Botanical Assessment for the proposed development of a Doringrivier Solar Energy Facility 1 on Portion 21 of Farm Doorn River 330, Theunissen , Free State Province

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Report compiled for: EnviroAfrica CC
Client: Keren Energy

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National Legislation and Regulations governing this report

This is a 'specialist report' and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2014.

Appointment of Specialist

David J. McDonald of Bergwind Botanical Surveys & Tours CC was appointed by EnviroAfrica CC to provide specialist botanical consulting services for the assessment of the area for the proposed development of a solar farm on Portion 21 of Farm Doorn River 330, Theunissen, Free State Province.

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Expertise

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- Qualifications: BSc. Hons. (Botany), MSc (Botany) and PhD (Botany)
- Botanical ecologist with over 40 years' experience in the field of Vegetation Science.
- Founded Bergwind Botanical Surveys & Tours CC in 2006
- Has conducted over 600 specialist botanical / ecological studies.
- Has published numerous scientific papers and attended numerous conferences both nationally and internationally (details available on request)

Curriculum Vitae – Appendix 1

Independence

The views expressed in the document are the objective, independent views of Dr McDonald and the study was carried out under the aegis of, Bergwind Botanical Surveys and Tours CC. Neither Dr McDonald nor Bergwind Botanical Surveys and Tours CC have any business, personal, financial or other interest in the proposed development apart from fair remuneration for the work performed.

Conditions relating to this report

The content of this report is based on the author's best scientific and professional knowledge as well as available information. Bergwind Botanical Surveys & Tours CC, its staff and appointed associates, reserve the right to modify the report in any way deemed fit should new, relevant or previously unavailable or undisclosed information become known to the author from on-going research or further work in this field, or pertaining to this investigation

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Declaration of independence:

I David Jury McDonald, as the appointed Specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
  - other than fair remuneration for work performed in terms of this application, have no business, financial, personal or other interest in the development proposal or application and that there are no circumstances that may compromise my objectivity; or
  - am not independent, but another specialist (the "Review Specialist") that meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, have throughout this EIA process met all of the requirements;
- have disclosed to the applicant, the EAP, the Review EAP (if applicable), the Department and I&APs all material information that has or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application; and
- am aware that a false declaration is an offence in terms of Regulation 48 of the EIA Regulations, 2014 (as amended).

Signature of the specialist:

Bergwind Botanical Surveys & Tours CC

Name of company:

18 August 2022; 25 January 2023

Date:

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1. Background and Brief

Bergwind Botanical Surveys & Tours CC was appointed by EnviroAfrica CC on behalf of Keren Renewable Energy Pty Ltd (the 'Applicant') to undertake a botanical assessment to determine the botanical sensitivity and suitability of the area proposed for development of a solar facility on Portion 21 of Farm Doorn River 330, Theunissen, Free State Province. The solar facility would be connected to the Eskom Theseus Substation that is near the site of the proposed solar facility.

The study is conducted in terms of the National Environmental Management Act (NEMA) (No.7 of 1998) as amended and the 2014 Environmental Regulations. The protocols pertaining to terrestrial ecological specialist assessments are applied (GN 320 of 2020).

2. Terms of Reference

- Take cognizance of, and comply with, the substantive content requirements outlined within Appendix 6 of GN R982, as amended (i.e. GN 326), which outlines the legal minimum requirements for specialist studies in terms of the 2014 NEMA EIA Regulations, as amended;
- Adhere to the protocols applicable to specialist for environmental impact assessments (Government Gazette, 2020).
- Investigate the area proposed for the solar farm and determine its botanical sensitivity and possible constraints that would prevent solar farm development.
- Described the local and regional context of the vegetation communities and plant species within the affected areas.
- The ecosystem status and conservation value of the vegetation communities, including the whether the potentially affected areas comprise critically endangered or endangered ecosystem(s) listed in terms of Section 52 of the NEMBA;
- Record any rare or endangered species encountered or likely to be or have been present.
- The presence of and proximity of the proposed site to protected area(s) identified in terms of NEMPAA and proximity to a Biosphere Reserve (where relevant) (within, at least, a 20km radius of the site).

3. Project Area

3.1 Locality and Extent

Portion 21 of Farm Doorn River 330, Theunissen, lies approximately 10 km southwest of the town Virginia, in the Free State Province (Figure 1). The property is 355 ha in extent. Importantly, this farm is near the Eskom Theseus Substation which is a suitable connection point to the national grid for any solar PV plant that may be built in the area.

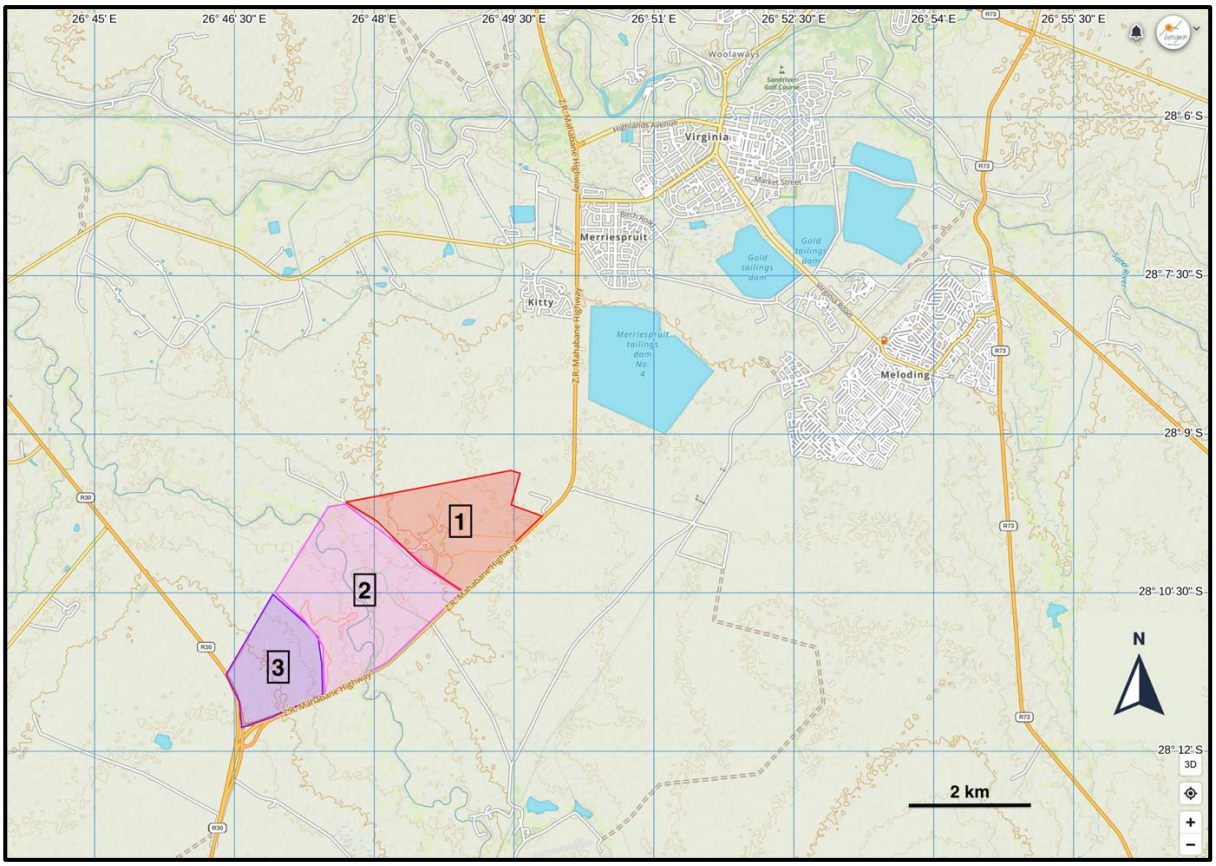


Figure 1. Topographical map of the general location of Portion 21 of Farm Doorn River 330, Theunissen (shown as 1 and shaded red on the map) where the proposed Doringrivier Solar 1 would be constructed. (Map source: GAIA GPS).

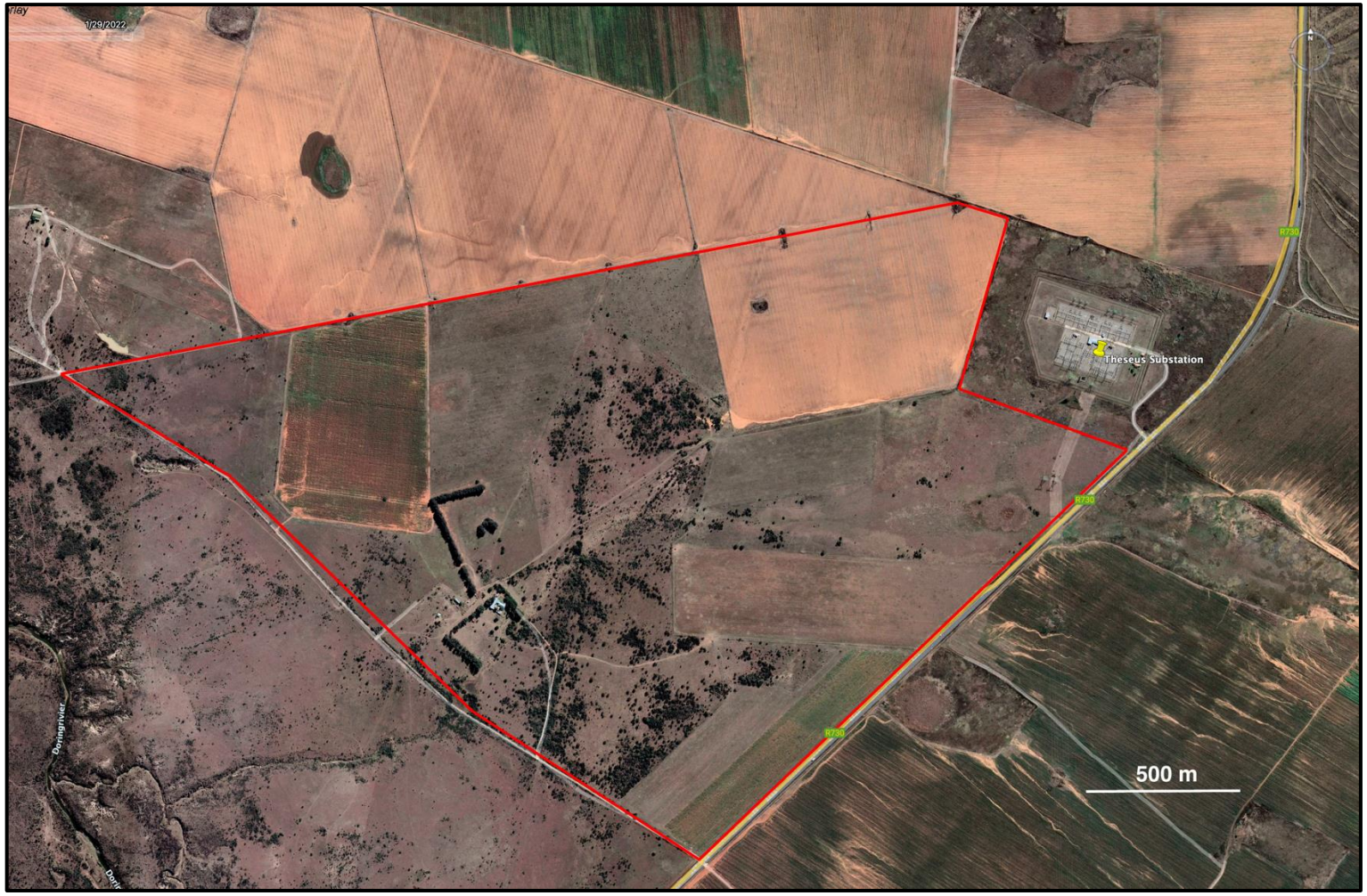


Figure 2. Google Earth Pro ™ of Portion 21 of Farm Doorn River 330, Theunissen (red boundary), the proposed site for Doringrivier Solar 1.

3.2 Topography, Geology and Soils

The topography of Portion 21 of Doorn River 330 (Doringrivier Solar 1) is relatively flat with very little relief. The lowest point is probably at the Highveld Salt Pan near the Theseus Substation.

The underlying geology of Portion 1 of Farm Doorn River 330 consists of sediments of the Adelaide Subgroup, of the Beaufort Group which in turn is part of the Karoo Supergroup. The Adelaide Subgroup was laid down in the Late Permian Period and consists of mud-rock and sandstone. The Adelaide Subgroup sediments were in turn later intruded by Karoo Dolerite during the Jurassic Period, forming extensive dolerite sills, resulting in ridges and koppies. There are no dolerite koppies near Portion 21 of Farm Doorn River 330 (Figure 3).

The red sandy soils found in areas where the Vaal-Vet Sandy Grassland occurs (or historically occurred) are the result of aeolian and colluvial sand overlying the sedimentary rocks of the Karoo Supergroup (Mucina *et al.* 2006). At Doorn River 330, Theunissen, these sandy soils overlie sediments the Adelaide Subgroup at the upper end of the soil catena. At lower elevations in the landscape, lower down in the soil catena, the red sand has been removed by erosion to expose lighter-coloured soils in the riparian zone of the Doring River. These soils are more clay-rich, highly erodible, duplex soils, that have been exposed at lower elevations near the river. Among other factors, the exposure could have been caused by historical overgrazing by cattle. This has resulted in severe erosion in some areas, where the topsoil has been lost, and the exposed, highly erodible subsoil is lost quickly to water erosion (Bell & Maud, 1994; Hensley *et al*., 2006; Paige-Green, 2008).

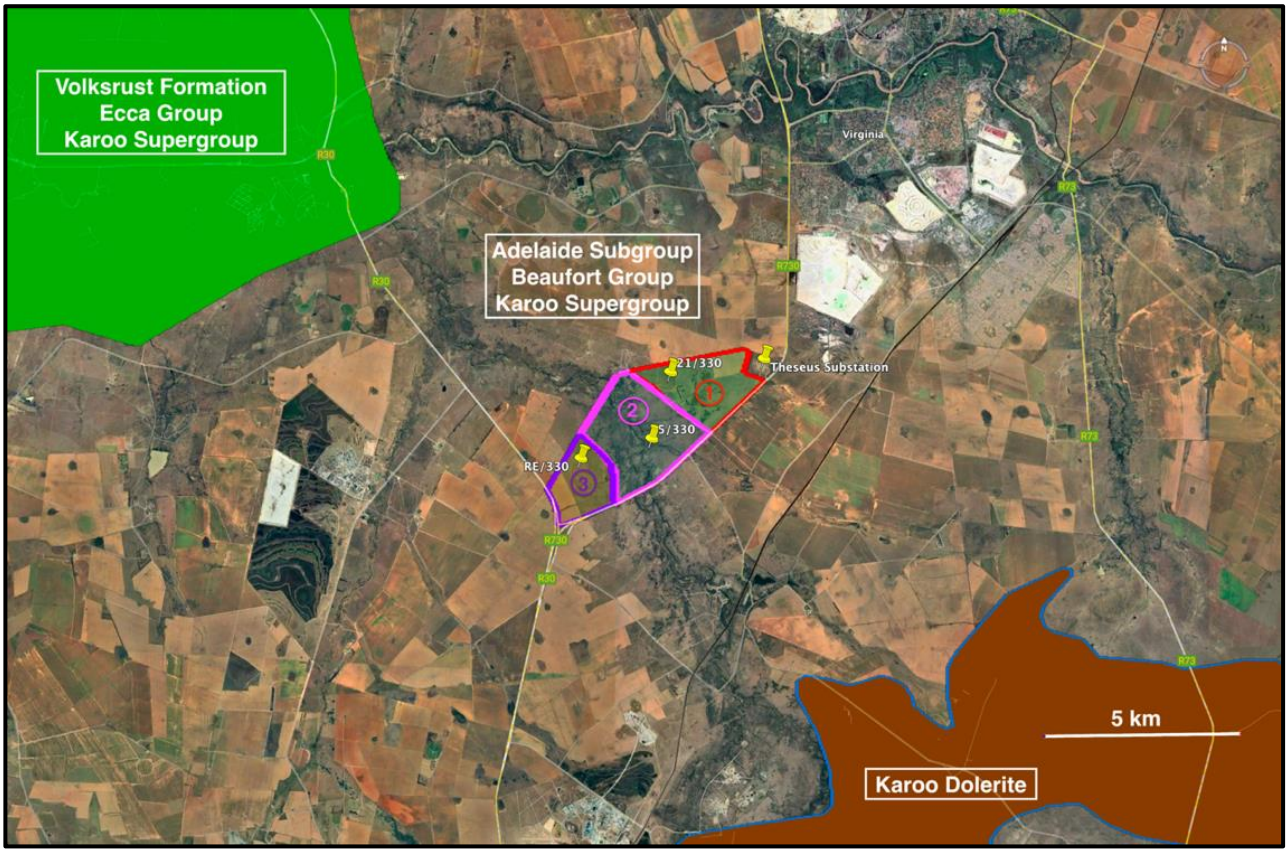
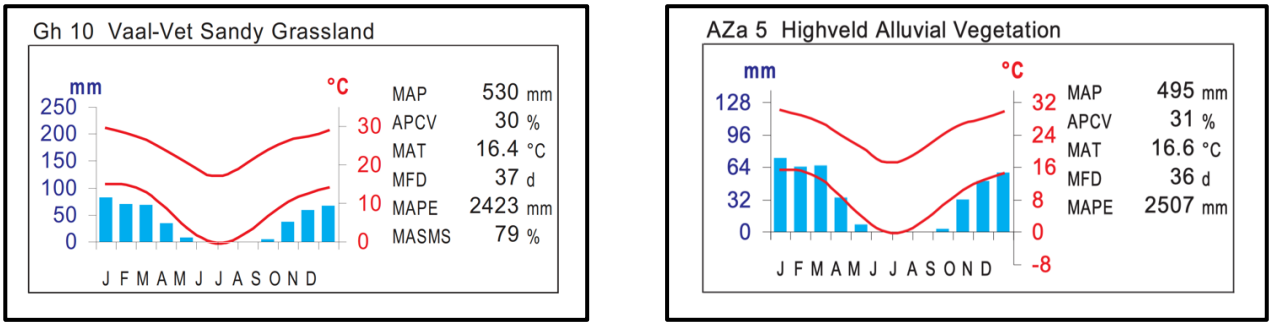


Figure 3. The parent farm Doorn River 330, Theunissen, and hence the three portions proposed for solar energy facilities is underlain by sedimentary rocks of the Adelaide Subgroup.

Figure 4. One of the maize fields on Portion 21 of Farm Doorn River 330, Theunissen, showing the red, sandy soil derived from sediments of the Adelaide Subgroup.

3.3 Climate

Farm Doorn River 330, Theunissen, is located in the summer rainfall region and the climate is classified as warm-temperate. Overall mean annual precipitation (MAP) is 495--530 mm. Temperatures are high in summer and low in winter with severe frosts on average for 40 days of the year. The climate diagrams (Figure 5) for the vegetation types shows the complete lack of rainfall in winter with rain occurring mainly from November to March. The climate modelled for Virginia, the nearest main centre (Figure 6), indicates a small amount of rain in the winter and agrees broadly with the climate diagrams for the two vegetation types



A B

Figure 5. Climate diagrams for Vaal-Vet Sandy Grassland (A) and Highveld Alluvial Grassland (B), the two main vegetation types in the study area (Mucina *et al.* 2006 in Mucina & Rutherford, 2006) showing MAP – Mean Annual Precipitation; ACPV = Annual Precipitation Coefficient of Variance; MAT = Mean Annual Temperature; MFD = Mean Frost Days; MAPE = Mean Annual Potential Evaporation; MASMA = Mean Annual Soil Moisture Stress.

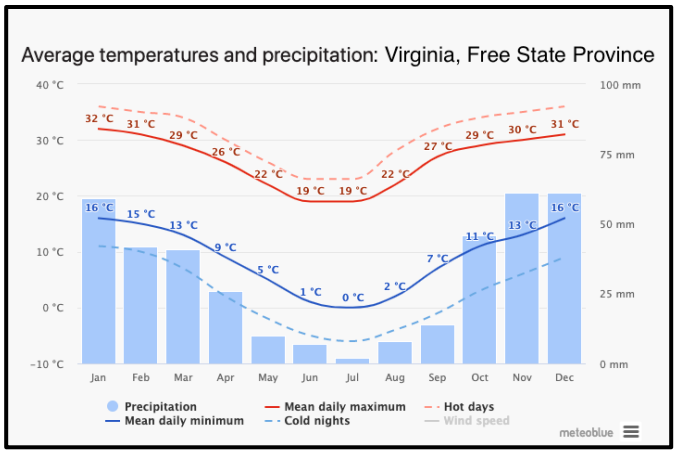


Figure 6. Climate chart for Virginia, Free State Province, modelled by meteoblue. The rainfall pattern is strongly biased towards summer rainfall (October to March) with the winters being cold

4. Methods

4.1 Desk-top analysis and reporting

Prior to carrying out fieldwork at Doorn River 330 in January 2022, the site was investigated at a desktop level using Google Earth Pro ™ satellite imagery. The natural vegetation that would occur at the farm was determined using the National Vegetation Map (SANBI, 2018) (referred to as VEGMAP). This map was overlaid on Google Earth imagery to enable vegetation mapping. No assumptions were made.

The National Web-based Environmental Screening Tool (https://screening.environment.gov.za/screeningtool) was applied to the study area to determine the sensitivity of the habitat and as a basis for checking the condition and sensitivity status during fieldwork.

4.2 Field Sampling

The vegetation was in peak summer growth phase at the time of the site visit, with most grasses in flower, and many trees likewise. Some herbaceous plants were not in flower, notably the autumn-flowering geophytes. This was thus the ideal time for the investigation since the vegetation was lush from the summer rains. The season of the survey was therefore **not a limitation**.

The study area was by accessed by vehicle and on foot for approximately four hours. The method used was a 'rapid-assessment technique' in which site observations and numerous photographs were taken at waypoints distributed along the survey route. The collected records form the basis for this report. The survey track and waypoints as recorded are shown in Figure 7, as part of the survey of all three portions of Farm Doorn River 330 earmarked for solar energy facilities.

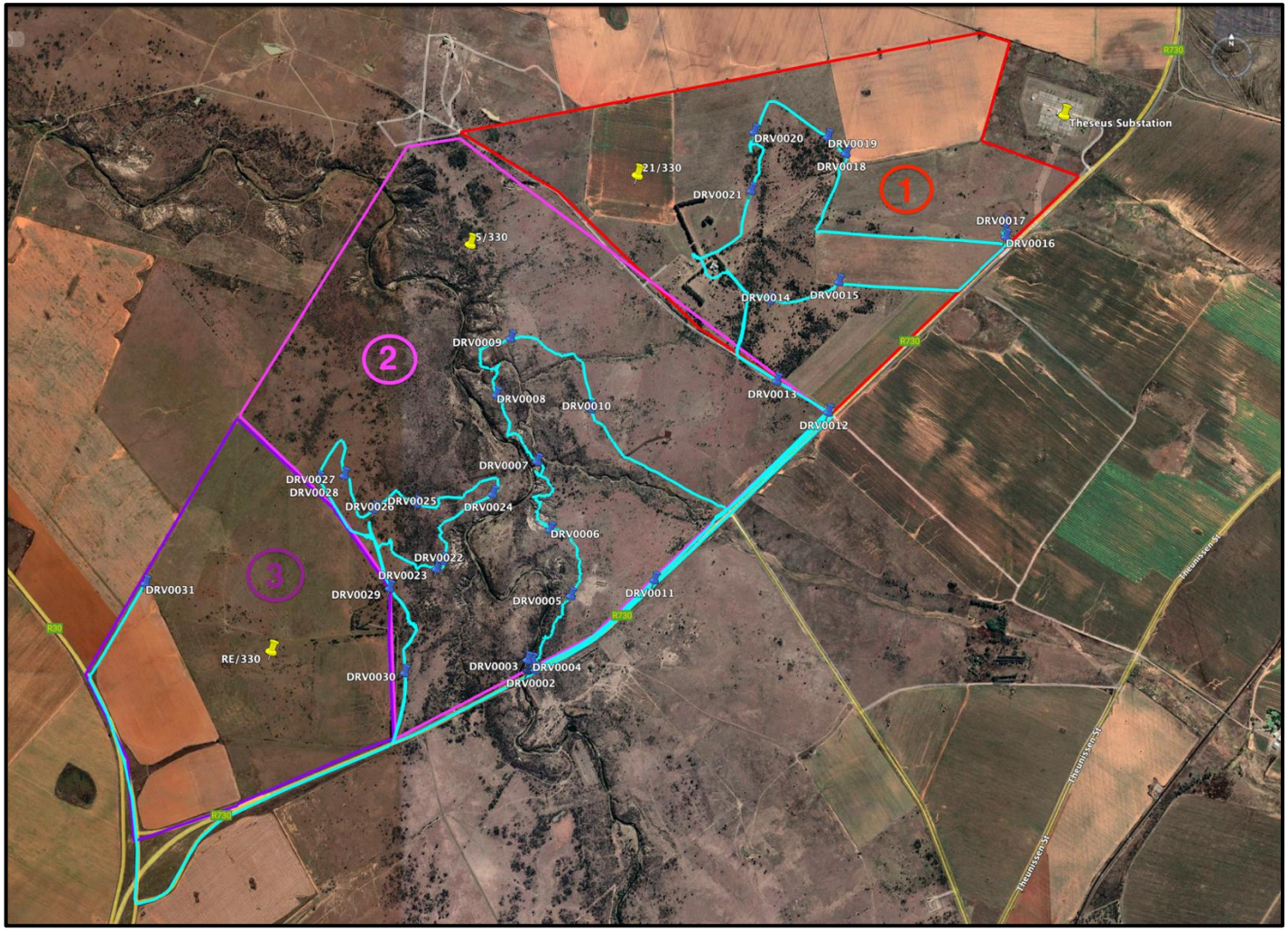


Figure 7. The three areas proposed for solar facility development, Doringriver Solar 1 (red boundary), Doringrivier Solar 2 (pink boundary) and Doringrivier solar 3 (purple boundary). The light blue line represents the survey track, and the sample waypoints are indicated by blue pins with (DRV#). The Eskom Theseus Substation is indicated at the upper right side of the image.

5. Disturbance regime

Portion 21 of Doorn River 330 has been actively farmed for some time with mixed agriculture of crops and beef cattle (Figure 8). The natural vegetation has been transformed by ploughing and planting of maize in some areas whereas in other areas Smuts Finger Grass (*Digitaria eriantha*) has been sown to augment the natural grassland plant community for improved grazing.

The vegetation pattern seen at Portion 21 of Doorn River 330, indicates a long absence of fire in this essentially grassland ecosystem. This has allowed *Vachellia karoo* (soetdoring, sweet-thorn) (formerly *Acacia karoo*) to become well-established in the central, unploughed area. This could also be attributed to overgrazing and trampling in the past that would have promoted the growth of sweet-thorn shrubs and trees. These plants, being legumes, would have altered the soil chemistry as well. *Vachellia karoo* is a widespread species and in some instances is a good indicator of disturbance or absence of fire (Dingaan, 2008).

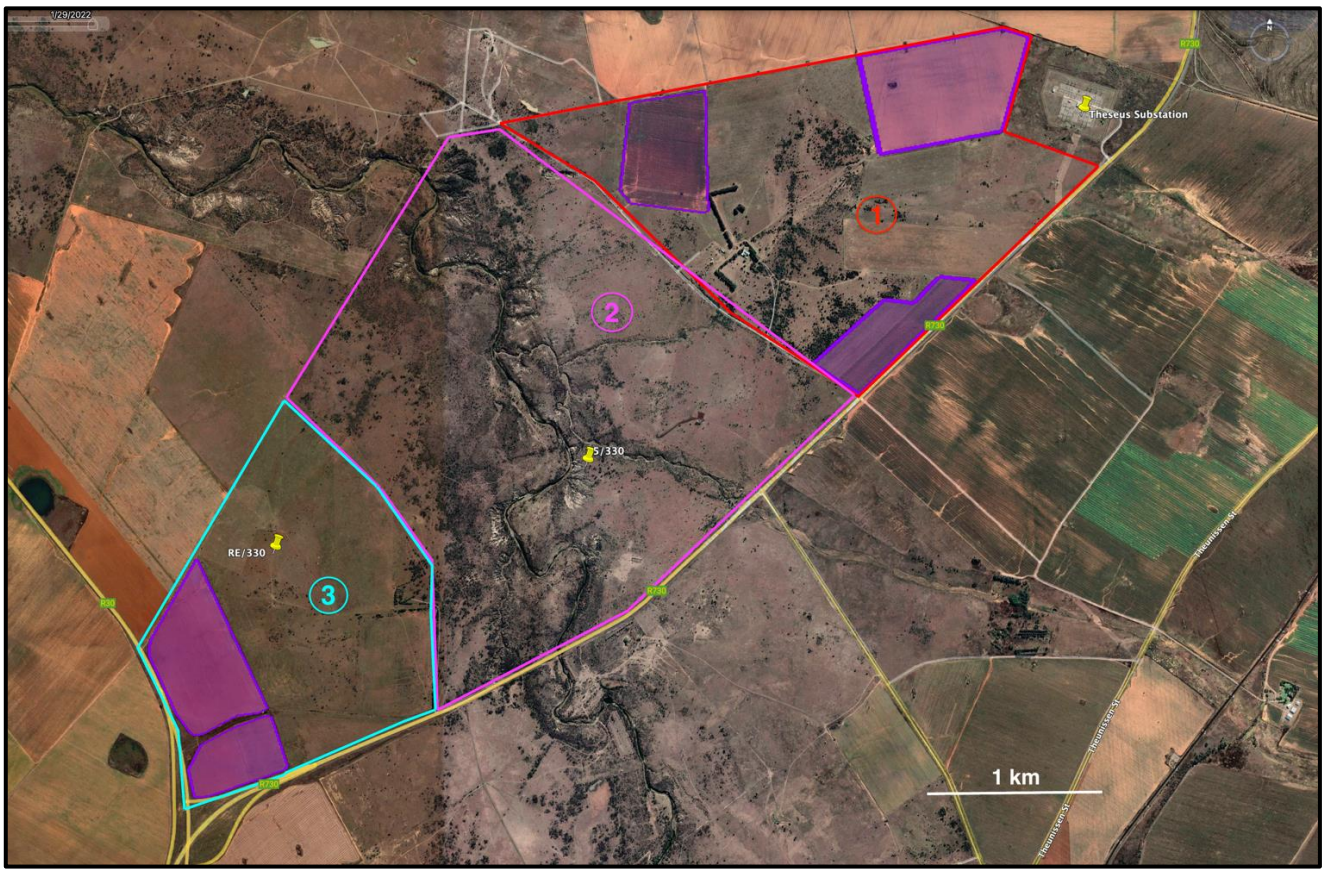


Figure 8. Google Earth Pro ™ aerial image with the areas earmarked for Doringrivier Solar 1, 2 & 3, indicating the areas, shaded in purple, that have been transformed by cultivation.

Figure 9. Heavy rain caused sheet erosion in this field of sunflower, where the soil has been cultivated.

6. Botanical evaluation of the study area

6.1 General description

The vegetation of Portion 21 of Farm Doorn River 330 falls within the Grassland Biome and towards the edge of the Vaal-Vet Sandy Grassland where it abuts an area mapped as Highveld Alluvial Grassland (SANBI, 2018) (Figure 10). This was confirmed during the field-survey.

Vaal-Vet Sandy Grassland, as the name indicates, is a low shrubland-grassland formation, where the dominant grasses are C4 grasses. These are grasses adapted to warm-temperate to sub-tropical conditions.

Species listed for Vaal-Vet Sandy Grassland by Mucina *et al.* (2006) include the following (Highveld Alluvial Grassland has many of the same plant species):

Trees: *Celtis africana, Cussonia paniculata, Pittosporum viridiflorum, Scolopia zeyheri, Searsia lancea, Ziziphus mucronata*.

Tall shrubs: *Buddleja saligna, Diospyros lycioides subsp. lycioides, Euclea crispa subsp. ovata, Grewia occidentalis, Gymnosporia buxifolia, Gymnosporia polyacantha, Olea europaea subsp. africana, Searsia burchellii, Searsia erosa, Tarchonanthus camphoratus.*

Low shrubs: *Anthospermum rigidum subsp. pumilum*, *Asparagus laricinus*, *Asparagus cooperi*, *Berkheya annectens*, *Chrysocoma ciliata*, *Clutia pulchella*, *Euryops empetrifolius*, *Felicia filifolia subsp. filifolia*, *Felicia muricata*, *Helichrysum*

dregeanum, *Nenax microphylla, Osyris lanceolata*, *Pentzia globosa*, *Rosenia humilis*, *Selago saxatilis*, *Solanum tomentosum var. coccineum.*

Graminoids: *Aristida adscencionis, Aristida congesta, Aristida diffusa, Cymbopogon pospischilii, Cynodon dactylon, Cynodon incompletus, Digitaria argyrograpta, Elionurus muticus, Enneapogon scoparius, Eragrostis chloromelas, Eragrostis lehmanniana, Eragrostis micrantha, Eragrostis obtusa, Eragrostis plana, Eragrostis superba, Eragrostis trichophora, Eustachys paspaloides, Heteropogon contortus, Panicum stapfianum, Setaria lindenbergiana, Setaria sphacelata, Sporobolus fimbriatus, Themeda triandra, Tragus berteronianus, Tragus koelerioides, Tragus racemosus, Triraphis andropogonoides.*

Herbs: *Berkheya onopordifolia* var. *onopordifolia, Hermannia coccocarpa*, *Indigofera alternans, Mohria caffrorum*, *Pupalia lappacea, Salvia repens.*

Geophytic herbs: *Oxalis corniculata, Oxalis depressa*

Succulent herbs: *Crassula lanceolata*

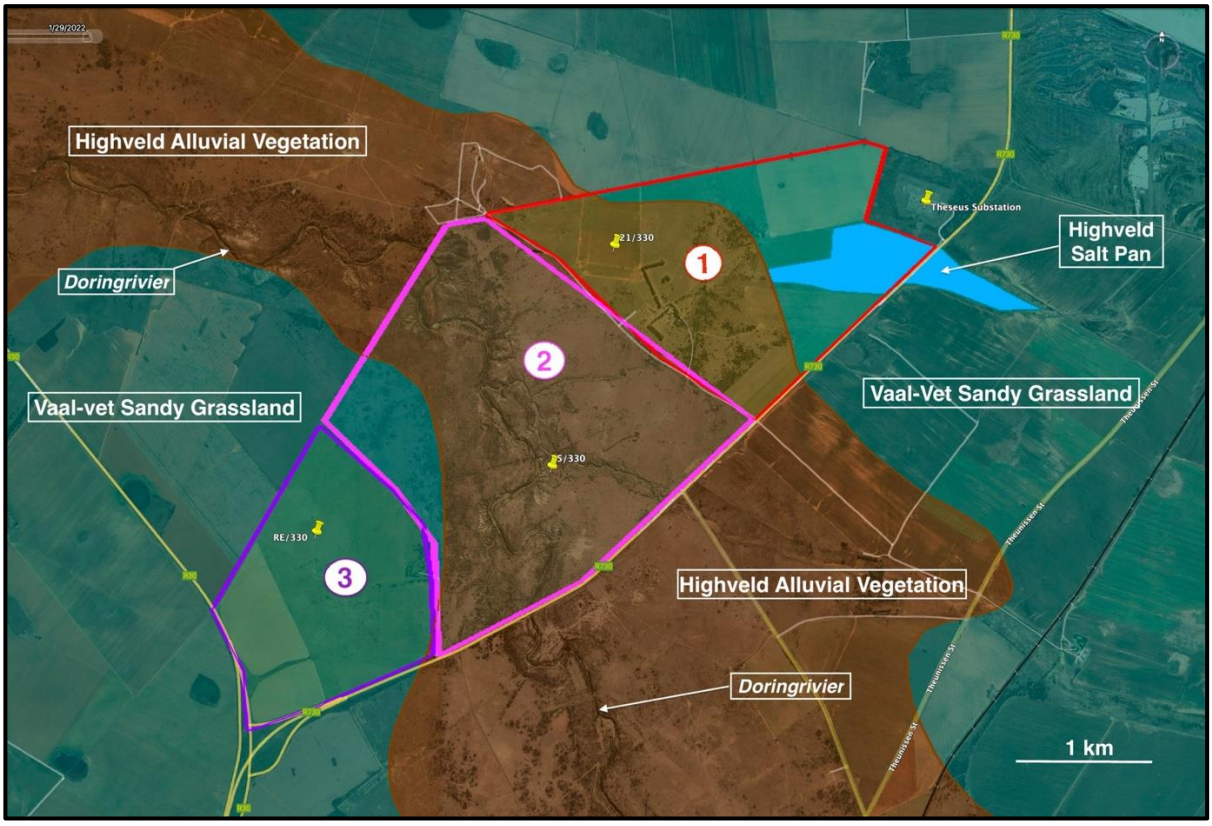


Figure 10. Extract from the Vegetation Map of South Africa, Lesotho & Swaziland (Mucina *et al.* 2005; SANBI, 2018) (VEGMAP) overlaid on a Google Earth pro ™ image, indicating that part of Portion 21 of Doorn River 330 (indicated as 1, with red boundary) is mapped as Vaal-Vet Sandy Grassland and part as Highveld Alluvial Vegetation. A Highveld Salt Pan is found in the northeast corner of the property.

6.2 Vegetation recorded at sample waypoints

Reference should be made to Figure 2 for the location of the respective waypoints. The co-ordinates of the waypoints with photographic illustrations to represent the vegetation found are presented in Table 1.

Table 1. The vegetation and habitat found at the sample waypoints on Portion 21 of Farm Doornrivier 330, Theunissen.

Waypoint	Co-ordinates	Notes	Illustration
DRV0012	**S 28° 10' 29.11"** **E 26° 48' 56.92"**	At the intersection of the "Game Breeders' Road" (gravel) and the main tar road to Virginia. Northeast of this point, looking towards the Theseus Substation, is a ploughed field that was under maize at the time of the survey. A strip of natural bush is alongside the maize field to the northwest.	 

DRV0013	**S 28° 10’ 23.50” E 26° 48’ 46.38”**	On the Game Breeders’ Road alongside an area of natural bush, dominated by *Vachellia karoo*.	 
DRV0014	**S 28° 10’ 08.93” E 26° 48’ 44.97”**	This location there is grassveld mixed with *Vachellia karoo*. The veld is used for grazing and has been augmented by sowing Smuts Finger Grass (*Digitaria eriantha*). The cover is good but the over-abundance of *D. eriantha* has changed the relative abundance of the different grasses. Apart from *D. eriantha*, the other plants that were recorded were, *Commelina africana, Eragrostis lehmanniana, Eragrostis superba, Gomphocarpus fruticosus, Kylingia alba, Nidorella* sp., *Oxalis* sp., *Senna italica* subsp. *arachoides*, *Setaria* sp., *Sporobolus* sp., *Themeda triandra and Vernonia bonariensis.*	

DRV0015	**S 28° 10' 05.61" E 26° 48' 59.06"**	Converted grassland. Natural veld with *Digitaria eriantha* added for better quality grazing. Not sensitive.	
DRV0016	**S 28° 09' 57.47" E 26° 49' 33.23"**	Area of natural grassland with no inter-sowing of *Digitaria eriantha*. Themeda triandra is common but co-dominant with *Eragrostis curvula*. A few scattered *Vachellia karoo* trees are present. Other plant species include *Asparagus laricinus, Boophone disticha, Chlorophytum* sp., *Cotula globosa, Eragrostis echinochloidea, Eragrostis superba, Gomphocarpus fruticosus, Setaria* sp., *Sporobolus* sp. and *Vernonia bonariensis.*	 

DRV0017	**S 28° 09’ 55.02“ E 26° 49’ 33.15”**	Vlei between the area of natural grassland at DRV0016 and the Theseus Substation. Two grass species are dominant namely, *Eragrostis plana* and *Echinochloidea holubii*. Both these grasses reach 1.5 m tall and form dense stands. This is the preferred habitat of the Yellow-crowned Bishop (*Euplectes afer*). These birds feed on the seeds of the grasses. Common Moorhen (*Gallinula chloropus*) was heard calling. On the edge of the vlei was an extensive mat of the fern *Marsilea* sp. growing in shallow water. *Setaria sphacelata* var. *sericea* was growing on the edge of the vlei.	   *Echinochloidea holubii*

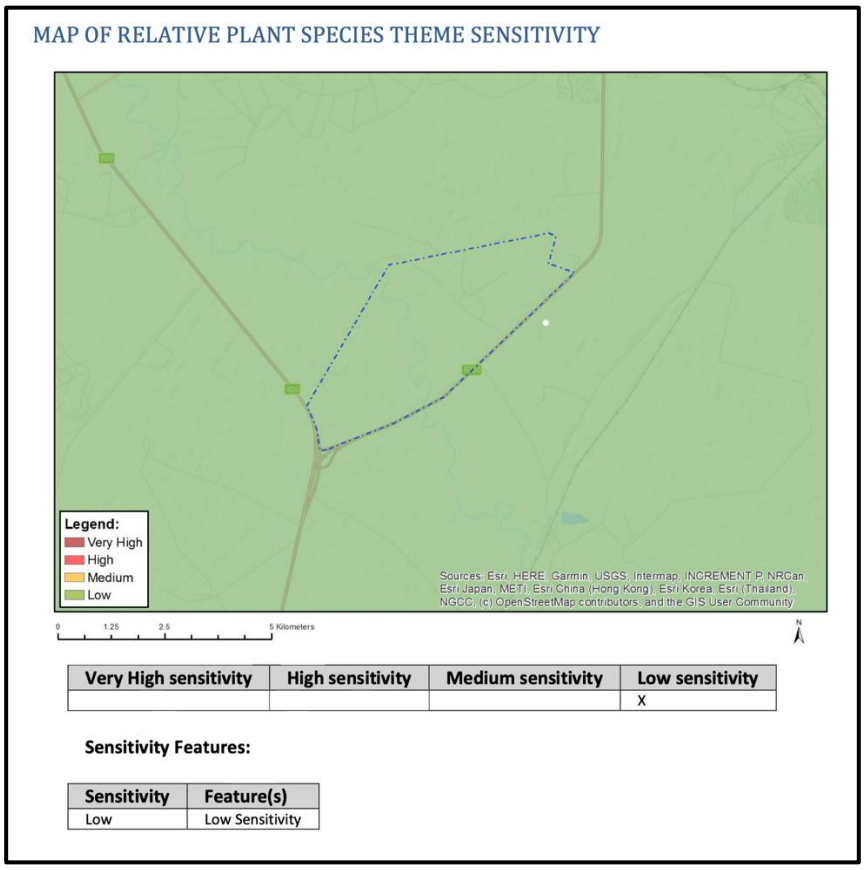
DRV0018	**S 28° 09' 42.40" E 26° 49' 00.51"**	Near a wind-pump at the boundary fence between a field of sunflower to the northeast and natural bush (a mix of thorn trees and grass) to the west.	
DRV0019	**S 28° 09' 39.48" E 26° 48' 56.77"**	Mixed grassland and asparagus thicket (*Asparagus laricinus*) with *Vachellia karoo*-dominated woodland to the west.	

DRV0020	**S 28° 09' 38.53" E 26° 48' 41.70"**	At a camp fence with cattle grazing the natural grassland to the northwest. The grassland was in good condition.	
DRV0021	**S 28° 09' 49.15" E 26° 48' 41.12"**	Open grassland with a few scattered *Vachellia karoo*. *Themeda triandra* is dominant in places. Other plant species recorded include, *Berkheya annectens, Chrysocoma ciliata, Digitaria eriantha, Digitaria monodactyle, Eragrostis curvula, Eragrostis echinochloidea, Hypoxis* cf. *costata* and *Sporobolus* sp.	 

7. Conservation Status and Vegetation Sensitivity

7.1 National Web-based Environmental Screening Tool

The National Web-based Environmental Screening Tool was applied to Portion 21 of Doorn River 330, where the Doringrivier Solar 1 is proposed to be built. The result from the screening tool for the plant species sensitivity theme (Figure 11) is that the sensitivity is **LOW**. From observations made in the field, there is agreement with this rating.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

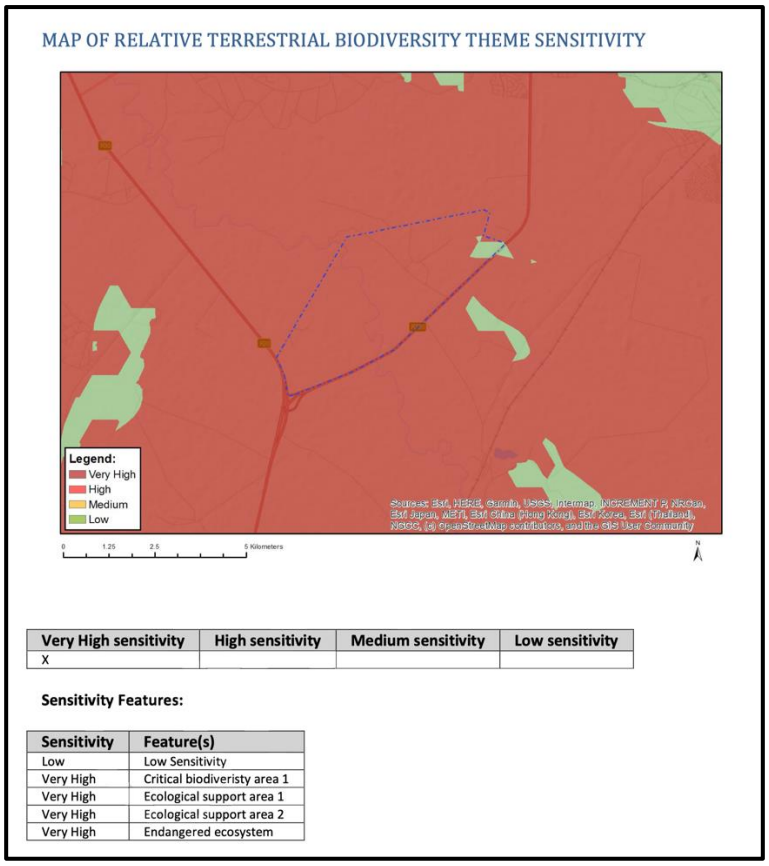
Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

Figure 11. The map for relative plant species theme sensitivity produced by the National Web-based Environmental Screening Tool, indicating that Portion 21 of Doorn River 330 (within the blue outlined polygon) has **Low Sensitivity**.

Results were also obtained from the screening tool for the terrestrial biodiversity sensitivity for Portion 21 of Doorn River 330. Figure 12 indicates that the screening tool rates the land portion as having **VERY HIGH** terrestrial biodiversity sensitivity with only the far northeast corner rated as **LOW**. From observations made at Portion 21 of Doorn River 330, this appears to be an overrated assessment in the 'VERY HIGH' area and an

underrated . A more realistic ranking would be **MEDIUM** sensitivity for the entire land portion.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Critical biodiveristy area 1
Very High	Ecological support area 1
Very High	Ecological support area 2
Very High	Endangered ecosystem

Figure 12. The map output from the National Web-based Environmental Screening Tool for the Relative Terrestrial Biodiversity Theme Sensitivity where the blue outlined polygon contains Portion 21 of Doorn River 330. Terrestrial Biodiversity is indicated as being **Very High.**

7.2 Threat Status

According to the National List of Threatened Terrestrial Ecosystems (Government Gazette, 2011), Vaal-Vet Sandy Grassland is an **Endangered A1** ecosystem, where the A1 criterion denotes irreversible loss of natural habitat. Highveld Alluvial Vegetation is not listed so by default is of **Least Concern**.

7.3 Red List Ecosystems (RLE)

The National List of Threatened Terrestrial Ecosystems (2011) is somewhat out of date and is now superseded to a large extent by the determination of ‘Red List Ecosystems’. These ecosystems have been mapped (SANBI, 2021) and for Farm Doorn River 330, only small areas remain of Endangered habitat, whereas the central part is of Least Concern, All other areas have been transformed (Figure 13).

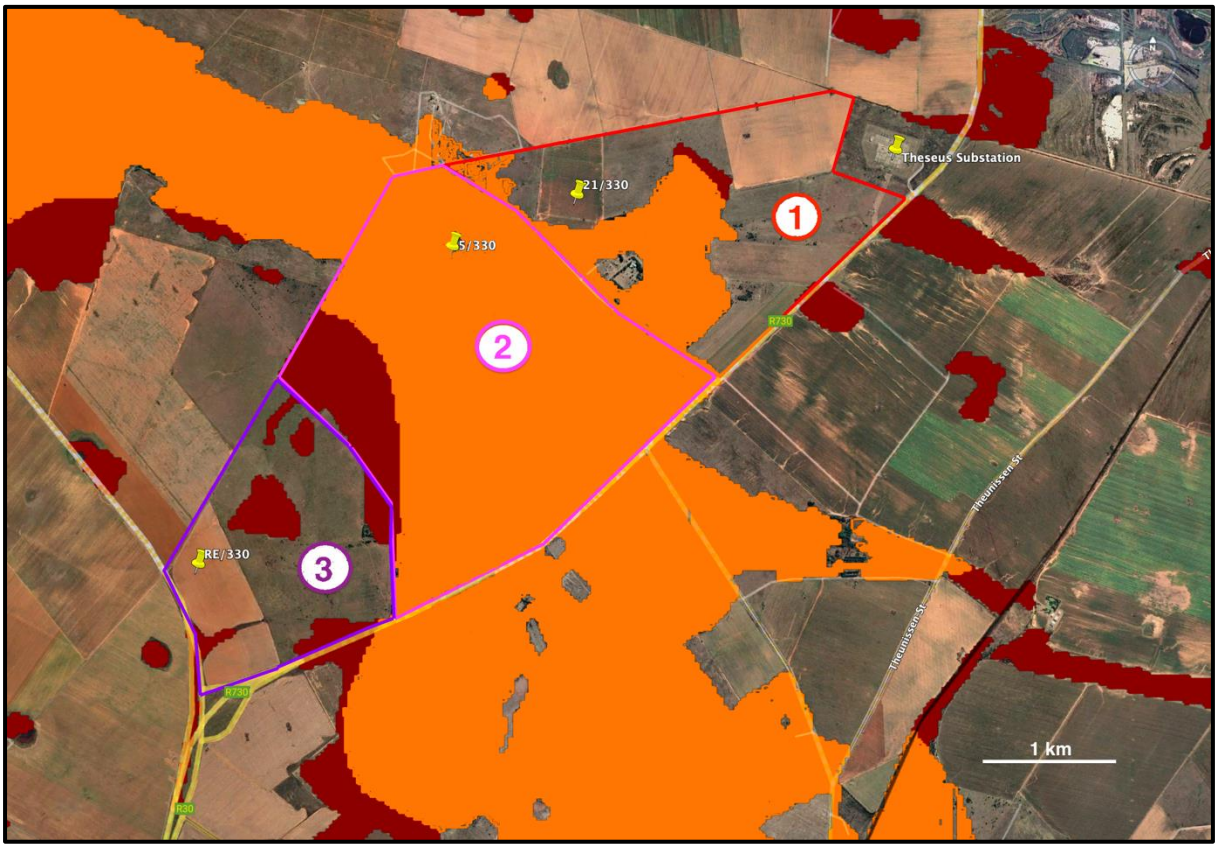


Figure 13. The RLE map overlaid on an Google Earth Pro ™ image for the Farm Doorn River 330, shows that in Portion 21 of Doorn River 330 (area with red boundary marked 1) is mostly transformed with a small area of endangered habitat (dark red shading) and a moderate-sized area of natural habitat that is of Least Concern (orange shading).

7.3 Critical Biodiversity Areas

The critical biodiversity areas (CBA) map for the Portion 21 of Doorn River 330 study area from the Department of Economic Development and Environmental Affairs, Free State Province, was overlaid on a Google Earth Pro™ image and examined to compare what was observed in the field with the aerial image and overlaid CBA map (Figure 14). No critical biodiversity areas are mapped on Portion 21 of Doorn River 330 (area 1 with red boundary on the map), just ecological support areas ESA1 and ESA2. One area is mapped as 'Other' and that is the salt pan / vlei habitat. The remaining areas are considered to be degraded.

The proposed SPV development area is not close to any protected area(s) identified in terms of NEMPAA and/or within 20 km proximity to a Biosphere Reserve.

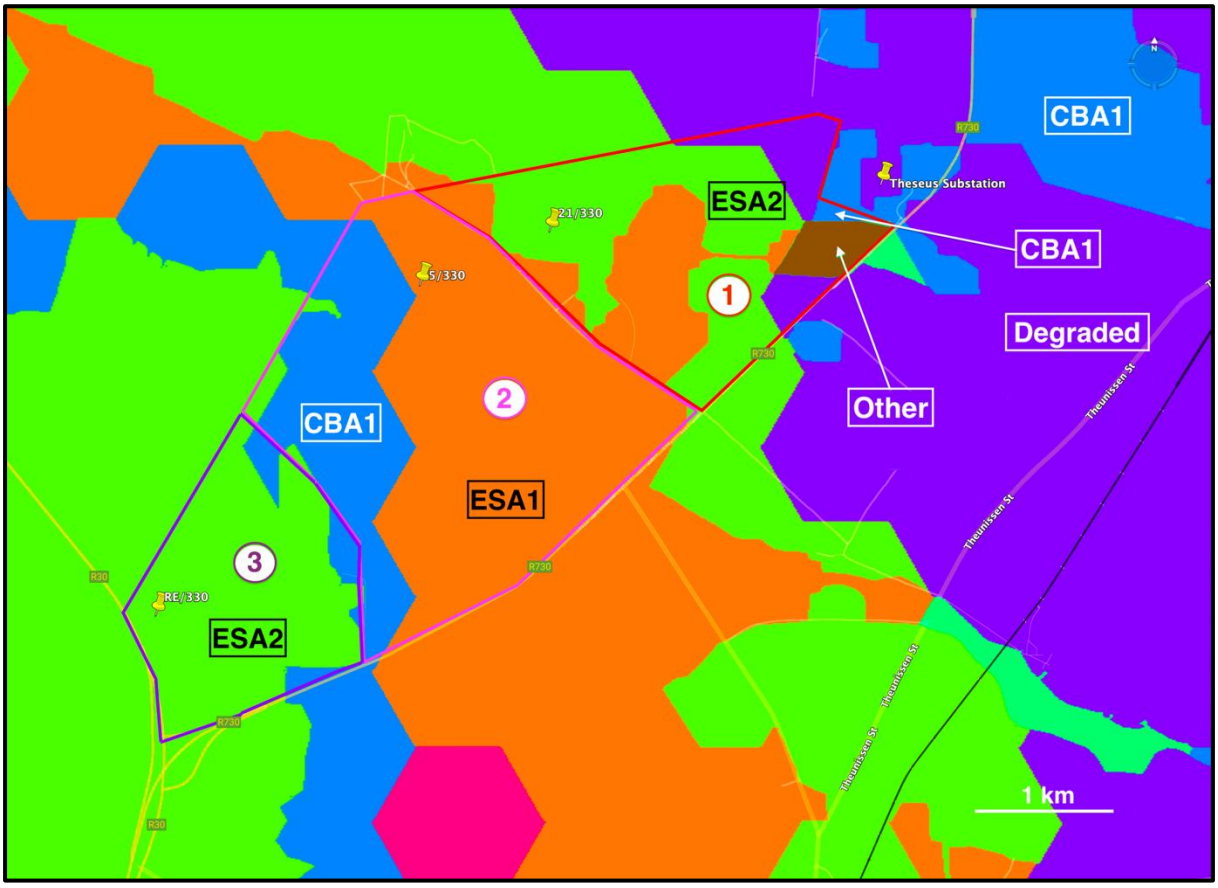


Figure 14. The Critical Biodiversity Map for Farm Doorn River 330, with focus on Portion 21 of Doorn River 330 (marked with 1 and a red boundary). Most of the site consists of ESA1 (orange) and ESA2 (green) areas, with some degraded areas (purple). The salt pan area with buffer is shaded brown and denoted 'Other'.

7.4 Sensitivity Mapping based on field observations

From the field-survey, a map has been compiled that represents the sensitivity status as determined from 'on-the-ground' observations (Figure 15). This map indicates areas of **High Sensitivity** where no solar photovoltaic SPV) installations should be built, **Medium Sensitivity** areas that are buildable with mitigation and **Low Sensitivity** areas that include cultivated land where SPVs could be built without compromise of sensitive plants communities on the site. The sensitivity classification (Figure 15) is in broad agreement the Critical Biodiversity Classification (Figure 14).

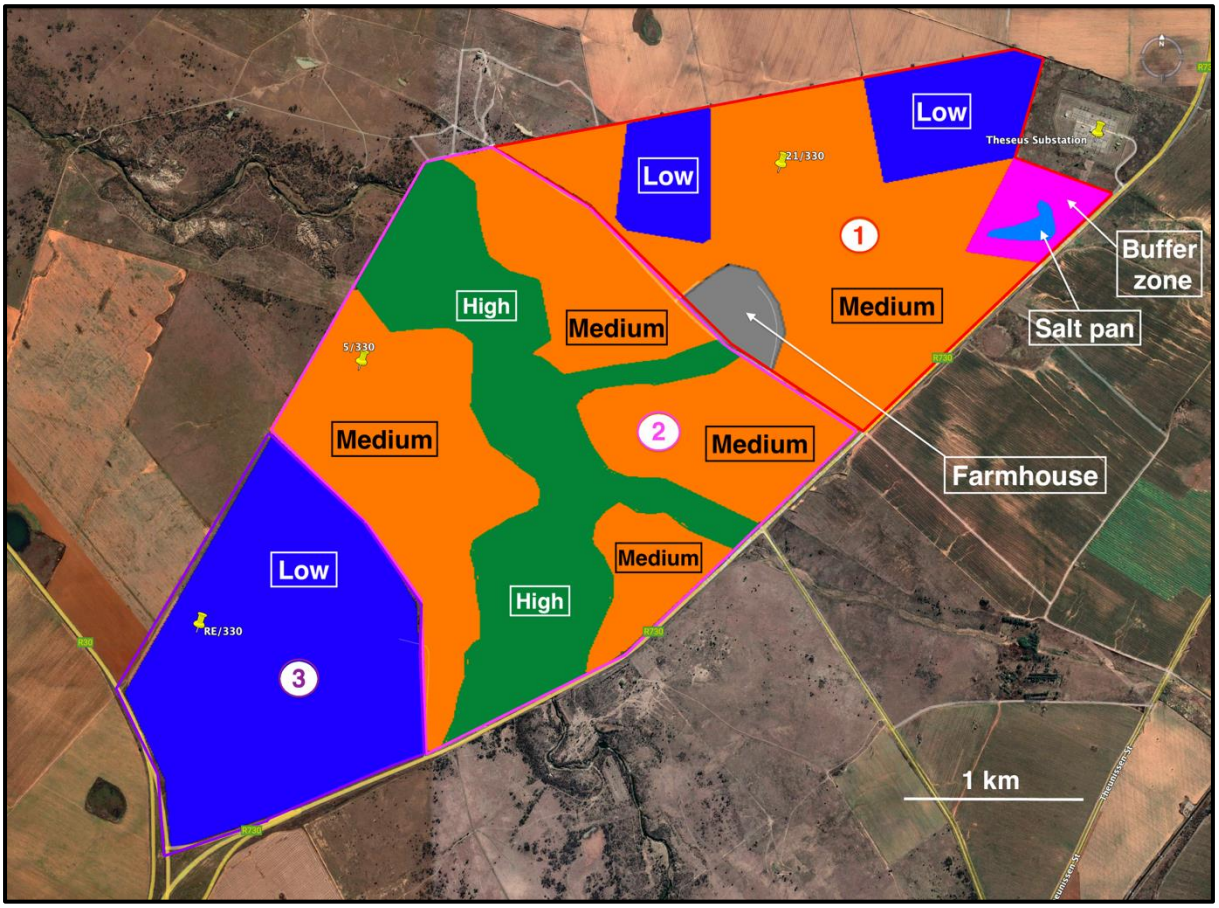


Figure 15. The sensitivity map for Portion 21 of Doorn River 330, Theunissen marked as "1" with a red boundary. The **Medium** sensitivity areas are shaded orange, the **Low** sensitivity areas are shaded blue, and the salt pan which is a high sensitivity area is shaded blue with a pink buffer zone.

8. Plant Species of Conservation Concern

No plant species of conservation concern were recorded on Portion 21 of Doorn River 330.

9. The proposed Doornrivier Solar PV layout

The sensitivity map (Figure 15) was presented to the proponents of the Doornrivier Solar 1 SPV installation and the botanical sensitivity of Portion 21 of Doorn River 330, Theunissen, was taken into account for determining the SPV layout. There is very little botanically sensitive vegetation (there being virtually no Vaal-Vet Sandy Grassland left uncultivated) on the site so only cultivated land, the farmhouse precinct and the salt pan / vlei have been excluded in the proposed layout of the Doornrivier Solar 1 (Figure 16).

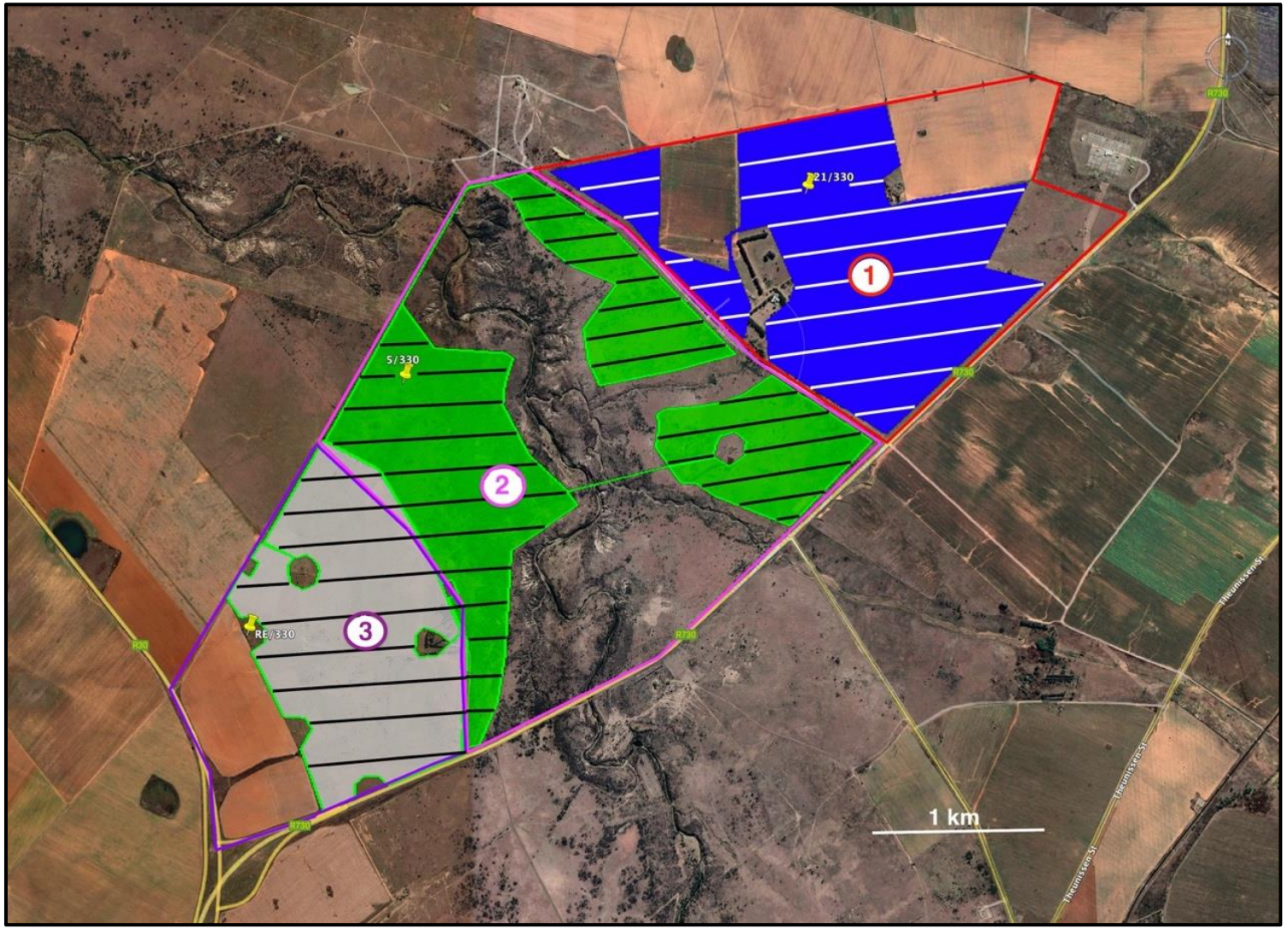


Figure 16. The proposed layout for Doornrivier Solar 1 (white parallel lines on blue background) within the area marked as “1”.

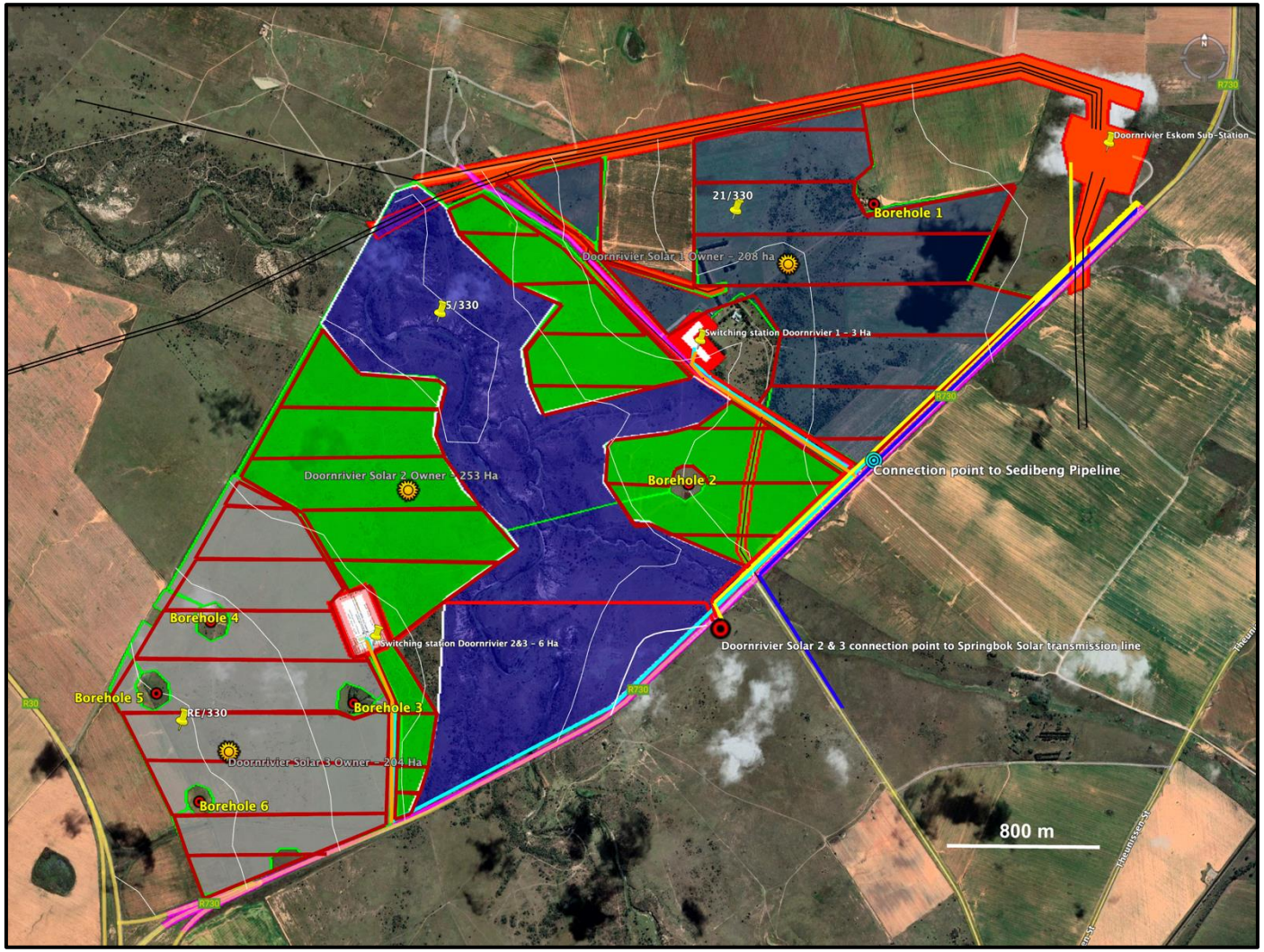


Figure 17. The preferred layout of Doringrivier Solar 1 ,2 and 3, as prepared by the engineering team.

10. Impact Assessment

The No Go alternative, the Preferred Alternative (Alternative 1) i.e. construction and operation of the Doornrivier Solar 1 facility (with layout as given in Figures 16 & 17) and Alternative 2, where the entire cadastral unit (excluding the residence) of Portion 21 of Farm Doorn River 330 is assessed.

10.1 The No Go Alternative

In the case of the No-Go Alternative, the Doornrivier Solar 1 facility would not be built and there would be very little change to the *status quo*. The farming operation would continue as it is at present. The No Go alternative is assessed in Tables 2 & 3.

10.2 Direct Impacts

Two alternatives, apart from the 'No Go' alternative, are considered, namely Alternative 1 (preferred), where the SDP in Figure 17 (slightly refined from that in Figure 16) and Alternative 2, where the entire area of Portion 21 of Farm Doorn River 330, Theunissen, would be developed i.e. including the cultivated fields excluded in Alternative 1.

The direct impact of Alternative 1 (preferred) of Doornrivier Solar 1 on the natural vegetation Portion 21 of Doorn River 330 would be **Medium**, and with mitigation **Low,** during the construction phase (Table 2) and **Low** during the operational phase (Table3). Some mitigation would be necessary. Only the loss of Highveld Alluvial Vegetation is assessed since very little Vaal-Vet Sandy Grassland remains. In the case of Alternative 2, the direct impact of the construction would also be **Medium** and with mitigation, **Low,** since the only addition would be cultivated fields (Table 2). For the operational phase (Table 3) the direct impact would be **Low** without mitigation and **Very Low** with mitigation.

Table 2. Impact: The loss of Highveld Alluvial Vegetation on Portion 21 of Doorn River 330 during the **construction phase** of Doornrivier Solar 1.

CRITERIA	'NO GO' ALTERNATIVE	Alternative 1: Doornrivier Solar 1 on Portion 21 of Doorn River 330		Alternative 2: The entire area of Portion 21 of Doorn River 330 (excluding the residence) would be developed	
Nature of direct impact (local scale)	Loss of Highveld Alluvial Vegetation				
		WITHOUT MITIGATION	**WITH MITIGATION**	**WITHOUT MITIGATION**	**WITH MITIGATION**
Extent	Local	Local	Local	Local	Local
Duration	Long-term	Long-term	Long-term	Long-term	Long-term
Intensity	Very Low	Medium	Low	High	Medium
Probability of occurrence	Probable	Definite	Definite	Definite	Definite
Confidence	High	High	High	High	High
Significance	Very Low Negative	Medium Negative	Low Negative	Medium Negative	Low Negative
Nature of cumulative impact	Loss of Highveld Alluvial Vegetation				
Cumulative impact prior to mitigation	N/A	Low Negative		Low Negative	
Degree to which impact can be reversed	N/A	Very Low		Very Low	
Degree to which impact may cause irreplaceable loss of resources	N/A	Low		Low	
Degree to which impact can be mitigated	N/A	Low		Low	
Proposed mitigation	N/A	Translocation of geophytic species		Translocation of geophytic species	

Cumulative impact post mitigation	N/A	Low Negative	Low Negative
Significance of cumulative impact (broad scale) after mitigation	N/A	Low Negative	Low Negative

Table 3. Impact: The loss of Highveld Alluvial Vegetation Portion 21 of Doorn River 330 during the **operational phase** of Doornrivier Solar 1

CRITERIA	**'NO GO' ALTERNATIVE**	**Alternative 1** **Doornrivier Solar 1** **Portion 21 of Doorn River 330**		**Alternative 2:** **The entire area of Portion 21 of Doorn River 330 (excluding the residence) would be developed**	
Nature of direct impact (local scale)	Loss of Highveld Alluvial Vegetation				
		WITHOUT MITIGATION	**WITH MITIGATION**	**WITHOUT MITIGATION**	**WITH MITIGATION**
Extent	Local	Local	Local	Local	Local
Duration	Long-term	Long-term	Long-term	Long-term	Long-term
Intensity	Low	Very Low	Very Low	Very Low	Very Low
Probability of occurrence	Probable	Definite	Definite	Definite	Definite
Confidence	High	High	High	High	High
Significance	Low Negative	Very Low Negative	Very Low Negative	Very Low Negative	Very Low Negative
Nature of cumulative impact	Loss of Highveld Alluvial Vegetation				
Cumulative impact prior to mitigation	N/A	Very Low Negative		Very Low Negative	
Degree to which impact can be reversed	N/A	Very Low		Very Low	
Degree to which impact may cause irreplaceable loss of resources	N/A	Very Low		Very Low	

Degree to which impact can be mitigated	N/A	Minimal	Minimal
Proposed mitigation	N/A	Sowing a suitable mix of grass seed on disturbed areas not required for operation.	Sowing a suitable mix of grass seed on disturbed areas not required for operation.
Cumulative impact post mitigation	N/A	Very Low Negative	Very Low Negative
Significance of cumulative impact (broad scale) after mitigation	N/A	Very Low Negative	Very Low Negative

10.3 Mitigation in the Construction and Operational Phases

Mitigation in the construction phase would be to relocate any geophytic species such as *Boophone disticha* to safe sites. Disturbance should be kept to a minimum i.e. construction must be limited to the footprint of the solar installation.

In the operational phase, areas that were used in the construction phase as laydown areas and that will not be used later, must be rehabilitated. This can be achieved by sowing a suitable mix of grasses onto the disturbed areas.

10.4 Cumulative Impacts

To determine cumulative impacts on the vegetation due to other renewable energy projects within 30 km of Doorn River, the respective projects (Table 4) were plotted on Google Earth (Figure 18). The vegetation types were overlaid and determined as in Table 4 and then the Red Listed Ecosystems – Remnants (Skowno *et al.* 2021) [RLE] were also superimposed on the project areas using Google Earth. The results of that visual inspection area given in the RLE Status (Remnants) column of Table 4.

Vaal-Vet Sandy Grassland is the most endangered vegetation type in most of the areas examined. However, the addition of the Doringrivier Solar 1 to the cumulative impacts would result in minimal further loss of endangered Vaal-Vet Sandy Grassland because there is very little of this vegetation that is undisturbed on Portion 21 of Farm Doorn River 330, Theunissen. No mitigation would be possible or required to offset these cumulative impacts.

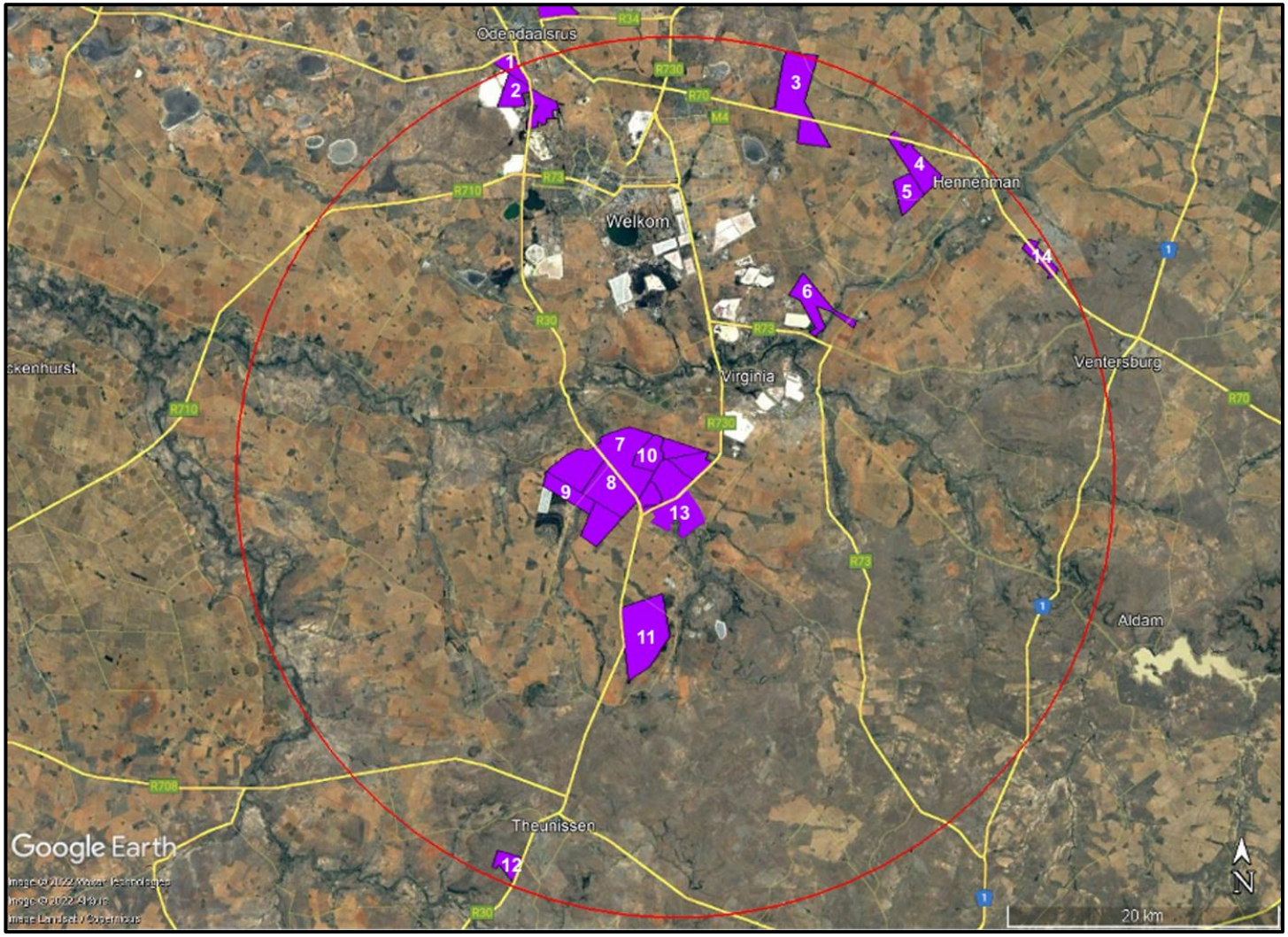


Figure 18. Solar PV projects within a 30 km radius (red circle) from Doorn River and the proposed Doringrivier 1, 2 & 3 Solar PV projects.

Table 4. List of solar PV applications within 30km of Doringrivier Solar 1. The remnant status was determined by inspection of the RLE Remnants (Skowno *et al.* 2021) using Google Earth, as they pertain to the project areas.

	Project name	Generating Capacity (MW)	Application date (year)	Application Status	Vegetation Types	RLE Status (Remnants)
1	Harmony Nyala solar energy facility	10	2015	Approved	Western Free State Clay Grassland	Least Concern (LC)
2	Harmony Eland solar energy facility	10	2015	Approved	Western Free State Clay Grassland	LC
3	Thabong Solar Farm	75	2013	In process	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	LC with two small areas of Endangered (EN) (Vaal-Vet Sandy Grassland)
4	Vogel's Rand Solar	10	2012	In process	Vaal-Vet Sandy Grassland	Small area of EN (Vaal-Vet Sandy Grassland)
5	Everest solar energy facility	75	2013	Lapsed	Vaal-Vet Sandy Grassland	Small area of EN (Vaal-Vet Sandy Grassland)
6	Onverwag and Vaalkranz	75	2013	Approved	Vaal-Vet Sandy Grassland	Very small area of EN (Vaal-Vet Sandy Grassland)
7	Selexos Solar	20	2012	Approved	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	Very small area of EN (Vaal-Vet Sandy Grassland)
8	Oryx solar energy facility	75	2013	In process	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	LC

9	Beatrix Gold Mine Co-Generation Facility	4	2012	Approved	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	Very small area of EN (Vaal-Vet Sandy Grassland)
10	Kalkoenkrans Solar PV Plant	-	2012	Lapsed	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	Very small area of EN (Vaal-Vet Sandy Grassland)
11	Selexos Solar – Farm Leeubult	19.9	2012	In process	Vaal-Vet Sandy Grassland	Very small area of EN (Vaal-Vet Sandy Grassland)
12	Sonvanger PV solar energy facility	-	2018	In process	Central Free State Grassland	No remnants
13	Springbok PV Plant	150		In process	Highveld Alluvial Vegetation Vaal-Vet Sandy Grassland	LC
14	Hennenman	5	2014	Approved	Central Free State Grassland	LC

11. Discussion and Recommendations

The botanical survey of Portion 21 of Doorn River 330, Theunissen, was aimed at determining (i) the vegetation type(s) and condition; (ii) the veracity of the existing CBA map; (ii) the sensitivity of any vegetation and (iv) areas that could be considered for the construction of a PV facility.

As described, three vegetation types, Vaal-Vet Sandy Grassland (Endangered), Highveld Alluvial Vegetation (Least Concern) and Highveld Salt Pan (Azonal -sensitive) are found on the property. The Vaal-Vet Sandy Grassland has mostly been lost to cultivation and only Highveld Alluvial Vegetation features prominently on the property. Since the latter vegetation type is not threatened locally or over a wide area, the direct and cumulative impacts would be **Low** to **Very Low** and effectively only ESAs would be impacted by the proposed infrastructure.

12. Conclusions

The general conclusion is that the proposed SPV layout (Alternative 1) takes into account sensitive areas and they will be avoided (mitigation). Further mitigation will be to safeguard geophytes that can be relocated. Rehabilitation of the disturbed areas that will not to be used later will ensure that **Low Negative** impacts can be maintained, and the acceptability of the proposed infrastructure would be raised.

The low level of sensitivity of the receiving environment from a botanical perspective, and its extent elsewhere in the Free State Province, indicates that the areas selected for Doornrivier Solar 1 (preferred alternative) are suited to the purpose of SPV development, and the proposal is supported.

13. References

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Hensley, M., le Roux, P., du Preez, C., van Huysteen, C., Kotze, E. & van Rensburg, L. (2006). Soils: The Free State's Agricultural Base. South African Geographical Journal, 88 (1): 11—21.

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South African National Biodiversity Institute (SANBI). 2021 Red List of Ecosystems (RLE) for terrestrial realm for South Africa - remnants [Vector] 2021. Available from the Biodiversity GIS website, downloaded on 30 August 2022.

Report submitted: 18 August 2022; amended and re-submitted 25 January 2023.

Appendix 1: Minimum Content Requirements for Botanical and Terrestrial Biodiversity Specialist Reports as per Protocol for the Specialist Assessment of Environmental Impacts on Terrestrial Biodiversity (GN 320 of 20 March 2020)

Protocol ref	**Botanical and Terrestrial Biodiversity Specialist Assessment Report Content**	**Section / Page**
3.1.1.	contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Cover & Page 2
3.1.2.	a signed statement of independence by the specialist;	Pages 3 & 4
3.1.3.	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Page 12
3.1.4.	a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	Page 12
3.1.5.	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Page 12
3.1.6.	a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Page 26
3.1.7.	additional environmental impacts expected from the proposed development;	N/A
3.1.8.	any direct, indirect and cumulative impacts of the proposed development;	Page 28--35
3.1.9.	the degree to which impacts and risks can be mitigated;	Page 33
3.1.10.	the degree to which the impacts and risks can be reversed;	Pages 31--33
3.1.11.	the degree to which the impacts and risks can cause loss of irreplaceable resources;	Pages 31--33
3.1.12.	proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Page 37
3.1.13.	a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a "low" terrestrial biodiversity sensitivity and that were not considered appropriate;	N/A
3.1.14.	a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	Page 37
3.1.15.	any conditions to which this statement is subjected.	N/A

Appendix 2: Curriculum Vitae

Dr David Jury McDonald Pr.Sci.Nat.

Name of Company: Bergwind Botanical Surveys & Tours CC. (Independent consultant)

Work and Home Address: 14 A Thomson Road, Claremont, 7708

Tel: (021) 671-4056 **Mobile:** 082-876-4051 **Fax:** 086-517-3806

E-mail: dave@bergwind.co.za

Website: www.bergwind.co.za

Profession: Botanist / Vegetation Ecologist / Consultant / Tour Guide

Date of Birth: 7 August 1956

Employment history:

- 19 years with National Botanical Institute (now SA National Biodiversity Institute) as researcher in vegetation ecology.
- Five years as Deputy Director / Director Botanical & Communication Programmes of the Botanical Society of South Africa
- Seventeen years as private independent Botanical Specialist consultant (Bergwind Botanical Surveys & Tours CC)

Nationality: South African (ID No. 560807 5018 080)
Languages: English (home language) – speak, read and write
Afrikaans – speak, read and write

Membership in Professional Societies:

- South Africa Association of Botanists
- International Association for Impact Assessment (SA)
- South African Council for Natural Scientific Professions (**Ecological Science, Registration No. 400094/06**)
- Field Guides Association of Southern Africa

Key Qualifications:

- Qualified with a M. Sc. (1983) in Botany and a PhD in Botany (Vegetation Ecology) (1995) at the University of Cape Town.
- Research in Cape fynbos ecosystems and more specifically mountain ecosystems.
- From 1995 to 2000 managed the Vegetation Map of South Africa Project (National Botanical Institute).
- Conducted botanical survey work for AfriDev Consultants for the Mohale and Katse Dam projects in Lesotho from 1995 to 2002. A large component of this work was the analysis of data collected by teams of botanists.
- **Director: Botanical & Communication Programmes** of the Botanical Society of South Africa (2000—2005), responsible for communications and publications;

involved with conservation advocacy particularly with respect to impacts of development on centres of plant endemism.

- Further tasks involved the day-to-day management of a large non-profit environmental organisation.
- **Independent botanical consultant** (2005 – to present) over 600 projects have been completed related to environmental impact assessments in the Western, Southern and Northern Cape, Karoo and Lesotho. A list of reports (or selected reports for scrutiny) is available on request.

Higher Education

Degrees obtained
and major subjects passed:

B.Sc. (1977), University of Natal, Pietermaritzburg
Botany III
Entomology II (Third year course)

B.Sc. Hons. (1978) University of Natal, Pietermaritzburg
Botany (Ecology /Physiology)

M.Sc. - (Botany), University of Cape Town, 1983.
Thesis title: 'The vegetation of Swartboschkloof, Jonkershoek, Cape Province'.

PhD (Botany), University of Cape Town, 1995.
Thesis title: 'Phytogeography endemism and diversity of the fynbos of the southern Langeberg'.

Certificate of Tourism: Guiding (Culture: Local)
Level: 4 Code: TGC7 (Registered Tour Guide: WC 2969).

Employment Record:

January 2006 – present: Independent specialist botanical consultant and tour guide in own company: **Bergwind Botanical Surveys & Tours CC**
August 2000 - 2005 : Deputy Director, later Director Botanical & Communication Programmes, Botanical Society of South Africa
January 1981 – July 2000 : Research Scientist (Vegetation Ecology) at National Botanical Institute
January 1979—Dec 1980 : National Military Service

Further information is available on my company website: www.bergwind.co.za