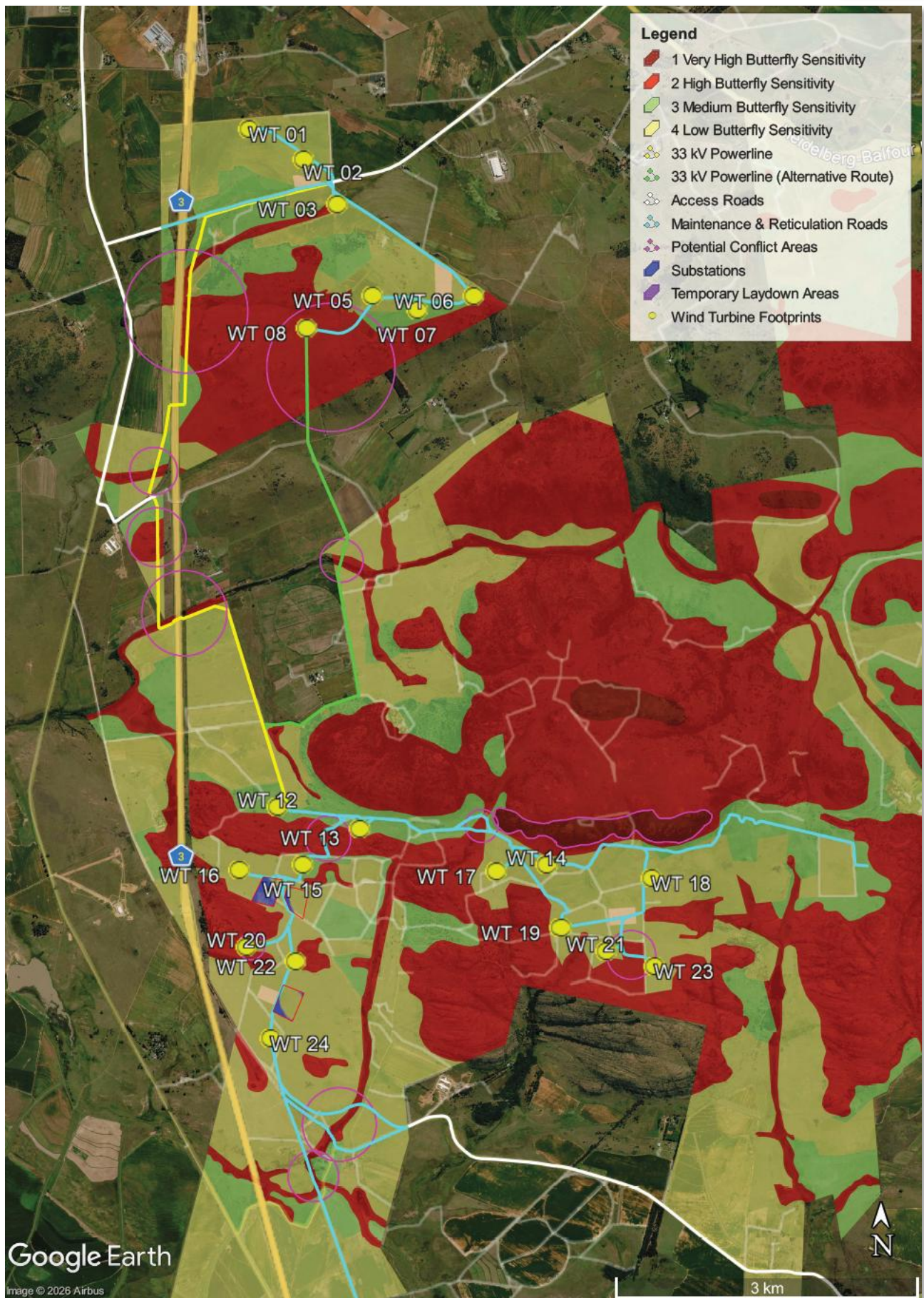


Figure 15: Habitat sensitivity for butterfly species within the project area in relation to the project components and layout, with an indication of potential conflict areas



12 QUANTIFICATION OF IMPACTS RELATING TO BUTTERFLY HABITAT SENSITIVITY

Appendix 3 provides a description of the method that was used to quantify the significance of anticipated impacts of the project.

12.1 ASSUMPTIONS

- ⇒ 'Pre-mitigation Impact Significance' assumes that the activity will take place in its entirety, i.e., the development will not be (further) divided into separate parts/sections that can be developed and operated individually or in isolation.
- ⇒ 'Pre-mitigation Impact Significance' assumes that a standard, generic, and industry acceptable standard mitigation approach is applied for the development, although not necessarily cognisant of detailed mitigation actions.
- ⇒ 'Post-Mitigation Impact Significance' assumes the complete, timeous, and comprehensive implementation of all recommended mitigation measures and maintained throughout the life of the activity.

12.2 DESCRIPTION OF IMPACTS

Direct Impacts

Direct impacts are primarily associated with land clearance, construction activities, and other project-related activities that affect existing environmental or social receptors through direct physical interaction. These impacts typically arise where land is permanently or temporarily occupied by project infrastructure, including wind turbine footprints, access roads, laydown areas, substations, and associated infrastructure. While direct losses or alteration of sensitive, range restricted, or protected habitat types are particularly relevant in this context, habitat types of lower sensitivity should not be regarded as ecologically unimportant, as they may perform important landscape-level functions, including serving as stepping stones, dispersal areas, refugia, or movement and migration corridors. Consequently, the ecological significance of habitat loss should be assessed not only in terms of the sensitivity of the vegetation or habitat type itself, but also in relation to its functional role within the broader landscape.

Activities that result in the complete removal of vegetation and associated habitat are inherently destructive on a local scale and may cause permanent loss of habitat structure and ecological functionality. In addition to loss of natural habitat, direct impacts also affect locally endemic and threatened species/populations and habitat that are associated with these taxa. These effects may manifest through reductions in local butterfly species richness, diversity and abundance, loss of habitat-dependent populations, reduced genetic variability, altered population dynamics, impaired species viability and ecosystem-level changes. Although some of these consequences are more relevant to indirect or cumulative impacts, they originate from the direct loss or transformation of habitat and can be particularly difficult to quantify with precision.

Direct impacts are generally relatively easy to identify because their spatial extent and physical causes are clearly associated with specific project activities. They are also generally measurable and predictable, allowing their magnitude and extent to be quantified with a reasonable degree of confidence. However, once a project activity requiring habitat clearance has been authorised, opportunities to avoid or substantially reduce the resulting direct impact are often limited. The most effective means of avoiding such impacts is generally



through the No-Go Option or, more practically, through substantial layout optimisation and the relocation or redesign of infrastructure to avoid sensitive habitat and important ecological features.

Accordingly, the assessment of direct impacts should focus not only on the area of habitat physically affected, but also on the ecological sensitivity, condition, functionality, connectivity and conservation importance of the affected habitat. This provides a more meaningful basis for determining the significance of habitat loss and for identifying opportunities to avoid or reduce impacts through project design and layout optimisation.

Indirect Impacts

Indirect impacts are effects that are not necessarily caused directly by a specific project activity or infrastructure component, but arise through secondary or more complex 'cause-and-effect' pathways. These impacts may, for example, result from dust deposition on vegetation and the associated reduction in photosynthetic capacity, elevated levels of disturbance in areas surrounding the development footprint, or progressive habitat degradation resulting from peripheral effects such as pollution, altered drainage, increased human activity, or the spread of invasive species.

Unlike direct impacts, indirect impacts are often not immediately apparent and may develop progressively over time. They can therefore be difficult to detect or quantify at a single point in time. Such 'spill-over' or 'edge effects' are typically separated from the development footprint both spatially and temporally. Spatially, these impacts may extend beyond the immediate project footprint, while temporally they may occur after the initial disturbance and range from almost immediate responses to effects that develop over several years. Indirect impacts are generally more diffuse and less locally destructive than direct impact and may extend across an area larger than the physical development footprint, although the extent will depend on the nature of the impact pathway and the characteristics of the receiving environment.

The assessment of indirect impacts therefore requires a greater degree of interpretation and professional judgement than is generally required for direct impacts. Their significance is typically estimated through consideration of the characteristics and intensity of the proposed development, the sensitivity and ecological functionality of the surrounding environment, likely impact pathways, and the anticipated magnitude, duration and spatial extent of the resulting effects. Specialist knowledge and, where appropriate, extrapolation from comparable developments or known ecological responses are important in establishing realistic expectations of the likely impact.

Indirect impacts generally cause deterioration or reduced ecological functionality in areas surrounding a development, with a decreasing intensity further away from the source, although the rate and extent of this attenuation are strongly influenced by the relevant impact vector or transport pathway. For example, airborne dust may affect vegetation within a relatively localised area, whereas pollutants transported through drainage systems or rivers may influence receptors considerably further downstream. Similarly, seeds or propagules of alien and invasive species may be transported through river systems and establish populations well beyond the immediate development area, potentially affecting areas tens of kilometres from the source.



The spatial extent of indirect impacts is therefore not necessarily determined by distance from the project alone, but by the characteristics of the pathway through which the impact is transmitted. In many cases, the principal ecological consequence is not an immediate reduction in individual species numbers, but a gradual decline in habitat quality, ecological connectivity and ecosystem functionality within the surrounding landscape. These changes may subsequently influence species occurrence, abundance, movement patterns and population viability, thereby creating secondary ecological consequences that can persist beyond the operational footprint of the development.

Cumulative Impacts

It is firstly important to note that the project cannot mitigate against impacts arising from unrelated developments. The cumulative assessment therefore considers the incremental contribution of the proposed WEF to existing and reasonably foreseeable regional pressures, rather than attributing all regional impacts to the proposed development.

As per DEA's requirements, specialists are required to assess the cumulative impacts. The purpose of the cumulative impact assessment is to establish whether impacts that are associated with the proposed project are relevant within the broader regional context and, specifically, whether the addition of the proposed development at the identified locations would contribute to or intensify existing regional impact patterns.

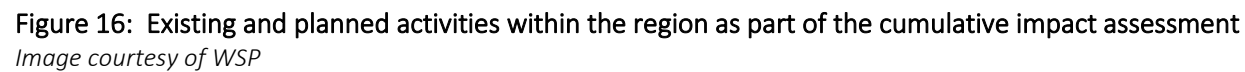
A project may have a low or acceptable impact when assessed in isolation but may cause meaningful collective contribution to impacts when considered in combination with similar and associated activities within the region, particularly where areas of elevated butterfly habitat sensitivity have been identified. These cumulative impacts are primarily associated with the progressive degradation, loss and fragmentation of sensitive butterfly habitat, which may affect population viability, dispersal, movement patterns and ecological connectivity. Over time, such effects may contribute to population declines and, where sufficiently severe and sustained, potentially increase the conservation risk or threat status of affected species.

The assessment of cumulative impacts (from the perspective of this butterfly assessment) therefore considers past, present, and (reasonably foreseeable) future impacts of the development/activity in combination with impacts from existing, authorised or planned similar activities and other land-use activities that are associated with the planned activity within the broader region.

The role of the cumulative assessment is therefore to test if such impacts are relevant to the proposed project in the proposed location (i.e., whether the addition of the proposed project in the area will increase the impact). This section will therefore address whether the proposed development will result in:

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

To assess cumulative impacts of the proposed development, existing and planned developments and applications within the wider region were considered (refer **Figure 14**).





12.3 IDENTIFICATION OF IMPACTS

Direct Impacts:

- Impact 1 Direct losses of sensitive species (Threatened, Near Threatened, Rare, Declining or Protected species) during the construction phase;
- Impact 2 Loss of habitat/areas that are considered suitable/highly suitable for sensitive butterfly species, including habitat losses occurring as a result of the removal of vegetation within development footprints, access and maintenance roads, underneath powerlines, within tower footprints, etc.;

Indirect Impacts:

- Impact 3: Persistent and exacerbated deterioration of sensitive, natural, range restricted, or untransformed habitat that may be present in the immediate or near vicinity to the development footprints, road fringes (fringe effects), specifically relating to habitat types considered suitable/highly suitable for sensitive butterfly species. This also refers to effects such as increased dust (e.g., loss of nectar sources), and contamination of water and soils through rubble, petroleum fuels, pollutants, etc.;
- Impact 4: Disruption of ecological processes, services, ecological functionality (including fire regimes, exacerbated erosion, increase /introduction of invasive species) within surrounding natural habitat;
- Impact 5 Increased disruption of local movement and migration patterns, ecological interaction, and ecological processes that may affect diversity patterns through loss of connectivity (increased fragmentation, barrier effects), and conservation corridor networks in the landscape;

Cumulative Impacts:

- Impact 6: Cumulative losses of species and habitat considered from a wider geographic perspective from similar types of developments, including elevated regional fragmentation and isolation levels; and
- Impact 7: Threshold considerations; the elevation of the conservation status of protected and/or other threatened species through cumulative losses of species and habitat from a wider geographic perspective.



12.4 QUANTIFICATION OF DIRECT AND INDIRECT IMPACTS

Nature of impact:	1. Direct Impact - Direct losses of sensitive species (Threatened, Near Threatened, Rare, Declining or Protected species) during the construction phase.	
	Without mitigation	With mitigation
Extent	3	2
Duration	5	5
Consequence/ Magnitude	10	2
Probability	4	3
Significance	54 (High)	33 (Medium)
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Limited mitigation will be possible through technical and layout design and avoidance strategies.	
Mitigation Measures:	Mitigation will entail avoiding losses of, and providing protection buffers around highly sensitive habitat, limiting development to areas of lower sensitivity. Extent of impact should be limited to areas of lower sensitivity. Ensuring absence of sensitive species through final walkdown and periodic monitoring.	
Cumulative Impacts:	Continued and exacerbated loss and decline of natural habitat on a local and regional scale. Increase in local developments and associated activities that area not always be under direct influence/control of developer. Sensitive habitat types, if not adequately buffered and protected will continuously deteriorate.	
Residual Impacts:	Areas subjected to land clearance will be irreversibly transformed and natural habitat will be lost. Sterilised and fragmented landscapes that are characterised by industrial activities, with isolated portions of remaining natural habitat. The inherent conservation status and -potential of remaining portions of natural habitat will be decreased. Place tower footprints outside recommended 200 m buffer around very high sensitivity habitat.	
Nature:	2. Direct Impact - Loss of habitat/areas that are considered suitable/highly suitable for sensitive butterfly species, including habitat losses occurring because of the removal of vegetation within development footprints, access and maintenance roads, underneath powerlines, within tower footprints, etc.	
	Without mitigation	With mitigation
Extent	2	2
Duration	5	4
Consequence/ Magnitude	10	6
Probability	4	2
Significance	68 (High)	28 (Low)
Status (positive or negative)	Negative	
Reversibility	Irreversible. Habitat transformation generally leads to irreversible impacts as the original status canoe be re-instituted through rehabilitation. Altered landscapes and biological attributes are likely to be less suitable to sensitive species. Protection of sensitive habitat types by means of buffering and activity control measures will cause deterioration and decreasing ecological integrity and functionality.	
Irreplaceable loss of resources?	Yes. Increase in sterilised and fragmented landscapes with only isolated portions of remaining natural habitat in-between will cause decreased conservation status.	
Can impacts be mitigated?	Apart from entirely preventing the activity, the prevention of habitat losses caused by the development is unlikely. It is however also worth noting that even when the project does not take place, the absence of a dedicated conservation/management programme, these sensitive areas does not guarantee the continued preservation of these sensitive areas.	
Mitigation Measures:	Only minor and localised losses are anticipated considering the proposed design. Habitat types of elevated sensitivity/importance on a local/regional scale were already excluded	



	from the development since the scoping phase. General mitigation measures include preventing, or strict control of construction/operational activities within/proximal to these parts of the landscape, while development and implementation of biodiversity monitoring and mitigation programme will guide activities.	
Cumulative Impacts:	Increase in sterilised and fragmented landscapes with isolated portions of remaining natural habitat in between. The inherent conservation status and -potential of remaining portions of natural habitat will be decreased.	
Residual Impacts:	Loss of minor areas of suitable habitat is unavoidable in the present design. Habitat types of elevated sensitivity/importance on a local/regional scale should be excluded from the development (as far as possible), also with reference to the implementation of a suitable buffer around areas of elevated sensitivity nearby to development footprints. No construction/operational activity should be allowed within these areas. Implementation of biodiversity monitoring and mitigation programme is recommended. Place tower footprints outside recommended 200 m buffer around very high sensitivity habitat.	
Nature:	3. Indirect Impact - Persistent and exacerbated deterioration of sensitive, natural, range restricted, or untransformed habitat that may be present in the immediate or near vicinity to the development footprints, road fringes (fringe effects), specifically relating to habitat types considered suitable/highly suitable for sensitive butterfly species. This also refers to effects such as increased dust (e.g., loss of nectar sources), and contamination of water and soils through rubble, petroleum fuels, pollutants, etc.	
	Without mitigation	With mitigation
Extent	2	1
Duration	5	4
Consequence/ Magnitude	8	4
Probability	4	3
Significance	60 (High)	27 (Low)
Status (positive or negative)	Negative	
Reversibility	Low – Moderate	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent through avoidance strategies, layout design, intensive rehabilitation actions in the event of impacts noted and stringent activity control in proximity to these areas.	
Mitigation Measures:	Sensitive areas were already largely excluded from the development, also with reference to the implementation of a suitable buffer around these parts of the landscape – no construction/operational activity should be allowed within these areas. Losses of (sensitive, untransformed) habitat outside development footprints should be avoided. Decline in habitat status of surrounding areas should be avoided through containment of activities. Erosion and pollution prevention. Restrict development to footprint areas only. Development and implementation of biodiversity monitoring and mitigation programme.	
Cumulative Impacts:	Continued and exacerbated loss/decline of natural habitat on a local and regional scale from the development in its totality, as well as considering unintended/peripheral impacts from similar and other activities will lead to exacerbated and continued loss of sensitive habitat types on a local and regional scale.	
Residual Impacts:	Fragmented and deteriorated landscapes that are characterised by similar industrial activities and associated activities, with isolated portions of remaining natural habitat. The inherent conservation status and -potential of remaining portions of natural habitat will be decreased. Ecological functionality of remaining portions of natural habitat might be affected to some extent.	



Nature:	4. Indirect Impact - Disruption of ecological processes, services, ecological functionality (including fire regimes, exacerbated erosion, increase /introduction of invasive species) within surrounding natural habitat.	
	Without mitigation	With mitigation
Extent	3	2
Duration	5	4
Consequence/ Magnitude	6	4
Probability	3	2
Significance	42 (Medium)	20 (Low)
Status (positive or negative)	Negative	
Reversibility	Moderate to poor reversibility	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	Ensure continued and normal ecological functionality of remaining natural habitat surrounding the development. Ensure that no unintended impacts occur, e.g. changed fire regimes. Minimise disruption of ecological functions, e.g. surface water flow, prevent erosion and fires, ensure continued ecological corridor functionality.	
Cumulative Impacts:	Continued and exacerbated loss of natural habitat on a local and regional scale will adversely affect ecological processes, whilst also continue to alter ecological functionality of remaining portions of natural habitat; e.g., decline in surface water quality, exacerbated erosion patterns. Habitat changes also likely as a result of increased invasive presence.	
Residual Impacts:	Highly fragmented landscapes (poor ecological functionality) will ultimately cause depleted biological diversity patterns as species are no longer able to access suitable habitat. With regards to invertebrate constituents, this could also result in lowered pollination success of certain species, which could cause vegetation structure changes and species composition, ecological infrastructure, integrity and functionality.	
Nature:	5. Indirect Impact - Increased disruption of local movement and migration patterns, ecological interaction, and ecological processes that may affect diversity patterns through loss of connectivity (increased fragmentation, barrier effects), and conservation corridor networks in the landscape.	
	Without mitigation	With mitigation
Extent	3	1
Duration	5	2
Consequence/Magnitude	6	2
Probability	3	2
Significance	42 (Medium)	10 (Low)
Status (positive or negative)	Negative	
Reversibility	Irreversible to low reversibility. With continued loss of natural habitat, a decline in ecological connectivity is expected. Migration and movement patterns of certain species that are highly dependent on certain habitat attributes will be permanently affected, while ubiquitous species will exhibit poor adaptability to changed habitat.	
Irreplaceable loss of resources?	Yes. With particular reference to highly sensitive species.	
Can impacts be mitigated?	Yes, to some extent.	
Mitigation Measures:	Ensuring minimal loss of high sensitivity areas, natural habitat. Ensure ecological connectivity and functionality. Develop and implement a biodiversity monitoring programme. Employ immediate and comprehensive rehabilitation of impacts outside development footprints.	
Cumulative Impacts:	Continued and exacerbated loss of natural habitat on a local and regional scale will adversely affect ecological processes, deplete migration corridors and decrease availability of 'ecological 'stepping' stones'.	
Residual Impacts:	Highly fragmented landscapes (poor ecological functionality) will ultimately cause depleted biological diversity patterns as species are no longer able to access suitable habitat as well as adversely affecting movement patterns across the landscape. Reduced	



	migration potential across a landscape, it could also cause lowered pollination success of certain species, which could cause vegetation structure changes and species composition, ecological infrastructure, integrity and functionality.
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12.5 QUANTIFICATION OF CUMULATIVE IMPACTS

Nature:	6. Cumulative Impact - Cumulative losses of species and habitat considered from a wider geographic perspective from similar types of developments, including elevated regional fragmentation and isolation levels.	
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	3	5
Duration	5	5
Consequence/ Magnitude	4	4
Probability	5	2
Significance	60 (High)	28 (Low)
Status (positive or negative)	Negative	
Reversibility	Transformation of natural habitat for industrial purposes is regarded irreversible. Cumulative increase of habitat losses will exacerbate existing impacts on species and populations.	
Loss of resources?	Yes, irreversible when habitat is transformed	
Can impacts be mitigated?	Yes, to some extent.	
Confidence in findings:	High	
Mitigation:	Minimising footprint, protection of highly sensitive features and habitat, prevent infrastructure, rural and infrastructure sprawl, development of research and improvement programmes, collaborative management between role players.	
Nature:	7. Cumulative Impact - Threshold considerations; the elevation of the conservation status of protected and/or other threatened species through cumulative losses of species and habitat from a wider geographic perspective.	
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	4	3
Duration	5	5
Consequence/ Magnitude	8	2
Probability	4	2
Significance	68 (High)	20 (Low)
Status (positive or negative)	Negative	
Reversibility	Irreversible. Loss of species/populations and exacerbation of conservation threat is extremely difficult/highly unlikely/impossible to reverse.	
Loss of resources?	Yes, national and international importance of species	
Can impacts be mitigated?	Yes, to some extent. Difficult to predict and control actions of other role players. Avoidance of high sensitivity areas have already largely been achieved.	
Confidence in findings:	High	
Mitigation:	Minimising footprint, protection of highly sensitive features and habitat, prevent infrastructure, rural and infrastructure sprawl, development of research and improvement programmes, collaborative management between role players on a landscape scale.	



13 MITIGATION RECOMMENDATIONS FOR ANTICIPATED IMPACTS ON BUTTERFLIES

13.1 MITIGATION HIERARCHY BACKGROUND

Mitigation aims to eliminate or reduce negative biodiversity impacts. Mitigation options should generally be considered in the following order of preference:

1. Avoidance of impacts altogether;
2. Reduction of impacts where unavoidable;
3. Restoration of habitats to their original state;
4. Relocation of affected species or habitats; or
5. Compensation for any residual, unavoidable damage.

The mitigation of negative impacts on biodiversity and ecosystem services is a legal requirement for authorisation purposes and must take on different forms, depending on the significance of the impact and the area being affected. Mitigation requires proactive planning that is enabled by following the mitigation hierarchy, illustrated in **Figure 17**. Its application, is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity, where:

Avoiding or preventing impacts – refers to considering options in project location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services, and people. This is the best option but is not always possible if development/construction is to take place. However, there are areas where the environmental and social constraints are too high, and development should not take place. Such areas are best identified early in the development life cycle, so that impacts can be avoided, and authorisations refused. In the case of areas where environmental constraints might be limiting, this includes some ecosystems, habitats, ecological corridors, or areas that provide essential ecosystem services and are of such significant conservation value or importance that their loss cannot be compensated for (i.e., there is no substitute). In such areas, it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation hierarchy (e.g., rehabilitating or offsetting impacts) to provide effective remedy for impacts on biodiversity or ecosystem services. Information about the location of many such areas is available, often making it possible to avoid them.

Reduction of impacts where unavoidable – refers to considering alternatives in the project location, siting, scale, layout, technology, and phasing that would minimise impacts on biodiversity and ecosystem services. Even in areas where the environmental and social constraints are not particularly high for development to proceed/take place every effort should still be made to minimise impacts.

Restoration of habitats to their original state – refers to rehabilitation of areas where impacts were unavoidable, and measures taken to return impacted areas to a condition ecologically similar to the 'pre-development natural state' or an agreed land use after closure. Although rehabilitation is important and necessary, unfortunately even with significant resources and effort, rehabilitation is a limited process that usually falls short of replicating the diversity and complexity of a natural system. Instead, rehabilitation helps to restore some resemblance of ecological functioning in an impacted landscape, to avoid on-going negative impacts, and/or to provide some sort of aesthetic fix for a



landscape. Rehabilitation should occur concurrently or progressively with the proposed activity, and/or on cessation of the activity.

Relocation of affected species or habitat – refers to the physical translocation of affected individuals within the footprint, or adjacent areas, where unavoidable and devastating effects are likely to occur. The translocation of individuals is generally subject to permitting requirements and should be based on a like-for like habitat, taking cognisance of potential impacts such as genetic populations, geographic isolation, etc. The relocation of habitat is generally in severely selective events where small, isolated, and biologically significant habitat can be realistically relocated and reproduced outside the affected footprint. This approach can also be augmented by propagation of certain species.

Offset impacts/Compensation for any residual, unavoidable damage –refers to compensating for remaining and unavoidable negative effects on biodiversity. When every effort has been made to minimise and then rehabilitate remaining impacts to a degree of no net loss of biodiversity against biodiversity targets, biodiversity offsets can provide a mechanism to compensate for significant residual negative impacts on biodiversity.

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives of project location, footprint siting, scale, layout, technology and phasing until the proposed development best ‘suits’ and can be accommodated without significant negative impacts in the receiving environment. In cases where the receiving environment cannot support the development (e.g., there is insufficient water) or where the project will eradicate unique biodiversity, the development may not be feasible; the earlier the developing company knows of these risks, and can plan to avoid them, the better. In cases where biodiversity impacts are likely to be severe, the guiding principle should therefore be to ‘anticipate and prevent’ rather than ‘assess and repair’.

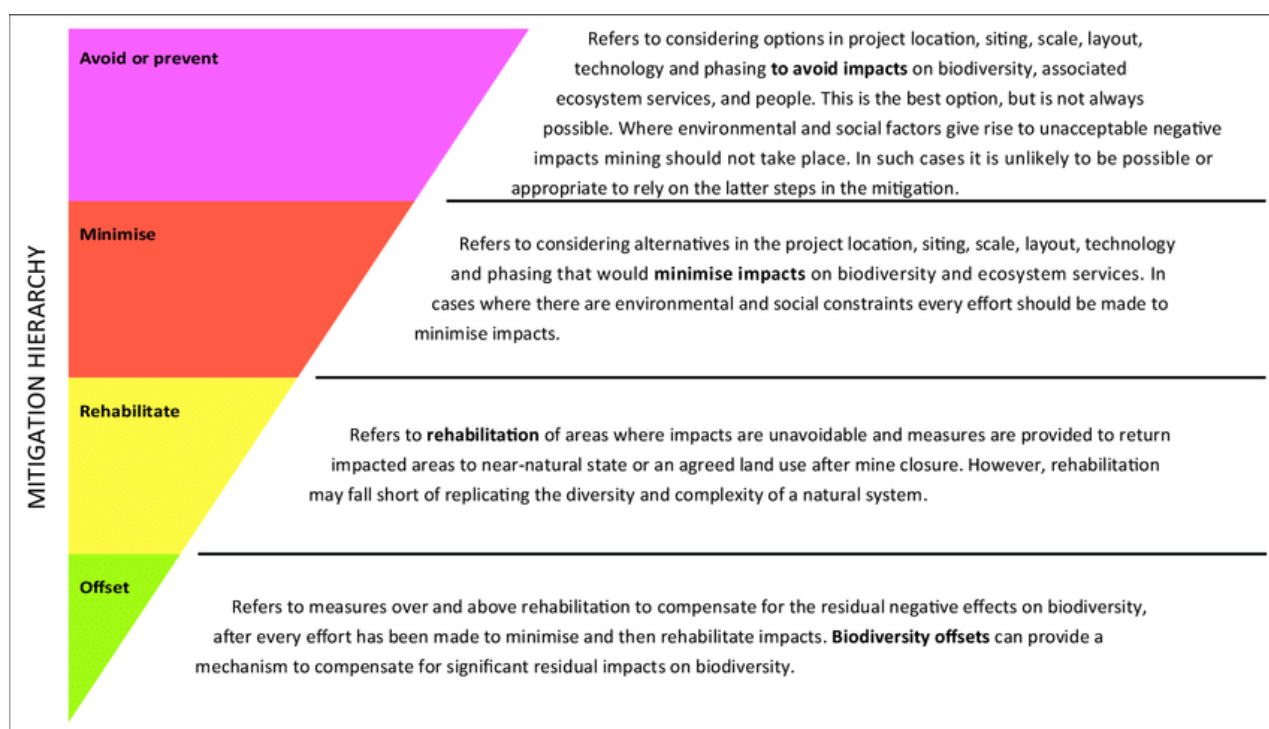


Figure 17: Mitigation hierarchy for dealing with negative impacts on biodiversity



The mitigation approach should be contained in the Environmental Management Programme (EMPr) for the activity, notably for the construction phase, and should be regarded as a 'Living Document' that will be amended and updated as new information becomes evident. The project should consider minimal disturbance and hazards to the surrounding natural environment. The proposed list of mitigation measures is not considered exhaustive and should be updated where additional or unprecedented impacts are noted during construction and operational phases, i.e., the document should be perceived as a 'living' document that addresses impacts, threats, and issues as they become evident.

13.2 APPLICATION OF THE MITIGATION HIERARCHY

To present the effect of impacts on sensitive areas as well as the need for mitigation strategies, the spatial location of development infrastructure in relation to ecological sensitivity was considered during earlier phases of the project. The level of intervention is assessed in this section, based on the estimated impact significance.

13.2.1 THE 'NO-GO' OPTION

The following aspects were considered:

1. Proposed development sites will include several comparatively small footprints, which include a mixture of natural and deteriorated habitat types within a wider region that already exhibits moderate to significant levels of transformation.
2. The regional importance of natural or pristine habitat types, from the perspective of butterfly habitat sensitivity, is considered high. It is however worth noting that most of the High or Very High Sensitivity areas have been effectively avoided through the iterative changes that have been implemented since the scoping phase.
3. Natural habitat types within the project area exhibit high levels of butterfly diversity and are therefore considered important on a local and regional scale.
4. The likely presence of sensitive butterfly species within remaining portions of natural habitat has been indicated in this report. It is nonetheless worth noting that most of the High or Very High Sensitivity areas have been effectively avoided through iterative changes to the project component layouts since the scoping phase of the project.
5. The continuous, timeous and comprehensive implementation of the recommended mitigation approach is expected to ameliorate impacts to an acceptable level.

No impact was identified that would cause irresponsible, unavoidable, unacceptable, or unmanageable consequences on the butterfly components of the project area. Considering the status of the receiving environment and the anticipated significance of impacts on ecological attributes, the No Go option is therefore not considered appropriate for this project.

13.2.2 OFFSET RECOMMENDATIONS

Biodiversity Offset recommendations will be considered should the Competent Authority deem this necessary upon review of this report. The recommendation is that, although considered beneficial, a Biodiversity Offset pertaining to threatened butterfly species, is not presently required for this project.



13.2.3 REHABILITATION APPROACH

The near-permanent nature of the proposed development (> 20 years) and considering continued expansion of similar activities and infrastructure within the immediate surrounds, implies that it is extremely unlikely that the development will be decommissioned within the immediate future. Addressing unforeseen impacts that result from the development in adjacent natural habitat should be attended immediately and dealt with on a case-by-case basis. The implementation of a generic mitigation approach, which should be based on results and recommendations from a dedicated environmental monitoring programme is expected to be successful in preventing any undue impacts in the surrounding natural environment.

13.2.4 EXCLUSION AND AVOIDANCE OF HIGH SENSITIVITY AREAS

Iterative changes to the layout of project components since the scoping phase of the project resulted in avoidance of most of the High Sensitivity areas that were initially identified. Minor conflict areas were subsequently identified where project infrastructure and High Sensitivity areas will overlap, or where turbine footprints are situated in proximity to confirmed localities (although outside a suitable buffer zone), refer **Section 11.4**). These potential conflict areas should be afforded additional attention by means of a monitoring programme and habitat management approach that is considerate of the preservation of habitat conditions.

13.2.5 MINIMIZATION OF IMPACTS

The recommended mitigation approach aims to minimize impacts caused by the development activity within the natural environment. The nature of the development dictates that natural habitat will be entirely compromised during land clearance activities (construction), and the resultant sterile environment will represent the status quo for the development footprint for a considerable time in future. The minimization approach therefore has the objective to limit adverse effects of the development on the surrounding ecological receiving environment and address impacts outside the development footprint caused by the development on a case-by-case basis.

13.2.6 AVOIDANCE OR PREVENTION

The nature of the development and characteristics of natural attributes within the development footprint allows for limited avoidance and prevention strategies. Loss of individual protected plants should be avoided by means of a relocation strategy for certain species.

Avoidance and prevention strategies will mostly be aimed at limiting the uncontrolled spread of impacts caused by the proposed activity into nearby/adjacent natural habitat, notably for declared alien and invasive plant species.

13.2.7 LAYOUT REDESIGN (LOCATION ALTERNATIVES)

Iterative changes of project layout and components since the scoping phase of the project resulted in avoidance of most of the High Sensitivity areas that were initially identified. These included the location of turbine footprints as well as appurtenant project infrastructure, such as laydown areas, substations, powerline servitudes, access and maintenance roads.



13.3 MITIGATION RECOMMENDATIONS

- ⇒ Development and implementation of an Alien and Invasive Plant Species Management Plan to combat the presence and exacerbation of invasive species within development areas.
- ⇒ Potential conflict areas where development/infrastructure will cause unavoidable impacts and habitat loss should be inspected during a high season (species – appropriate) season survey to ascertain the absence of threatened or protected butterfly species from the proposed development footprints.
- ⇒ Areas where maintenance and access roads are planned that could potentially result in impacts on sensitive habitat or threatened species, should be inspected during a high season (species – appropriate) season survey to ascertain the absence of threatened or protected butterfly species from proposed development footprints.
- ⇒ No development should be allowed in wetland habitat types. In addition, wetlands, ephemeral habitat types, riparian zones should be afforded a protective buffer to avoid unnecessary impacts that could result in deterioration of existing habitat conditions.
- ⇒ Areas where turbine footprints and other transformative infrastructure are planned should be inspected prior to any construction activity to confirm the absence of threatened or protected invertebrate species.
- ⇒ Construction activities in proximity to sensitive habitat should be restricted to periods when sensitive species life cycles are low, i.e., generally during the autumn and winter periods.
- ⇒ Dedicated management plans for water crossings, laydown areas and construction sites should be compiled, with specific reference to the prevention of surface water pollution (water crossings, wetlands, etc.) ground water pollution, or any form of hydrocarbon contamination.
- ⇒ Development/construction areas should be demarcated by semi-permanent means to avoid impacts in adjacent areas, with specific reference to activities in proximity to areas of elevated sensitivity. No personnel or vehicle movement or construction activities outside designated construction areas should be allowed.
- ⇒ Development and implementation of an annual (post construction) butterfly monitoring project (as part of an encompassing biodiversity monitoring programme) that will objectively assess changes in butterfly diversity, abundance, sensitive species, habitat status, impacts, and relevant mitigation recommendations.
- ⇒ Develop an understanding of appropriate fire regimes, preventing ‘out of season’ fire events and instituting appropriate fire regimes that are considerate of the local ecology (e.g., grassland, savanna, etc.). A single, generic burning regime across the entire WEF is not necessarily appropriate; different habitat types should be considered individually.
- ⇒ Develop and promote an understanding of an appropriate grazing and herbivore management strategy that will be beneficial to the local and regional ecology to promote diversity and ecological status.
- ⇒ Prohibit or strictly control the use of broad-spectrum insecticides and unnecessary herbicide application in retained butterfly habitat. Where vegetation control is necessary, use targeted methods and maintain pesticide-free buffer areas around breeding habitat and important nectar/host plants. The use of manual control methods is preferred and advised.



- ⇒ Restore disturbed areas with locally indigenous vegetation, prioritising the actual host and nectar plants of the affected species rather than generic grass-seed mixes. Restoration should aim to recreate functional habitat, not simply achieve vegetation cover.
- ⇒ Minimise unnecessary night-time lighting around substations, buildings, roads and construction areas, particularly near known sensitive *Lepidoptera* habitat. Use the lowest practical intensity, directional/shielded fittings and avoid illumination of surrounding natural vegetation.



14 APPENDIX 1: SYNOPTIC CV: REINIER F. TERBLANCHE

Reinier is an ecologist and in particular a habitat specialist with an exceptional combination of botanical and zoological expertise which he keeps fostering, updating and improving. He is currently in the process of completing a PhD research project for which he registered at the Department of Conservation Ecology at the University of Stellenbosch, focussing on the landscape ecology of selected terrestrial and wetland butterflies in South Africa. Reinier's experience includes being a lecturer in ecology and zoology at the North West University, Potchefstroom Campus (1998-2008). Reinier frequently collaborates with institutes, organizations and universities on animal, plant and habitat research.

Qualifications:

Qualification	Main subject matter	University
M.Sc. <i>Cum Laude</i> , 1998: Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
B.Sc. Hons <i>Cum Laude</i> , 1992: Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy, Taxonomy, Modern Systematics, System Modelling, Plant Ecology, Taxonomy Project, Statistics Attendance Course.	North-West University, Potchefstroom
B.Sc. Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
Higher Education Diploma, 1990	Numerous subjects aimed at holistic training of teachers.	North-West University, Potchefstroom

In research, Reinier specializes in conservation biology, threatened butterfly species, vegetation dynamics and ant assemblages at terrestrial and wetland butterfly habitats as well as enhancing quantitative studies on butterflies of Africa. He has published extensively in the fields of taxonomy, biogeography and ecology in popular journals, peer-reviewed scientific journals and as co-author and co-editor of books (see 10 examples below).

Reinier practices as an ecological consultant and has been registered as a Professional Natural Scientist by SACNASP since 2005 (Reg. No. 400244/05). His experience in consultation includes:

- ⇒ Flora and fauna habitat surveys;
- ⇒ Threatened species assessments;
- ⇒ Riparian vegetation index surveys;
- ⇒ Compilation of Ecological Management Plans;
- ⇒ Biodiversity Action Plans;
- ⇒ Status quo of biodiversity for Environmental Management Frameworks;
- ⇒ Wetland Assessments; and
- ⇒ Management of Rare Wetland Species.

Recent activities/awards:

- ⇒ Best Poster Award at Oppenheimer De Beers Group Research Conference 2015, Johannesburg;
- ⇒ Co-author of Guidelines for Standardised Global Butterfly Monitoring, 2015, Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany (UNEP-WCMC), GEO BON Technical Series 1;
- ⇒ Awarded the prestigious Torben Larsen Memorial Tankard in October 2017; awarded annually to the person responsible for the most outstanding written account on Afrotropical Lepidoptera;
- ⇒ Lectured as Conservationist-in-Residence in the Wildlife Conservation Programme of the African Leadership University, Kigali, Rwanda, 9-23 February 2019.
- ⇒ Won a photographic competition which resulted in his photograph of the Critically Endangered *Eriksonia edgei* (Waterberg Copper) being published on the front cover of the Synthesis Report of the National Biodiversity Assessment (2018) prepared by SANBI.

**Experience:**

Lecturer: Zoology (1998-2008)	Main subject matter and level	Organization
Lectured subjects	- 3 rd year level - Ecology, Plant Parasitology - 2 nd year level - Ethology <i>Master's degree</i> Evolutionary Ethology, Systematics in Practice, Morphology and Taxonomy of Insect Pests, Wetlands.	North-West University, Potchefstroom and University of South Africa
Co-promoter	PhD: Edge, D.A. 2005. Ecological factors that influence the survival of the Brenton Blue butterfly	North-West University, Potchefstroom
Study leader/assistant study leader	Six MSc students, One BSc Honours student: Various quantitative biodiversity studies (terrestrial and aquatic).	North-West University, Potchefstroom
Teacher (1994-1998)	Biology and Science, Secondary School	Afrikaans Hoër Seunskool, Pretoria
Owned Anthene Ecological CC (2008 – present)	- Flora and Fauna habitat surveys - Highly specialized ecological surveys - Riparian vegetation index surveys - Ecological Management Plans - Biodiversity Action Plans - Biodiversity section of Environmental Management Frameworks - Wetland assessments	Private Closed Corporation that has been subcontracted by many companies
Herbarium assistant 1988-1991	Part-time assistant at the A.P. Goossens Herbarium, Botany Department, North-West University, 1988, 1989, 1990 and 1991 (as a student).	North-West University, Potchefstroom

EXAMPLES OF PUBLICATIONS OF WHICH R.F. TERBLANCHE IS AUTHOR/CO-AUTHOR

(Three books, two chapters in books and five articles are listed here as examples)

1. HENNING, G.A., **TERBLANCHE, R.F.** & BALL, J.B. (eds). **2009.** *South African Red Data Book: butterflies.* SANBI Biodiversity Series 13. South African National Biodiversity Institute, Pretoria. 158p. ISBN 978-1-919976-51-8.
2. MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M., PRINGLE, E.L., **TERBLANCHE, R.F.** & WILLIAMS, M.C. (eds). **2013.** *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and atlas.* Safronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
3. VAN SWAAY, C., REGAN, E., LING, M., BOZHINOVSKA, E., FERNANDEZ, M., MARINI-FILHO, O.J., HUERTAS, B., PHON, C.-K., KÖRÖSI, A., MEERMAN, J., PE'ER, G., UEHARA-PRADO, M., SÁFIÁN, S., SAM, L., SHUEY, J., TARON, D., **TERBLANCHE, R.F.** & UNDERHILL, L. **2015.** Guidelines for Standardised Global Butterfly Monitoring. Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany. GEO BON Technical Series 1.
4. **TERBLANCHE, R.F.** & HENNING, G.A. **2009.** *A framework for conservation management of South African butterflies in practice.* In: Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds). *South African Red Data Book: Butterflies.* SANBI Biodiversity Series 13. South African National Biodiversity Institute, Pretoria. p. 68 – 71.
5. EDGE, D.A., **TERBLANCHE, R.F.**, HENNING, G.A., MECENERO, S. & NAVARRO, R.A. **2013.** Butterfly conservation in southern Africa: Analysis of the Red List and threats. In: Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds). *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* pp. 13-33. Safronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
6. **TERBLANCHE, R.F.**, SMITH, G.F. & THEUNISSEN, J.D. **1993.** Did Scott typify names in *Haworthia* (Asphodelaceae: Aloioideae)? *Taxon* **42**(1): 91-95. (International Journal of Plant Taxonomy).
7. **TERBLANCHE, R.F.**, MORGENTHAL, T.L. & CILLIERS, S.S. **2003.** The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* **46**(1): 73-90.
8. EDGE, D.A., CILLIERS, S.S. & **TERBLANCHE, R.F.** **2008.** Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* **104**: 505-510.
9. GARDINER, A.J. & **TERBLANCHE, R.F.** **2010.** Taxonomy, biology, biogeography, evolution and conservation of the genus *Erikssonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.
10. **TERBLANCHE, R.F.** **2016.** *Acraea trimeni* Aurivillius, [1899], *Acraea stenobea* Wallengren, 1860 and *Acraea neobule* Doubleday, [1847] on host-plant *Adenia repanda* (Burch.) Engl. at Tswalu Kalahari Reserve, South Africa. *Metamorphosis* **27**: 92-102.



15 APPENDIX 2: LEGISLATIVE BACKGROUND

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

- (a) Details of:
 - (i) The person who prepared the report, and
 - (ii) The expertise of that person to carry out the specialist study or specialised process;
- (b) A declaration that the person is independent in a form as may be specified by the competent authority;
- (c) An indication of the scope of, and the purpose for which, the report was prepared;
- (d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
- (e) A description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- (g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
- (h) A summary and copies of any comments that were received during any consultation process;
- (i) Any other information requested by the competent authority.

Compliance with provincial, national, and international legislative aspects is strongly advised during the planning, assessment, authorisation, and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to the following:

Table 9: Legislative considerations relevant to this project

Legislation	Relevance
Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001	Declared Weeds and Invaders in South Africa are categorised according to one of the following categories: <ul style="list-style-type: none"> o Category 1 plants: are prohibited and must be controlled. o Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread. o Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodlines of watercourses and wetlands.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement 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.
Environmental Management Act (No. 107 of 1998)	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 wellbeing. 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



Table 9: Legislative considerations relevant to this project

<i>Legislation</i>	<i>Relevance</i>
	<p>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.</p> <p>EMA requires, inter alia, that:</p> <ul style="list-style-type: none"> ○ “development must be socially, environmentally, and economically sustainable”; ○ “disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied”, ○ “a risk-averse and cautious approach is applied, that considers the limits of current knowledge about the consequences of decisions and actions”.
National Environmental Management: Biodiversity Act (Act No 10 of 2004) (NEMBA)	<p>To provide for management and conservation of South Africa’s biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.</p>
	<p>As the principal national act regulating biodiversity protection, NEMBA (DFFE), is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. In terms of NEMBA, the developer has a responsibility for:</p> <ul style="list-style-type: none"> ○ The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations). ○ Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all developments in the area are in line with ecological sustainable development and protection of biodiversity. ○ Limit further loss of biodiversity and conserve endangered ecosystems. Chapter 4 of the Act relates to threatened or protected ecosystems or species.
National Environmental Management Act (No 10 of 2004)	<p>According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":</p> <ul style="list-style-type: none"> ○ A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. <p>Such activities include any that are “of a nature that may negatively impact on the survival of a listed threatened or protected species”.</p> <p>This section also provides for the consideration of the following:</p> <ul style="list-style-type: none"> ○ Alien and invasive species, as depicted by various Acts and relevant legislation; ○ Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection; ○ GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List; ○ GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List; and ○ Government Notice No. 40733 of 2017: FINAL National Biodiversity Offset Policy.
National Environmental Management Protected Areas Act, No. 57 of 2003	<p>To provide 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.</p>
National Forest Act of 1998	<p>Provides for the protection of certain tree species, groups of trees, woodland or forests as declared by the minister and prohibits the destruction of indigenous trees in any natural forest without a licence</p>



16 APPENDIX 3: IMPACT ASSESSMENT METHOD

To ensure standardisation of the Impact Assessment Process and the successful integration of specialist findings, a standard ratings approach is employed to establish the significance of anticipated and likely impacts on the receiving environment.

The potential environmental impacts associated with the project will be evaluated according to:

- ⇒ The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- ⇒ The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being local/site of development and 5 being international):
- ⇒ The **duration**, wherein it will be indicated whether:
 - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
 - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
 - medium-term (5–15 years) – assigned a score of 3;
 - long term (> 15 years) - assigned a score of 4; or
 - permanent - assigned a score of 5;
- ⇒ The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- ⇒ The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- ⇒ the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- ⇒ the status, which will be described as either positive, negative or neutral.
- ⇒ the degree to which the impact can be reversed.
- ⇒ the degree to which the impact may cause irreplaceable loss of resources.
- ⇒ the degree to which the impact can be mitigated.

The significance is calculated by combining the criteria in the following formula:

$$S = (E + D + M) \times P$$

(S = Significance weighting, E = Extent, D = Duration, M = Magnitude, P = Probability)

The significance weightings for each potential impact are as follows:

- ⇒ < 30 points: Low (i.e., where this impact would not have a direct influence on the acceptability of the development footprint, or the decision process to develop in the area),
- ⇒ 30-60 points: Medium (i.e., where the impact could influence the acceptability of the development footprint, or the decision process to develop in the area unless it is effectively mitigated),
- ⇒ > 60-90 points: High (i.e., where the impact must have an influence on the acceptability of the development footprint, or the decision process to develop in the area).
- ⇒ > 90 points: Very High (i.e., where the impact must have an influence on the acceptability of the development footprint, or the decision process to develop in the area, and may constitute a fatal flaw where motivated by a specialist consultant)



17 APPENDIX 4: COMMENTS RECEIVED FROM I&APS

Date of Comment, Format of Comment, Name of Organisation/I&AP	Comments	Response (Butterfly Specialist)	Report Reference
Mpumalanga Tourism and Parks Agency (MTPA)	<p>Butterfly Habitat Monitoring: Population monitoring for the Heidelberg Copper butterfly must be incorporated into the post-construction monitoring programme, with surveys conducted annually during appropriate flight seasons to assess population trends and the effectiveness of habitat management measures.</p>	In addition to avoidance mitigation options at potential conflict sites, the inclusion of a population monitoring programme as part of the mitigation recommendations will be prioritised. Notably, it will be recommended that population monitoring be done during typical emergence/presence periods (e.g., September, December to January), specifically at habitats/sites that are closest or within range of proposed turbines following the construction phase.	Detailed mitigation priorities are included in the EIA report
	<p>Invertebrate Sensitivities - Heidelberg Copper butterfly (<i>Chrysoritis aureus</i>): The MTPA requires strict adherence to the specialist-identified High and Very High Sensitivity areas for the Heidelberg Copper butterfly, as the primary means of reducing potential negative impacts on this taxon. As a lycaenid butterfly, the Heidelberg Copper is predominantly a low-flying species, typically recorded within one to two metres above the ground surface, and direct collision with turbine blades is therefore not considered the primary risk.</p>	<p>Noted and agreed. Layout changes subsequent to the submission of the draft scoping report has already considered layout changes to exclude most High Sensitivity areas. Exclusion of Very High Sensitivity areas will greatly reduce anticipated and likely impacts on areas of suitable habitat for the species. Also, the specialist has indicated that some considerations can be provided in High Sensitivity areas, as per the shapefiles, where certain areas might be suitable for limited development options. These areas should be monitored as part of a biodiversity monitoring programme.</p> <p>Agreed with risks from turbine blades. Direct impacts to individuals are not a great concern at this stage, habitat loss from development footprints, and construction/access roads, and laydown areas represent a major consideration at this stage.</p>	Reference to confirmed distributional data provided by MTPA are included in the maps, discussions, habitat sensitivity, and development recommendations.
	<p>It is noted that an estimated 83 individual Heidelberg Copper butterflies have been recorded within the project area and project footprint. The MTPA strongly recommends the development of a Biodiversity Management Plan (BMP) specifically addressing the conservation management requirements of this species, incorporating active management of fire regime, maintenance and restoration of suitable habitat, and targeted alien invasive plant control.</p>	<p>The specialist will liaise with MTPA to obtain latest observation records for the project area and augment/amend maps and sensitivities where necessary as part of the EIA report.</p> <p>The recommendation of a BMP will be included as part of EIA recommendations, with specific reference to suggested components.</p> <p>Not entirely certain about the 83 Heidelberg Copper observations. It is likely a referral to 83 butterfly species mentioned in the Executive Summary?</p>	Reference to confirmed distributional data provided by MTPA are included in the report.



Date of Comment, Format of Comment, Name of Organisation/I&AP	Comments	Response (Butterfly Specialist)	Report Reference
	In respect of turbine WT-14, the blade sweep area overlaps with a High Sensitivity area for the Heidelberg Copper. An adjustment to the positioning of this turbine is required. As previously noted, the MTPA recommends that WT-14 be relocated southwards or removed from the layout.	Noted. Avoidance as an initial strategy will be preferred. As mentioned earlier, the <u>limited</u> development of some High Sensitivity areas might be possible, with the additional inclusion of periodic monitoring of these areas to establish the status of sensitive species in these parts. As part of technical considerations, the proposed development layout indicates that the position of WT-14 has been adjusted to lower sensitivity areas. A brief review of the MBSP (2014) plan indicates that the turbine position is also placed outside CBA areas.	Reference to confirmed distributional data provided by MTPA are included in the, adjustment of turbine position has been included in subsequent iterations of project footprint.
	<u>Biodiversity Management Plan for the Heidelberg Copper and Associated Grassland Habitats:</u> A site-specific Biodiversity Management Plan (BMP) must be developed for the Heidelberg Copper butterfly and its associated grassland habitats, to be implemented throughout the operational lifespan of the project.	Noted, comments as above.	Recommendations pertaining to management plans included in mitigation approach
	The BMP must incorporate a fire management plan designed to maintain suitable open grassland structure for butterfly populations, avoiding both excessive burning and the encroachment of woody vegetation.	Noted, comments as above.	Recommendations pertaining to fire regime management included in mitigation approach
Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)	Invertebrates: 24. An Ecological Invertebrate Habitat Survey (which starts on Page 82 of Appendix G2), was undertaken due to sensitivities identified for a number of threatened butterfly species that are highlighted in the Environmental Screening Report, including the Endangered Heidelberg Copper (<i>Chrysoritis aureus</i>). MTPA has records of the species occurring on the site (in Mpumalanga), however the specialist concluded that the site “appears to be less than suitable” for its presence, although did confirm that the host plant was recorded at several places on rocky ridges within the site. Nevertheless, the specialist assigned a rating of Very High	The specialist will ensure to liaise with MTPA, DARDLEA to ensure that all historical records are included, and to confirm accurate correlation with the Very High Sensitivity/No-go Areas confirmed during scoping. <i>As a sidenote, it is interesting that the Environmental Screening Report did not reflect these records. Typically, the confirmed records for Endangered taxa should yield a High or Very High Sensitivity in the Environmental Screening Report for the relevant parts of the project area. The information might be very recent and not yet captured as part of the sources for the National Environmental Screening Tool.</i> Distribution patterns of <i>Chrysoritis aureus</i> are much more restricted than the host plant <i>Clutia pulchella</i> ; the presence of <i>Clutia</i> represents only one	Refer Section 10.3.1 and Table 4 for clarified response. Also note that MPTA distributional data are included in this report, maps, discussion and ultimate recommendations. Suitable adjustment of potential conflict situations has been achieved.



Date of Comment, Format of Comment, Name of Organisation/I&AP	Comments	Response (Butterfly Specialist)	Report Reference
	Sensitivity (No-Go) to certain areas where <i>C. aureus</i> has historically been found. The Specialist must liaise with MTPA to ensure that their historical records are included in the 'No-Go' areas.	of the critical habitat requirements. As mentioned, a Very High Sensitivity was precautionary assigned to all areas considered highly suitable, which were excluded from subsequent iterations of the layout footprint.	
	25. The specialist concluded that “provided the wind energy infrastructure is micro-sited to areas of lower anticipated sensitivities, habitats that sustain a high diversity of butterfly species could be safe guarded”. Furthermore, it is noted that the layout has changed since the Ecological Invertebrate Habitat Survey was undertaken. The Ecological Invertebrate Specialist must verify that all recommendations have been implemented, including any updates provided as part of the EIA specialist assessment, and any updates to the categories for butterfly ecological sensitivity.	<p>The development of a detailed mitigation approach that is cognisant of the Mitigation Hierarchy will be included in the EIA report. Typically, avoidance is preferred. The proposed layout is largely considerate of high sensitivity areas. Areas of minor impacts should be included in a periodic biodiversity monitoring programme.</p> <p>It is worth noting that the scoping phase of the project aimed to provide a qualitative evaluation of habitat sensitivity pertaining to butterfly SCC. The execution of a detailed and quantitative survey across a project area that is in excess of 8,000 ha is not possible within EIA timeframes and efforts to confirm habitat sensitivity were focused in certain areas.</p> <p>Final layout, tower positions, access/construction/maintenance roads represent the important activities and components of the project in the context of avoiding impacts on butterfly SCC; the EIA report will be cognisant of the latest project layout and configuration in order to highlight areas of potential conflict and to ensure that these areas have effectively been excluded from the development footprint.</p> <p>Distributional information pertaining to the relevant butterfly SCC, with specific reference to MTPA observation records, will be used to augment results of the study. It is also worth noting that the conservation status (national and international) of species is continually being updated to reflect new data and information on certain species. Although considered unlikely for these relevant species, care will be taken to ensure the latest conservation status in the EIA report.</p>	Detailed mitigation priorities and updated development footprint maps are included in the EIA report
	26. The specialist must also confirm whether the persistence of important butterfly species in the no go	Habitats of <i>Chrysoritis aureus</i> (the Heidelberg Copper) most likely require fire from time to time to maintain suitable habitat conditions. This means	Detailed mitigation priorities and monitoring



Date of Comment, Format of Comment, Name of Organisation/I&AP	Comments	Response (Butterfly Specialist)	Report Reference
	areas will require management interventions e.g., burning regimes, monitoring etc. if the WEF and associated infrastructure is developed.	that if habitats are close by proposed locations of turbines a practical and suitable fire regime should be implemented. The development and implementation of a BMP and post-construction monitoring regime will form a critical recommendation for implementation after construction.	recommendations are included in the EIA report
Adjacent Landowner Jaun Venter 15 April 2026 Email	My concerns are as follows: 1. Impact on Birdlife and Biodiversity The presence of sensitive species such as the Heidelberg copper butterfly raises further ecological concerns.	The Heidelberg Copper (<i>Chrysoritis aureus</i>) is associated with very localized areas and also with extremely defined (narrow) habitat and life requirements. This means that with careful consideration of the location of the wind turbines (and other components) the proposed development and the conservation of the localized butterfly species could be compatible, particularly with the implementation of a dedicated (post-construction) monitoring programme that aims to increase awareness and conservation of the species as well as the implementation of a BMP. The development and execution of a periodic biodiversity monitoring programme for the project is recommended to evaluate potential conflict areas on a case-by-case basis.	Detailed mitigation priorities and monitoring recommendations are included in the EIA report



17.1 GENERAL COMMENTS ON RESPONSES RECEIVED

- ⇒ Walks across habitats from the lowest to highest points in the project area during the scoping assessment confirmed that the Threatened *Chrysoritis aureus* butterfly species is a key issue within the project area, despite no observations made during the initial surveys. However, confirmed localities of this species has been supplied by MPTA, which have been included in the mapping, sensitivity analysis, and recommendations of this EIA report.
- ⇒ The absence of other localized threatened butterfly species, e.g., the localized threatened *Lepidochrysops praeterita* that is dependent on *Ocimum obovatum*, could be confirmed by ground truthing in specific areas.
- ⇒ The exploration and evaluation of habitats within the site indicated that the proposed development and project components, with careful consideration of the locations of the wind turbines during the EIA phase, is unlikely to cause significant impacts on invertebrates of conservation concern; the Precautionary Principle will nonetheless be employed where any uncertainty is encountered.
- ⇒ Many areas were noted within the project area where *Clusia pulchella* (host plant species for *Chrysoritis aureus*) is present, but the absence of other habitat and/or life requirements of the butterfly species ultimately render their presence uncertain or unlikely, which seemingly is in accordance with research about the habitat and life requirements of the butterfly (see Henning, Terblanche & Ball, 2009, Terblanche, Morgenthal & Cilliers, 2003, Terblanche & van Hamburg, 2003, Terblanche & van Hamburg, 2004, Mecenero *et al.*, 2013). Notably, localised bush encroachment could potentially have caused deterioration of suitable habitat for *Chrysoritis aureus*. This factor should ideally be further investigated (although beyond the scope of this study and project). During the time of the scoping surveys the typical feeding marks of caterpillars of *Chrysoritis aureus*, or absence thereof, in conjunction with suitable (more treeless habitat) have also been used to augment tentative scoping results. Current indications of suitable habitat in the project area are therefore precautionary, but the confidence for the absence of *Chrysoritis aureus* at very large areas of the site is already high. Notwithstanding these initial results, supplementary distribution records from DARDLEA/MTPA will be obtained and incorporated with results and also considered in more detail during the EIA phase of the project to increase confidence about the presence or absence of *Chrysoritis aureus*, specifically around potential conflict areas that have been indicated during the scoping process.
- ⇒ Surveys that focus on *Chrysoritis aureus* in particular should be conducted as part of the post-construction monitoring programme.



18 CONDITIONS, LIMITATIONS AND ASSUMPTIONS

- ⇒ Findings, results, observations, conclusions and recommendations presented in this report are based on the authors' best scientific and professional knowledge as well as the interpretation of information available to them at the time of compiling this report.
- ⇒ Due care and diligence were exercised by the authors in rendering services, preparing this document and executing responsibilities as specialist consultants.
- ⇒ It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true.
- ⇒ Even though care is taken to ensure the accuracy of surveys, data analysis and other aspects of this report, it should be noted that ecological/biodiversity studies, notably for EIA purposes, are limited in time, budget and scope. It is not the purpose of this report to present exhaustively detailed information. Decisions and discussions are therefore, and to some extent, based on reasonable and informed interpretations and assumptions that are extracted from *bona fide* information sources and from deductive reasoning (Precautionary Principle).
- ⇒ To obtain a comprehensive understanding of the dynamics of terrestrial ecological and diversity patterns, with particular reference to endemic, rare, or threatened species in any area, biodiversity assessments should ideally consider investigations at different time scales (across seasons/years) and through replication. However, such long-term studies are generally not part of the terms of reference for EIA assessments.
- ⇒ Results presented in this report are based on a snapshot investigation of the project area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the project area. Specifically, no discipline-specific, long-term survey methods were used in the collation of data from the site. Although as much as possible data was obtained from opportunistic observations during the brief survey period, these surveys are customarily limited by budgetary and time constraints – results presented in this report need to be interpreted with these limitations in mind.
- ⇒ Background information that was used to inform and augment the assessment was limited to data and GIS coverage available for the project site on a relevant scale. A paucity of site-specific data is typical of these data sources and should be accepted as a norm.
- ⇒ Notably, rare and endemic species normally do not occur in great densities and, because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible. Results are ultimately based on estimations and specialist interpretation of imperfect data.
- ⇒ It is emphasised that information, as presented in this document, only have bearing on the sites as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.
- ⇒ Additional or supplementary information may become known during a later stage of the process or development. The authors therefore reserve the right to modify aspects of the report, including findings and recommendations, should new information become available from ongoing research or additional work performed in the immediate region of this specific area, or any forthcoming information pertaining to this investigation after the submission of this report.
- ⇒ The respective companies and specialists therefore do not accept any liability for conclusions, suggestions, limitations and recommendations made in good faith, based on available information, or based on data that was obtained from surveys of a brief nature.
- ⇒ This report should always be considered in its entirety. Reading and representing portions of the report in isolation could lead to incorrect conclusions and assumptions. In case of any uncertainty, the authors should be contacted to clarify any viewpoints, recommendations and/or results.

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