Botanical Assessment for the proposed development of a Doringrivier Solar Energy Facility 2 on Portion 5 of Farm Doorn River 330, Theunissen , Free State Province

Botanical Surveys & Tours

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Report compiled for: EnviroAfrica CC
Client: Keren Energy

August 2022; amended January 2023

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 5 of Farm Doorn River 330, Theunissen, Free State Province.

Details of Specialist

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Expertise

Dr David J. McDonald:

- 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

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of the report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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:

22 August 2022; 31 January 2023

Date:

CONTENTS

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 5 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.

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.
- 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 5 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.

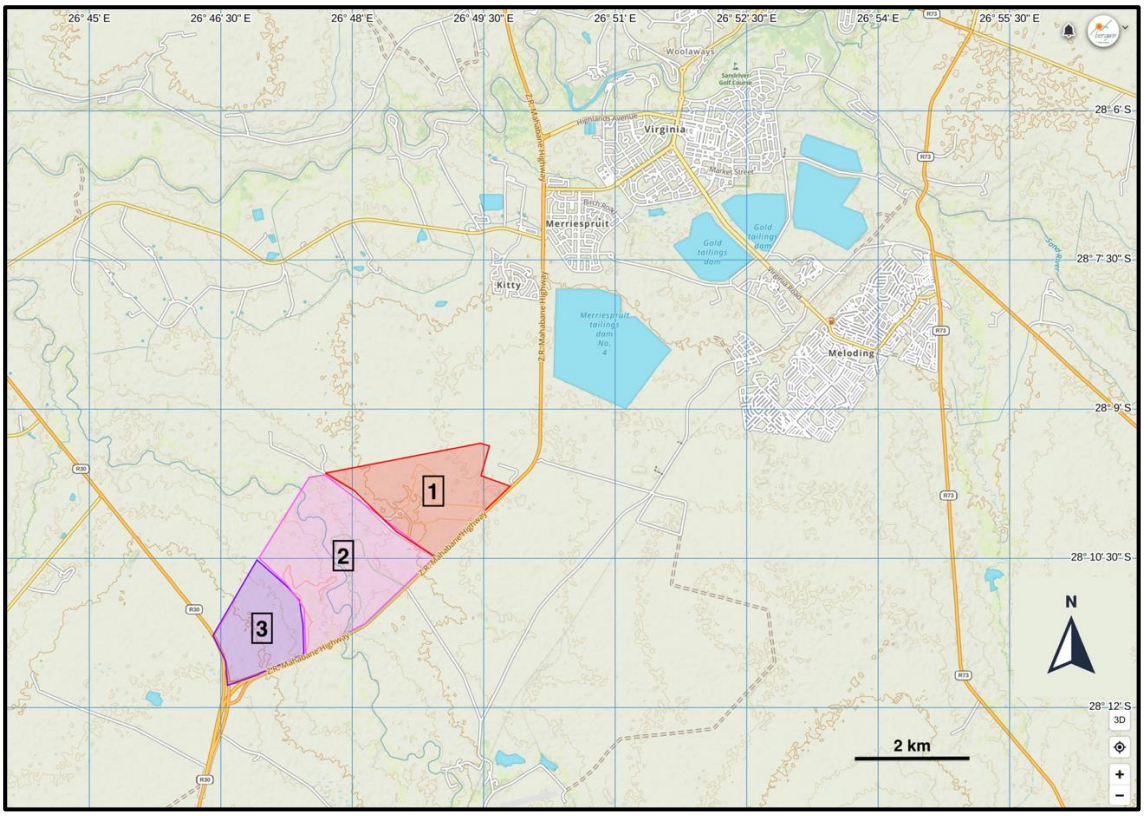


Figure 1. Topographical map of the general location of Portion 5 of Farm Doorn River 330, Theunissen (shown as 2 and shaded pink on the map) where the proposed Doringrivier Solar 2 would be constructed. (Map source: GAIA GPS).

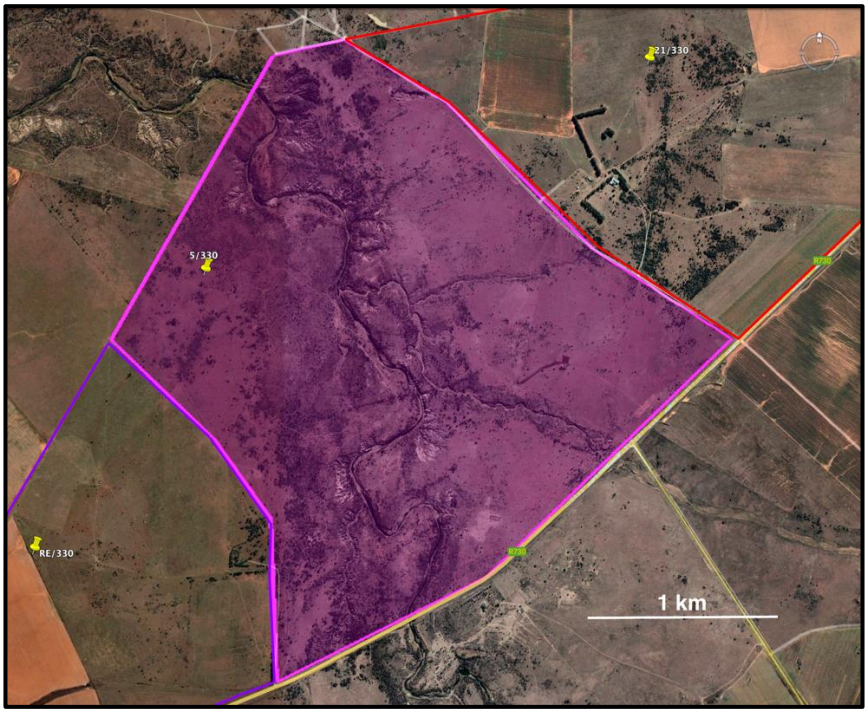


Figure 2. Google Earth Pro™ of Portion 5 of Farm Doorn River (pink boundary), the proposed site for Doringrivier Solar 2.

3.2 Topography, Geology and Soils

The topography of Portion 5 of Doorn River 330 (Doringrivier Solar 2) slopes gently from the east and west until the river, where there a shallow gradient to the Doring River and in other places a sharp drop in elevation to the bed of the river.

The underlying geology of Portion 5 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 5 of Farm Doorn River 330 (Figure 3). It has been well documented that soils in the Free State that have developed where the underlying geology is the Beaufort Group have dispersive clays in the subsoil horizons. These are referred to as duplex soils. When the clays in the soil matrix are exposed to relatively pure water, they deflocculate to form colloidal (murky) suspensions and the soils are hence highly erodible (Bell & Maud, 1994; Hensley *et al*., 2006; Paige-Green, 2008).

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

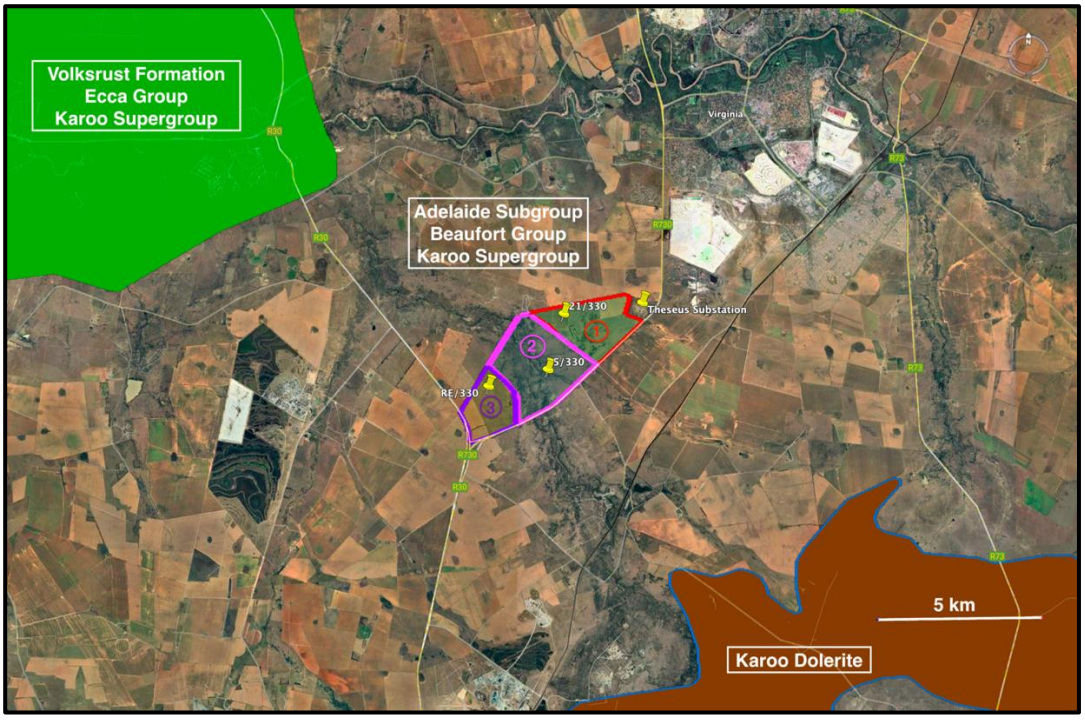


Figure 3. The parent farm Doorn River 330, Theunissen, and hence the three portions proposed for solar energy facilities, is underlain by sedimentary rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup.

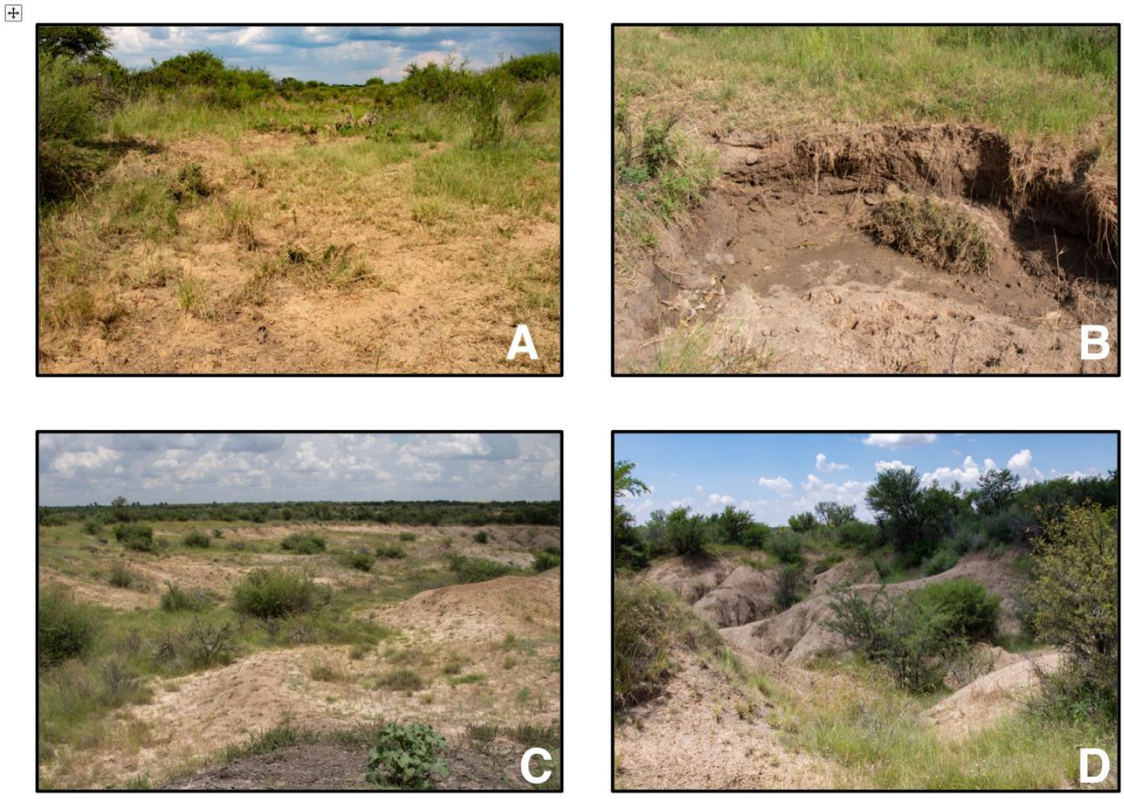
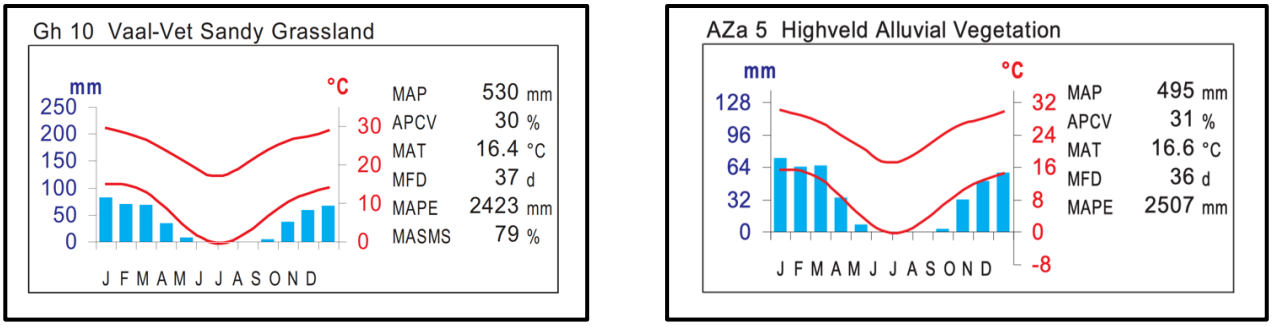


Figure 4. Images showing the progression of erosion at Portion 5 of Doorn River 330. A. Trampling by cattle and exposure of topsoil. B. Topsoil unstable and breaking off in 'peds'. C. Subsoil with dispersive clays that are eroding in the absence of topsoil – mid -stages of gulley formation and some natural revegetation occurring. D. Deep gulleys, where there is no longer any topsoil and the terrain is very unstable.

3.3 Climate

Farm Doorn River 330, Theunissen, is 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 (Figure 5).



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.

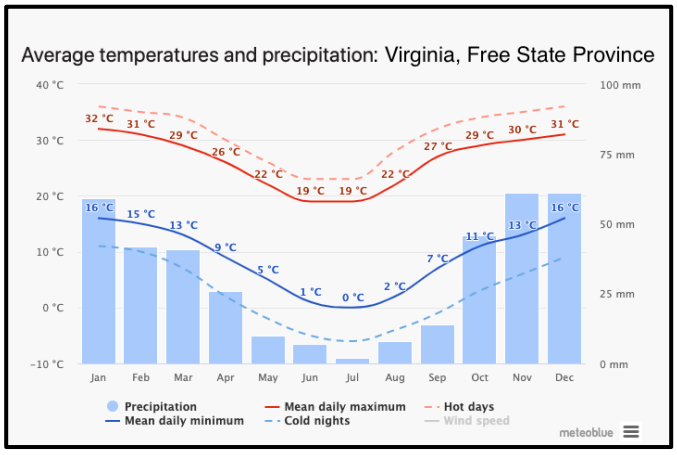


Figure 6. Climate chart for Virginia, Free State Province, modelled by meteoblue. The rainfall pattern is strongly biased towards summer rainfall (October to March) with the winters being cold

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.

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 and surveyed for 7 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.

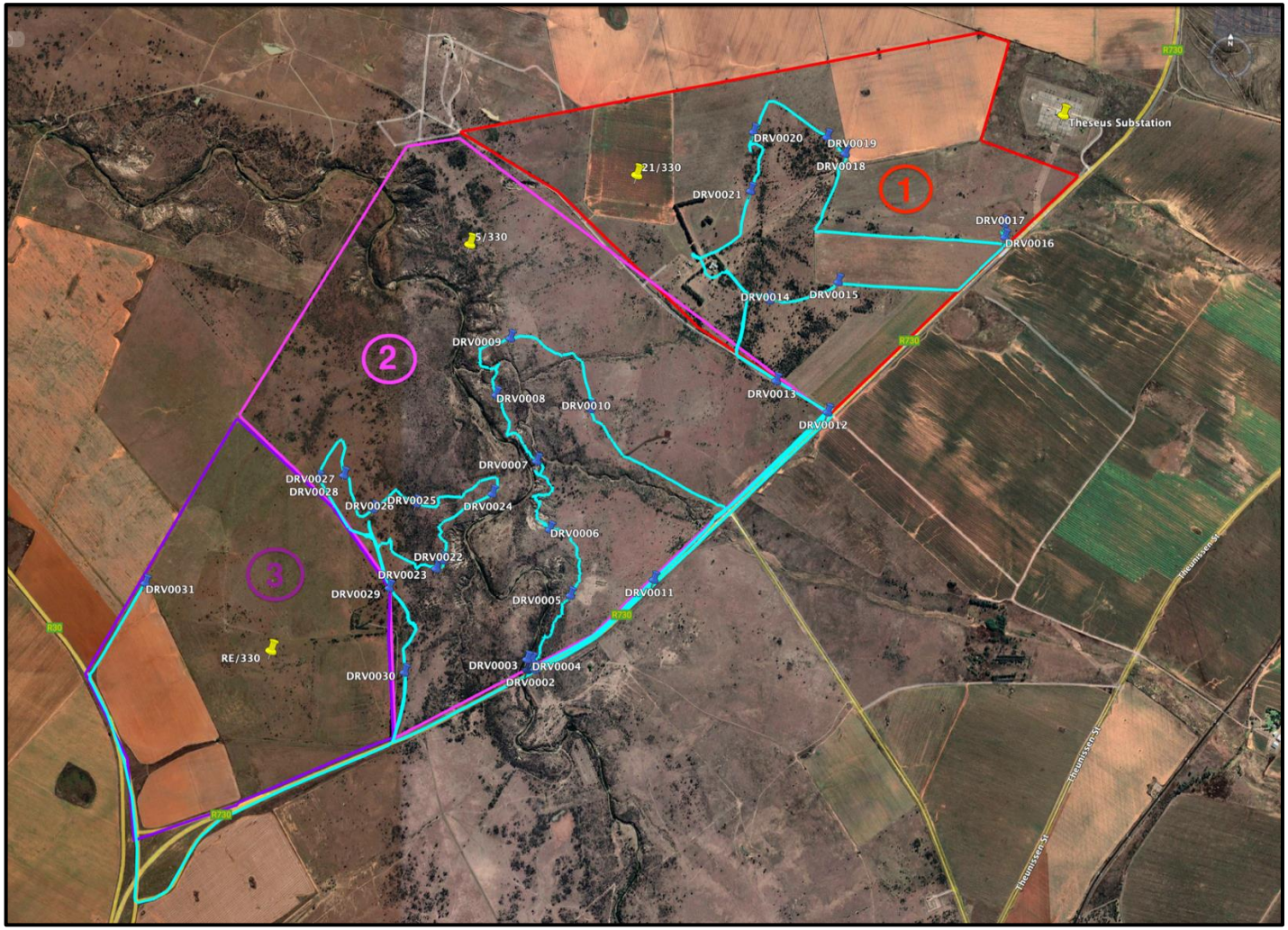


Figure 7. The three areas proposed for solar facility development, Doringriver Solar 1 (red boundary), Doringrivier Solar 2 (pink boundary) and Doringrivier Solar 3 (purple boundary). The light blue line represents the survey track, and the sample waypoints are indicated by blue pins with DRV#. The Eskom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

5. Disturbance regime

Portion 5 of Doorn River 330 (indicated as 2, with pink boundary in Figure 8), has been actively farmed for some time with beef cattle. No cultivation has taken place in this area and the greatest agent of disturbance is the cattle. It appears that overgrazing was the initial cause of the gulley erosion. Some parts of the area where gulley erosion is found are now restoring with vegetative cover (Figure 9), probably due to lower stocking rates.

The vegetation pattern seen at Portion 5 of Doorn River 330, indicates lack of fire in this essentially grassland ecosystem. This has allowed *Vachellia karoo* (soetdoring, sweet-thorn) (formerly *Acacia karoo*) to increasingly encroach into the grasslands on both the east and west sides of the river. 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 also have altered the soil chemistry. *Vachellia karoo* is a widespread species and in some instances is a good indicator of disturbance or absence of fire (Dingaan, 2008).

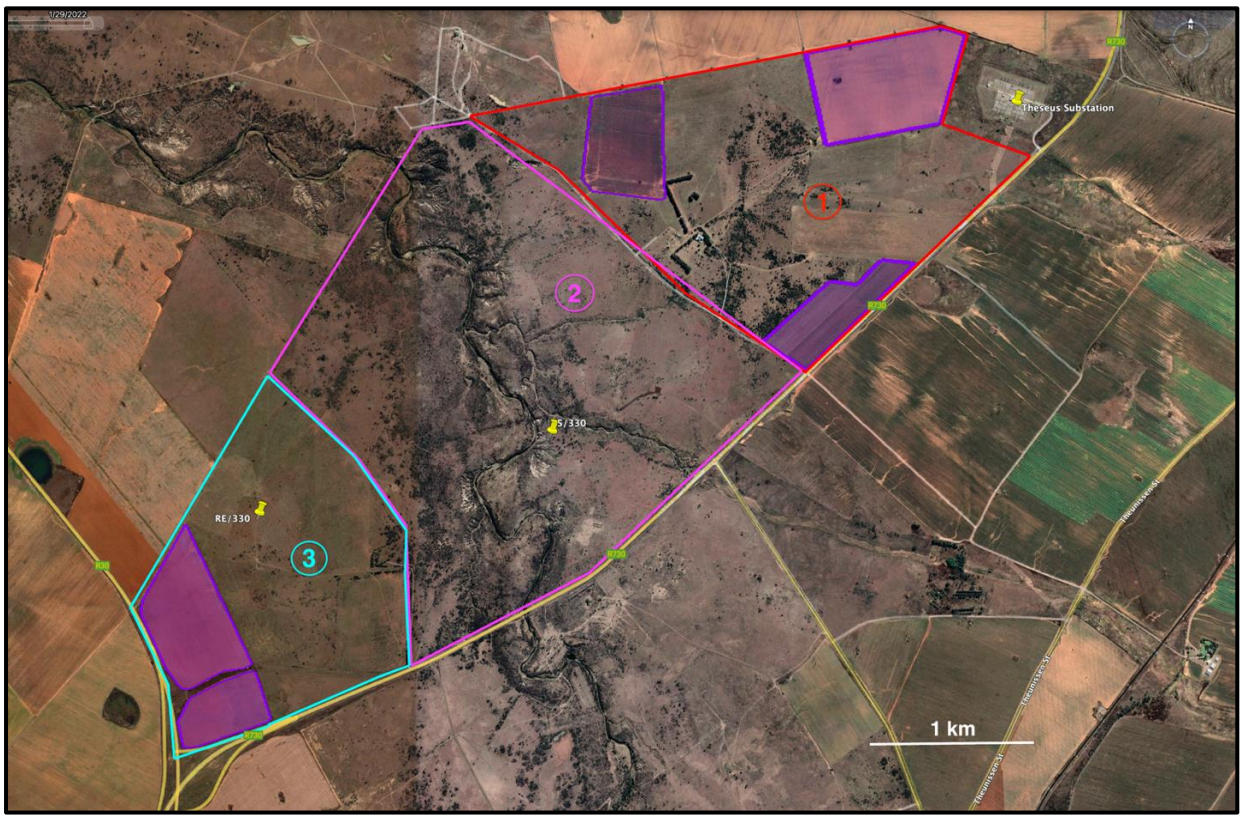


Figure 8. Portion 5 of Doorn River 330 (indicated by 2 with a pink boundary), has never been cultivated. The purple shaded areas on the neighbouring portions (1 & 3) indicate cultivated lands. The most important disturbance at Portion 5 is the erosion in the riparian and near-riparian zone, caused initially by overgrazing.

Figure 9. Grass and sweet-thorn (*V. karoo*) are returning to the eroded gulleys, leading to stabilization of the eroded areas at Portion 5 of Doorn River 330.

6. Botanical evaluation of the study area

6.1 General description

The vegetation of Portion 5 Doorn River 330 falls within the Grassland Biome and towards the edge of the Vaal-Vet Sandy Grassland. The area mapped as Highveld Alluvial Grassland along the Doring River, and which takes up the greater part of Portion 5 Doorn River 330 abuts an area of Vaal-Vet Sandy Grassland to the west (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 **Highveld Alluvial Vegetation** by Mucina, Rutherford & Powrie (2006) include the following:

Riparian thickets Small Trees:

Acacia karroo (d), Salix mucronata subsp. mucronata (d), S. mucronata subsp. woodii (d, within sub escarpment grasslands of KwaZulu-Natal), Ziziphus mucronata (d), Celtis africana, Rhus lancea. Tall Shrubs: Gymnosporia buxifolia (d), Searsia pyroides (d), Diospyros lycioides, Ehretia rigida, Grewia flava. Low Shrubs: Asparagus laricinus (d),

A. suaveolens (d). Woody Climber: Clematis brachiata. Succulent Shrub: Lycium hirsutum (d). Graminoids: Setaria verticillata (d), Panicum maximum. Herb: Pollichia campestris.

Reed beds Megagraminoid: *Phragmites australis (d).*

Flooded grasslands & herblands Low Shrubs: *Gomphocarpus fruticosus (d), Felicia muricata.*

Succulent Shrub: *Salsola rabieana.*

Graminoids:

Agrostis lachnantha (d), Andropogon eucomus (d), Chloris virgata (d), Cynodon dactylon (d), Eragrostis plana (d), Hemarthria altissima (d), Imperata cylindrica (d), Ischaemum fasciculatum (d), Miscanthus junceus (d), Paspalum distichum (d), Andropogon appendiculatus, Brachiaria marlothii, Cyperus denudatus, C. longus, Echinochloa holubii, Eragrostis obtusa, E. porosa, Fimbristylis ferruginea, Panicum coloratum, Pycreus mundii, Sporobolus africanus, S. fimbriatus, Themeda triandra, Urochloa panicoides.

Herbs:

Persicaria lapathifolia (d), Alternanthera sessilis, Barleria macrostegia, Corchorus asplenifolius, Equisetum ramosissimum, Galium capense, Hibiscus pusillus, Lobelia angolensis, Nidorella resedifolia, Persicaria amphibia, P. hystricula, Pseudognaphalium oligandrum, Pulicaria scabra, Rorippa fluviatilis var. fluviatilis, Senecio inornatus, Stachys hyssopoides, Vahlia capensis.

Geophytic Herbs: *Crinum bulbispermum, Haplocarpha lyrata.*

Open water Aquatic Herb: *Myriophyllum spicatum.*

Species listed for **Vaal-Vet Sandy Grassland** by Mucina *et al.* (2006) include the following:

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*

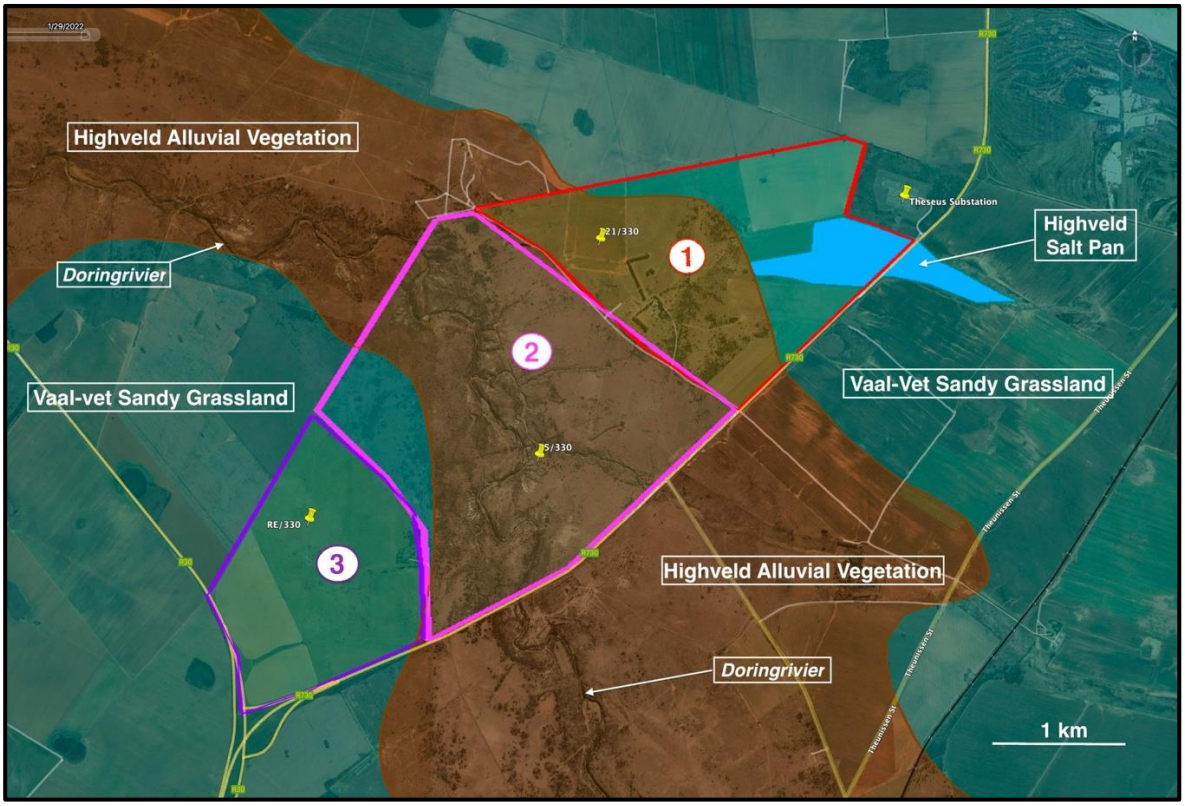


Figure 10. Extract from the Vegetation Map of South Africa, Lesotho & Swaziland (Mucina *et al.* 2005; SANBI, 2018) (VEGMAP) overlaid on a Google Earth pro ™ image, indicating that part of Portion 5 of Doorn River 330 (indicated as 2, with pink boundary) is mapped as mostly Highveld Alluvial Vegetation and a small area of Vaal-Vet Sandy Grassland.

6.2 Vegetation recorded at sample waypoints

Reference should be made to Figure 7 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. Plant species marked with * are alien, invasive species.

Table 1. The vegetation and habitat found at the sample waypoints on Portion 5 of Farm Doorn River 330, Theunissen.

Waypoint	Coordinates	Descriptive notes	Illustrations
DRV0001	**S 28° 11' 15.71" E 26° 47' 55.37"**	This was the beginning point of the survey on the pipeline servitude that runs parallel to the highway. The vegetation is mostly grasses but there are a few *Vachellia karoo* trees. Near this point is an individual of **Prosopis glandulosa* subsp. *torreyana.* Other species include, *Aristida congesta, *Bidens pilosa, Chloris virgata, Chrysocoma ciliata, Commicarpus pentandrus, Digitaria eriantha, Digitaria* sp. (small), *Eragrostis lehmanniana, Eragrostis superba, Felicia muricata, Helichrysum rugulosum, Heliotropium lineare, Melolobium candicans, Nidorella resedifolia* subsp. *resedifolia, Salvia verbenaca, Sporobolus* sp., *Themeda triandra, *Vernonia bonariensis* and *Zinnia peruviana.*	
DRV0002	**S 28° 11' 15.68" E 26° 47' 56.95"**	Riparian scrub that has invaded into the grassland in the absence of fire. Mid-high to tall shrubs with a graminoid and low shrub field stratum. Plant species recorded include, *Asparagus laricinus, Berkheya annectens, Chlorophytum sp., Clematis brachiata, Commelina africana, Cynodon dactylon, Diospyros lycioides, Eleusine coracana, Galium capense, Oxalis sp., Pavonia burchellii, Searsia sp., Setaria sp. Solanum elaeagnifolium, Sporobolus sp., Themeda triandra, Zinnia peruviana, Robinia pseudacacia Schkuria pinnata, Senecio inaequidens, Vachellia karoo, Ziziphus mucronata* *Mesemb sp.*	

			
DRV0003	**S 28° 11' 13.83" E 26° 47' 55.31"**	This waypoint was recorded on the east bank of the Doring River. The thicket-grassland mosaic comes right down to the riparian zone. *Phragmites australis* forms a fringe along the water's edge together with *Juncus* sp. A *Crinum* sp., most likely *Crinum bulbispermum* was noted on the opposite bank. *Imperata cylindrica* and *Cotula* sp. were found on the sandy alluvial soil. Other species recorded were, *Araujia sericifera, Aristida congesta, Cyperus usitatus, Diospyros lycioides, Eriosema* sp., *Melinis nerviglumis, Phragmites australis* and *Setaria verticillata.*	

DRV0004	**S 28° 11' 14.01" E 26° 47' 56.28"**	Open grassy area with less thicket but *Vachellia karoo* present. Other species include, *Berkheya annectens, Bidens Pilosa, Blepharis subvolubilis, Chlorophytum* sp., *Chrysocoma ciliata, Commelina* sp. (blue flowers) *Cylindropuntia imbricata, Cymbopogon pospischilii, Cynodon dactylon, Eragrostis echinochloidea, Eragrostis lehmanniana, Eragrostis plana, Fingerhuthia africana, Helichrysum rugulosum, Hermannia coccocarpa, Melolobium candicans Nidorella resedifolia subsp. resedifolia, Plantago lanceolata, *Prunus persica, *Pyrus communis, Salvia verbenaca, Schkuria pinnata, Setaria* sp., *Sporobolus* sp. – dominant, *Themeda triandra, Vernonia bonariensis, Vicia* sp., **Yucca sp.* and **Zinnia peruviana.*	
DRV0005	**S 28° 11' 02.25" E 26° 48' 04.21"**	This location was away from the river where the cattle graze. A grazing lawn of *Cynodon dactylon* is found here with scattered small trees of *Vachellia karoo* and thickets of *Asparagus laricinus*. This area is in moderate to poor condition. *Searsia lancea* trees, surrounded by shrubs are found here. *Chrysocoma ciliata* is common as is *Nidorella resedifolia subsp. resedifolia*. A single plant of alien **Prosopis glandulosa* var. *torreyana* (mesquite) was recorded here.	

DRV0006	**S 28° 10' 50.4" E 26° 48' 0.00"**	This waypoint was recorded in an area of severe gulley erosion on the slopes east of the Doring River and leading to it. The erosion is rehabilitating slowly and must be excluded from any SPV construction footprint.	
DRV0007	**S 28° 10' 38.2" E 26° 47' 57.34"**	At this point there is grassland and thorn-tree thicket on a spur between a tributary and the main Doring River. This vegetation is similar to the typical vegetation found in the zone of highveld Alluvial Vegetation. A small group of *Ammocharis coranica* were found here.	 

DRV0008	**S 28° 10' 26.03" E 26° 47' 48.97"**	This location has an open grassy area with generally the same suite of plant species, but with sparse occurrence of *Themeda triandra*. The area was obviously burnt a few years prior to the survey because the young *Vachellia karoo* trees have been burnt and either killed or set back. This area is grazed by cattle, but not excessively. Some alien cactus species, **Echinopsis spachiana* and **Cylindropuntia imbricata* were recorded here. They should be eradicated.	   *Cylindropuntia imbricata* (above) *Echinopsis spachiana* (left)

DRV0009	**S 28° 10' 15.82" E 26° 47' 51.89"**	On a flat area with slop to northeast and the Doring River to the southwest. This area is dominated by *Themeda triandra* and is in fair condition. This is the type of terrain on which the solar installations should be built, away from the river and away from the eroded areas. This veld extends to the boundary in the northeast and north. This vegetation is not sensitive as long as a good buffer zone is left along the river. Other plant species recorded here include, *Berkheya annectens, Desmodium sp., Digitaria sp., Felicia muricata, Geigeria sp., Indigofera alternans Nidorella resedifolia* subsp. *resedifolia, Pterodiscus speciosus, Scabiosa sp., Searsia lancea, Setaria sp., Sporobolus sp., Vachellia karoo.*	
DRV0010	**S 28° 10' 28.52" E 26° 48' 08.30"**	This area has *Themeda triandra*-dominated grassveld with scattered thickets of *V. karoo* and *Asparagus laricinus*. The thickets are not sensitive and can be removed. The veld at this location was in reasonable condition; not overgrazed.	 

DRV0011	**S 28° 10' 59.40" E 26° 48' 21.30"**	This waypoint was taken on the access road on Portion 5 of Doorn River 330, parallel to the tarred highway. Photos were taken looking north over an area that is not sensitive and of the same vegetation type (Highveld Alluvial Vegetation). This area could be developed because the thicket and encroaching *V. karoo* are not sensitive.	
DRV0022	**S 28° 10' 55.88" E 26° 47' 38.06"**	At this waypoint on the west side of the Doring River, the vegetation is the same mixed thicket with grassland. There is severe erosion on the west side of the river near here as well. The dominant grasses here are *Digitaria eriantha* and *Eragrostis plana*. The veld is in fair condition. Other species include, *Asparagus laricinus, Berkheya annectens, Bidens pilosa, *Echinopsis spachiana, Chrysocoma ciliata, Commelina africana, Eragrostis echinochloidea, Eragrostis superba, Felicia muricata, Galium capensis, Helichrysum rugulosum, Lycium cf. arenicola*, *Selago saxatilis*, *Senecio, Setaria sphaecelata, Solanum elaeagnifolium*, *Tephrosia* sp., *Themeda triandra, Vachellia karoo, Vernonia bonariensis* and *Ziziphus mucronata.*	 

DRV0023	**S 28° 10' 57.43" E 26° 47' 36.68"**	This is the same veld as found at DRV0022. *Vachellia karoo* is abundant but many have been killed by fire. *Aristida congesta* was found here, which was not noted at DRV0022.	
DRV0024	**S 28° 10' 43.90" E 26° 47' 48.22"**	This area is tramped out and grazed hard by cattle. The dominant grasses are *Eragrostis lehmanniana* and *Aristida congesta*. The same Highveld Alluvial Vegetation but with a different disturbance regime. *Cynodon dactylon* has been grazed to 'lawns' in places.	 

DRV0025	**S 28° 10' 45.66" E 26° 47' 32.60"**	This area has a strong growth of *V. karoo*. It appeared that *V. karoo* was encroaching strongly into the grassland here along with *Asparagus laricinus* that occurs in thickets.	
DRV0026	**S 28° 10' 46.68" E 26° 47' 23.93"**	This waypoint was recorded in a patch of really old, moribund veld that has a grey appearance.	
DRV0027	**S 28° 10' 40.58" E 26° 47' 17.78"**	This area supports old but not moribund grassland. There is very little *Themeda triandra* present. The dominant species are *Setaria sphaecelata* and *Eragrostis plana*. *Boophone disticha* and *Ammocharis coranica* were present as well. A *Hypoxis* sp. with long leaves was found but not identified.	

DRV0028	**S 28° 10' 41.25" E 26° 47' 12.54"**	This waypoint was at the western boundary fence. The grassland at DRV0028 is uniformly continuous westwards. On the adjoining property a few *Ziziphus mucronata* trees were present.	 
DRV0029	**S 28° 11' 00.91" E 26° 47' 27.11"**	At this waypoint, the grassland is the same as at DRV0028 but with well-established *V. karoo* trees. Not much young *V. karoo* growth nor much *Asparagus laricinus* thicket here either. Some parts around here have old vegetation.	

DRV0030	**S 28° 11' 16.19" E 26° 47' 30.20"**	This area support old veld dominated by *Eragrostis plana* and *Digitaria eriantha*. *Helichrysum rugulosum* was abundant. Other species include, *Asparagus laricinus*, *Cymbopogon pospishcillii, Gomphocarpus fruticosus, Nidorella resedifolia* subsp. *resedifolia*, *Senecio* sp., *Setaria sphaecelata*, *V. karoo, Vernonia bonariensis*.	

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 5 of Doorn River 330, Theunissen, where the Doornrivier Solar 2 is proposed to be built. The result from the screening tool for the plant species sensitivity theme (Figure 10) is that the sensitivity is **LOW.** This rating is too generalised because from the field observations, the riparian zone of the Doring River should be rated as having **MEDIUM** sensitivity and the remaining areas have **LOW** sensitivity. No distinction is made by the screening tool.

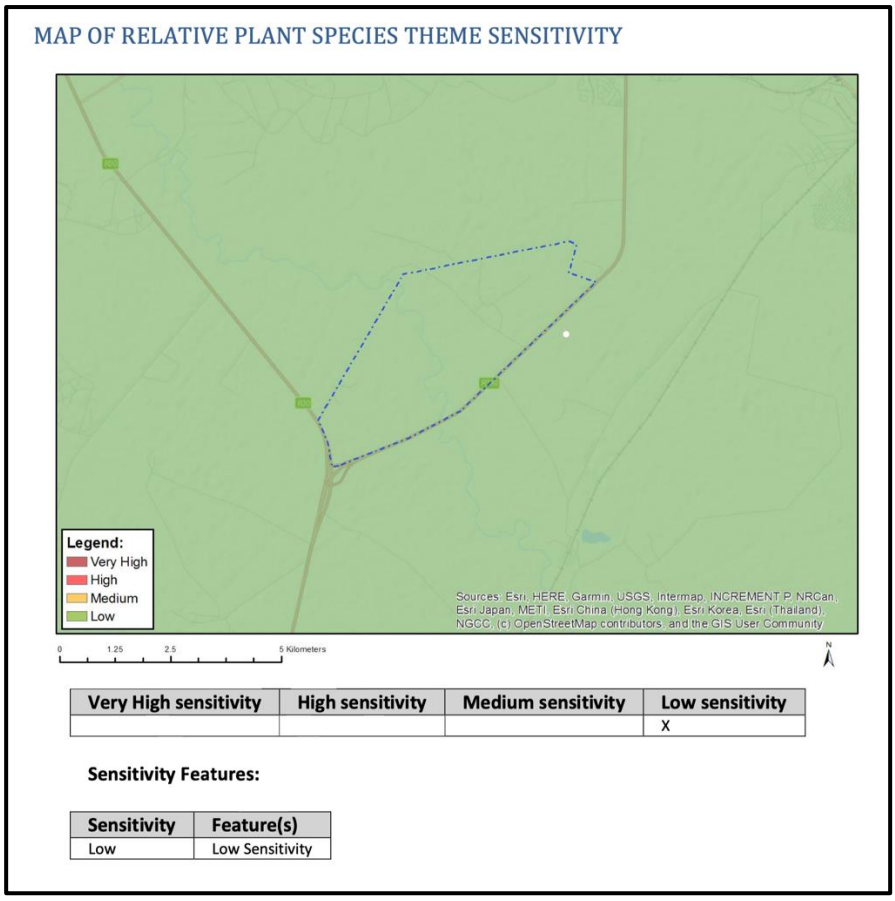
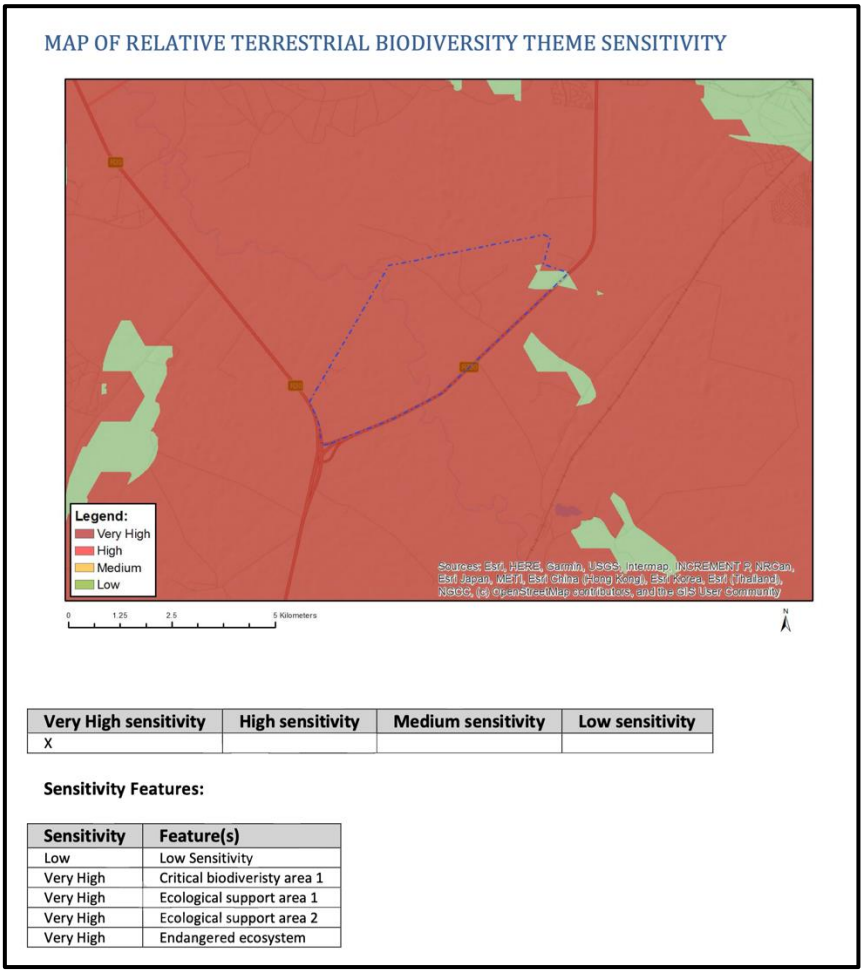


Figure 11. The map for relative plant species theme sensitivity produced by the National Web-based Environmental Screening Tool, indicating that Farm Doorn River 330, Theunissen (area inside the dotted blue boundary) has **Low** sensitivity.

Results were also obtained from the screening tool for the terrestrial biodiversity sensitivity for Farm Doornrivier 330, Theunissen. Figure 12 indicates that the screening tool rates the entire area assessed as having **VERY HIGH** terrestrial biodiversity sensitivity. Without a very detailed study of the flora and fauna, it is not possible to

challenge this rating, however, field observations indicate that the area should be rated as having **MEDIUM** sensitivity.



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. It 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**.

7.4 Sensitivity Mapping based on field observations

From the field-survey a map has been compiled that represents the status as determined from 'on-the-ground' observations (Figure 13). This map indicates areas of **High Sensitivity** where no SPV installations should be built, **Moderate to High**

Sensitivity areas (the greater part of the Transmission Corridor falls in this category), areas of **Moderate Sensitivity** that are buildable with mitigation, **Low Sensitivity** areas that are not currently cultivated and **Very Low Sensitivity** areas that where building of SPV's (and transmission line infrastructure) may be built without constraints.

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**. It is notable that there is an area in the western corner of Portion 5 of Doornrivier 330, ("2 " in Figure 10) that is mapped as Vaal-Vet Sandy Grassland and that has been assigned as **Endangered** on the RLE map (Figure 13) and CBA1 on the Critical Biodiversity Areas map (Figure 14).

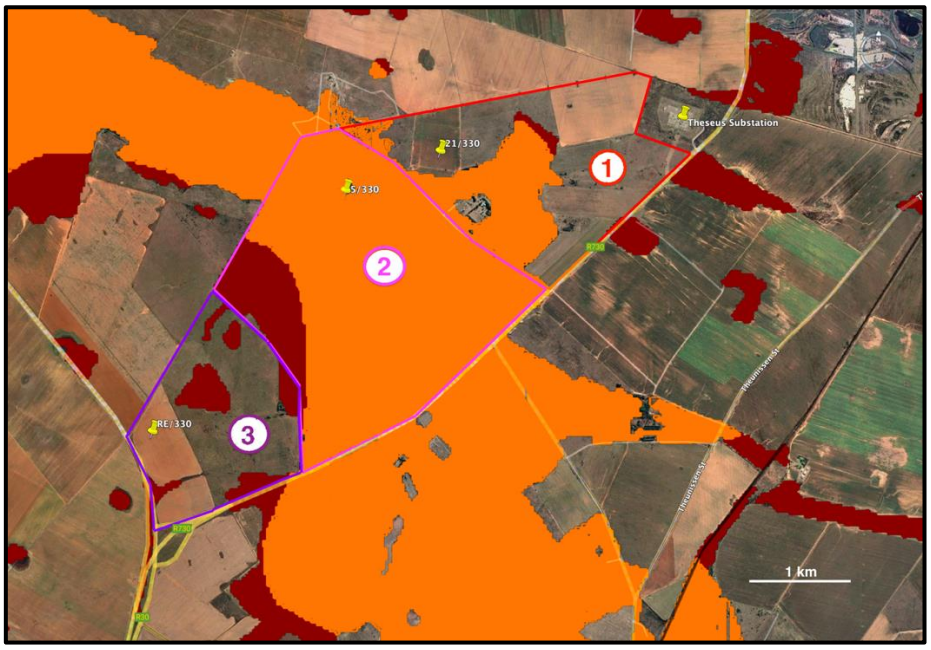


Figure 13. The RLE map overlaid on an Google Earth Pro ™ image for the Farm Doorn River 330, shows that in Portion 5 of Doorn River 330 (area with pink boundary, marked 2) is mostly of **Least Concern** (orange shading) with an area of **Endangered** habitat (dark red shading) in the western corner.

7.3 Critical Biodiversity Areas

The critical biodiversity areas (CBA) map for the Portion 5 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 with the overlaid CBA map (Figure

14). A critical biodiversity area (CBA1) is mapped in the western part of Portion 5 of Doorn River 330 (area 2 with pink boundary on the map), the remaining part of the land portion is assigned to ecological support areas (ESA1).

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

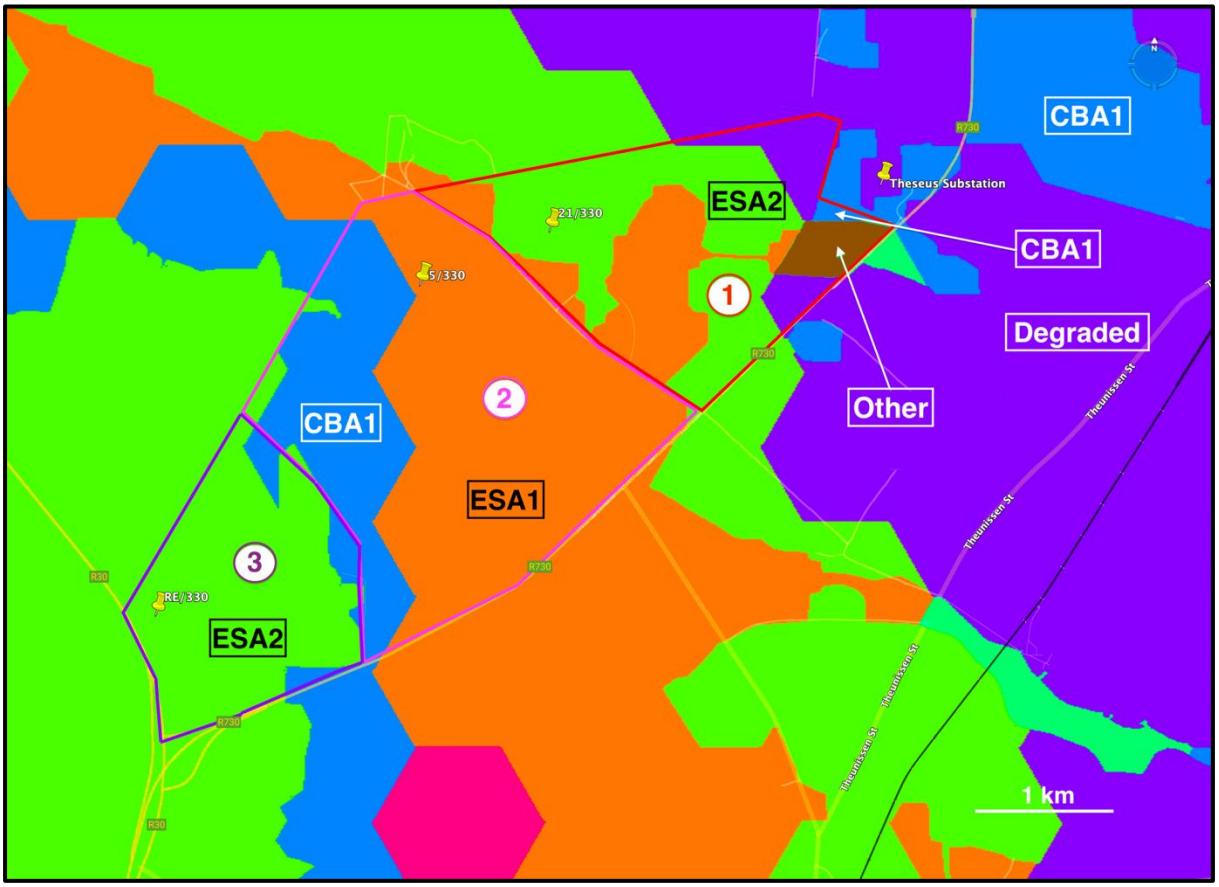


Figure 14. The Critical Biodiversity Map for Farm Doorn River 330, with focus on Portion 5 of Doorn River 330 (marked with 2 and a pink boundary). Most of the site consists of ESA1 (orange) a small amount as ESA2 (green) areas and a significant area in the west as CBA1.

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), except that in the case of

Portion 5 of Doorn River 330. The area mapped as Vaal-Vet Sandy Grassland and rated as CBA1 (Figure 14) and an **Endangered** RLE (13), differs imperceptibly from the adjoining areas of Highveld Alluvium Vegetation to the east. This is the reason that this area is assigned a **Medium** rating in Figure 15, and is acceptable for building a SPV facility.

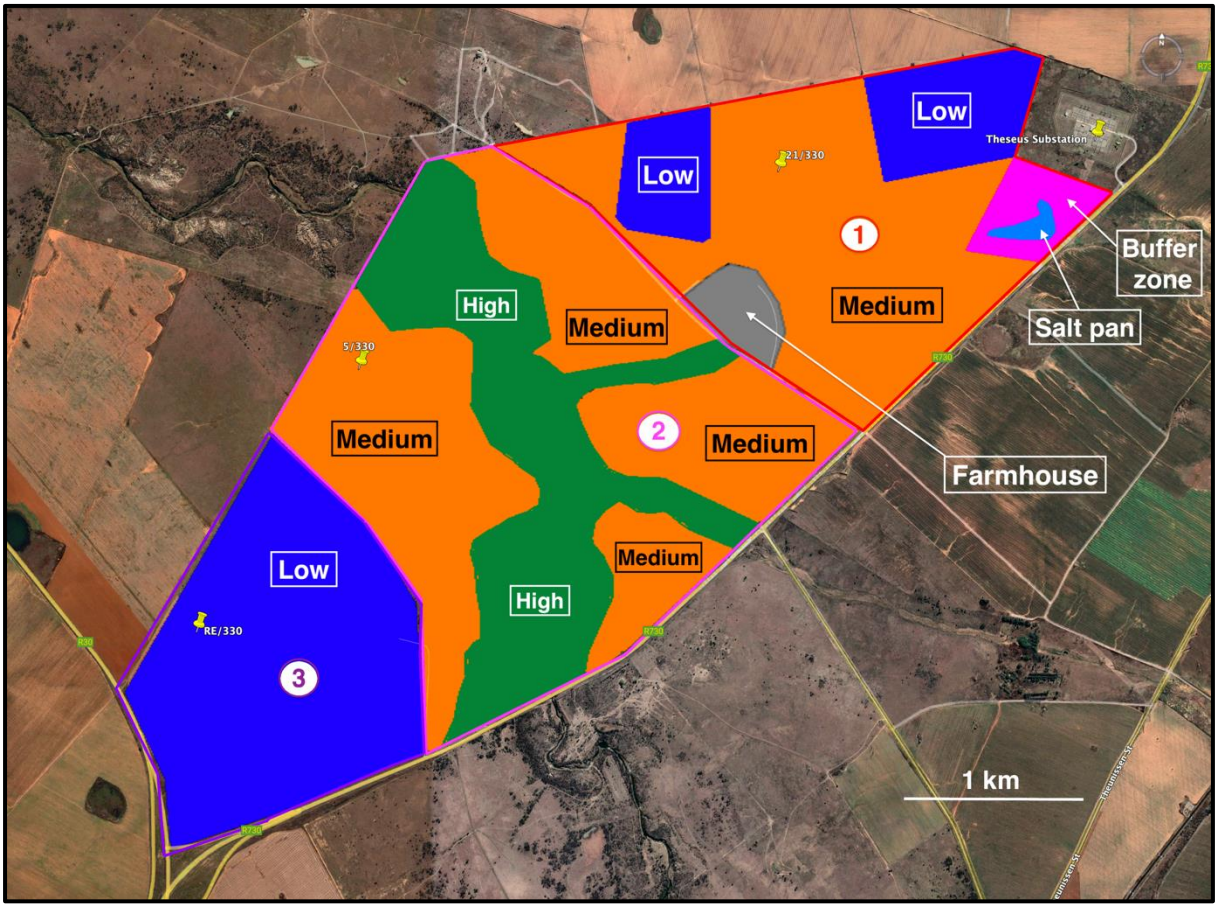


Figure 15. The sensitivity map for Portion 5 of Doorn River 330, Theunissen marked as "2" with a pink boundary. The High sensitivity areas are shaded green and the **Medium** sensitivity areas are shaded orange.

8. Plant Species of Conservation Concern

No plant species of conservation concern were recorded on Portion 5 of Doorn River 330, Theunissen.

9. The proposed Doornrivier Solar PV layout

The sensitivity map (Figure 15) was presented to the proponents of the Doornriver Solar 2 SPV installation and the botanical sensitivity of Portion 5 of Doorn River 330, Theunissen, was taken into account when planning the SPV layout. The only area considered to have **High Sensitivity** is the riparian zone and the buffer zone for the river. Consequently, the proposed SPV layout avoids the riparian zone and has targeted the mixed *Vachellia karoo* and grassland of the Highveld Alluvial Vegetation and the area of Vaal-Vet Sandy Grassland in the west (Figure 16).

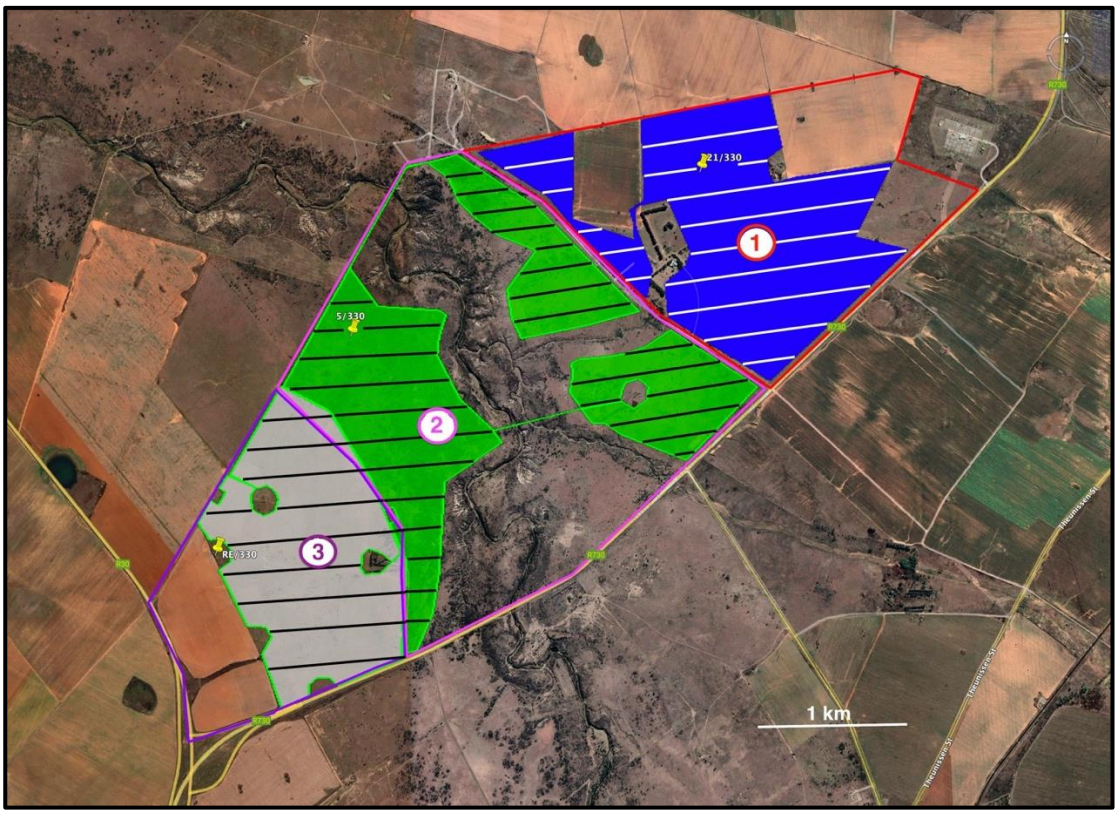


Figure 16. The proposed layout for Doornrivier Solar 2 (dark parallel lines on green background) within the area marked as “2”.

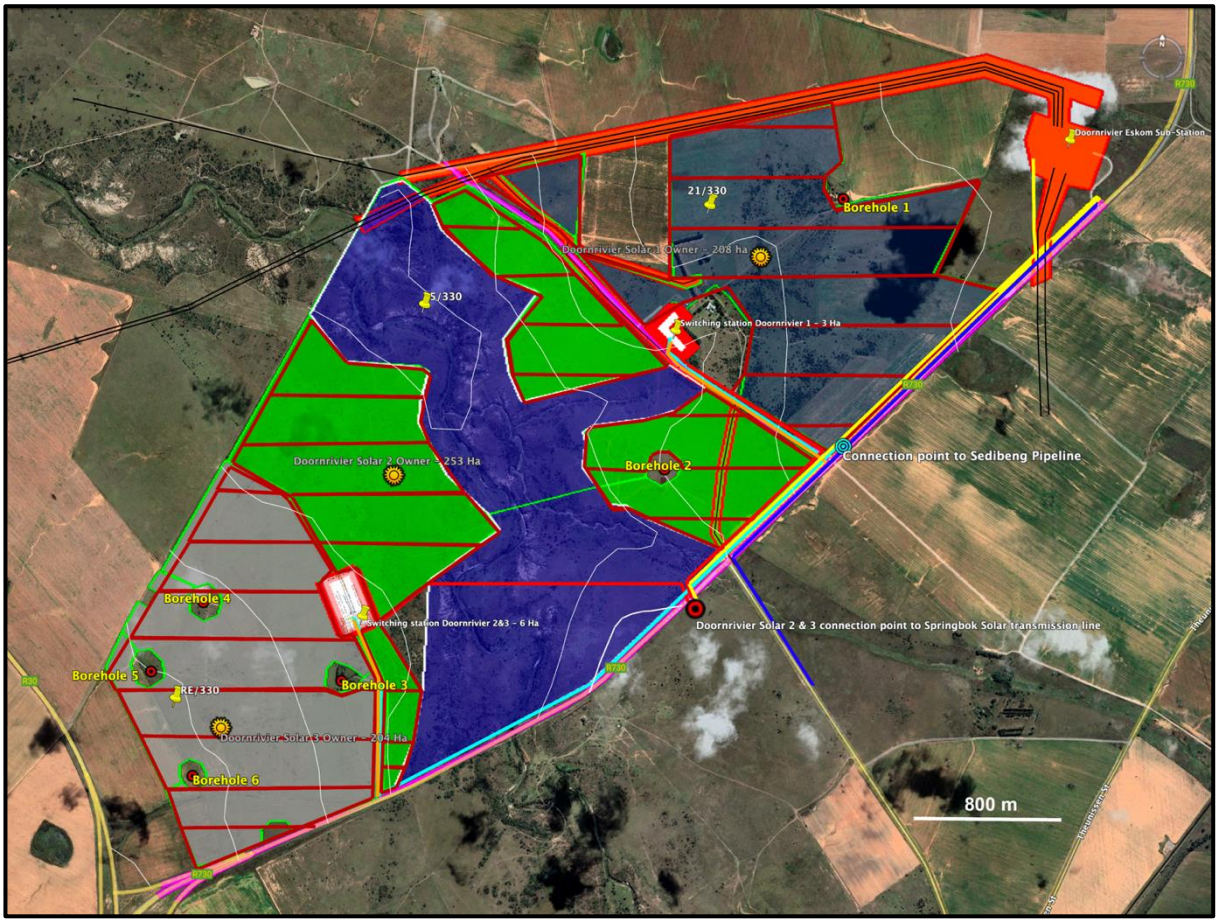


Figure 17. The preferred layout of Doringrivier Solar 1 ,2 and 3, as prepared by the engineering team.

10. Impact Assessment

The No Go alternative, the Preferred Alternative (Alternative 1) i.e. construction and operation of the Doornrivier Solar 2 facility (with layout as given in Figures 16 & 17) and Alternative 2, that would be the development of the entire cadastral unit, excluding a buffer zone along the river of 32 m on either side, are assessed.

10.1 The No Go Alternative

In the case of the No-Go Alternative, the Doornrivier Solar 2 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: The preferred alternative – Doornrivier Solar 2

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 5 of Farm Doorn River 330, Theunissen, excluding the riverine buffer zone, would be developed.

The direct impact of the Doornrivier Solar 2 Alternative 1 (Preferred Alternative) on the natural vegetation of Portion 5 of Doorn Rivier 330, would be **Medium** without mitigation**,** and with mitigation, **Low,** during the construction phase. The direct impact of Alternative 2 would be **High** without mitigation and **Medium** with mitigation in the construction phase (Table 2).

In the operational phase, the direct impact of Alternative 1 would be **Medium** without mitigation and **Low** with mitigation. For Alternative 2 in the operational phase, the direct impact would be **Medium** without mitigation and **Low** with mitigation (Table 3). Some mitigation would be necessary. The loss of Highveld Alluvial Vegetation and Vaal-Vet Sandy Grassland is assessed together because there is little difference between them on the portion of land in question.

Table 2. Impact: The loss of Highveld Alluvial Vegetation and Vaal-Vet Sandy Grassland on Portion 5 of Doorn River 330 during the **construction phase** of Doornrivier Solar 2.

CRITERIA	**'NO GO' ALTERNATIVE**	**Alternative 1** **Doornrivier Solar 2** **Portion 5 of Doorn River 330**		**Alternative 2** **The entire area, excluding the riverine buffer zone of Portion 5 of Doorn River 330, would be developed.**	
Nature of direct impact (local scale)	Loss of Highveld Alluvial Vegetation and Vaal Vet Sandy Grassland				
		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	High negative	Medium negative

Nature of cumulative impact	Loss of Highveld Alluvial Vegetation and Vaal-Vet Sandy Grassland		
Cumulative impact prior to mitigation	N/A	Low Negative	Medium negative
Degree to which impact can be reversed	N/A	Low	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; avoid eroded areas; avoid riparian zone.	Translocation of geophytic species; avoid eroded areas; avoid riparian zone. Removal of alien invasive 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 and Vaal-Vet Sandy Grassland during the **operational phase** of Doornrivier Solar 2.

CRITERIA	**'NO GO' ALTERNATIVE**	**Alternative 1** **Doornrivier Solar 2** **Portion 5 of Doorn River 330**		**Alternative 2** **The entire area, excluding the riverine buffer zone of Portion 5 of Doorn River 330, would be developed.**	
Nature of direct impact (local scale)	Loss of Highveld Alluvial Vegetation and Vaal-Vet Sandy Grassland				
		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 and Vaal-Vet Sandy Grassland				
Cumulative impact prior to mitigation	N/A	Very Low Negative		Low Negative	
Degree to which impact can be reversed	N/A	Low		Low	
Degree to which impact may cause irreplaceable loss of resources	N/A	Low		Low	
Degree to which impact can be mitigated	N/A	Not required		Not required	
Proposed mitigation	N/A	Laydown areas and other areas not required after construction must be rehabilitated.		N/A Laydown areas and other areas not required after construction must be rehabilitated.	
Cumulative impact post mitigation	N/A	Very Low Negative		Low negative	
Significance of cumulative impact (broad scale) after mitigation	N/A	Very Low Negative		Low negative	

10.3 Mitigation in the Construction and Operational Phases

The main mitigation is avoidance of High Sensitivity areas in the Preferred Alternative. This avoidance has been achieved by the design of the SPV layout. Further mitigation in the construction phase would be to relocate any geophytic species such as *Boophone disticha* and *Ammocharis coranica* 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 but that would not be used later i.e. during the operational phase and beyond,

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 (SANBI, 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 Doringrivier Solar 2 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 5 of Farm Doorn River 330, Theunissen. No mitigation would be possible or required to offset these cumulative impacts.

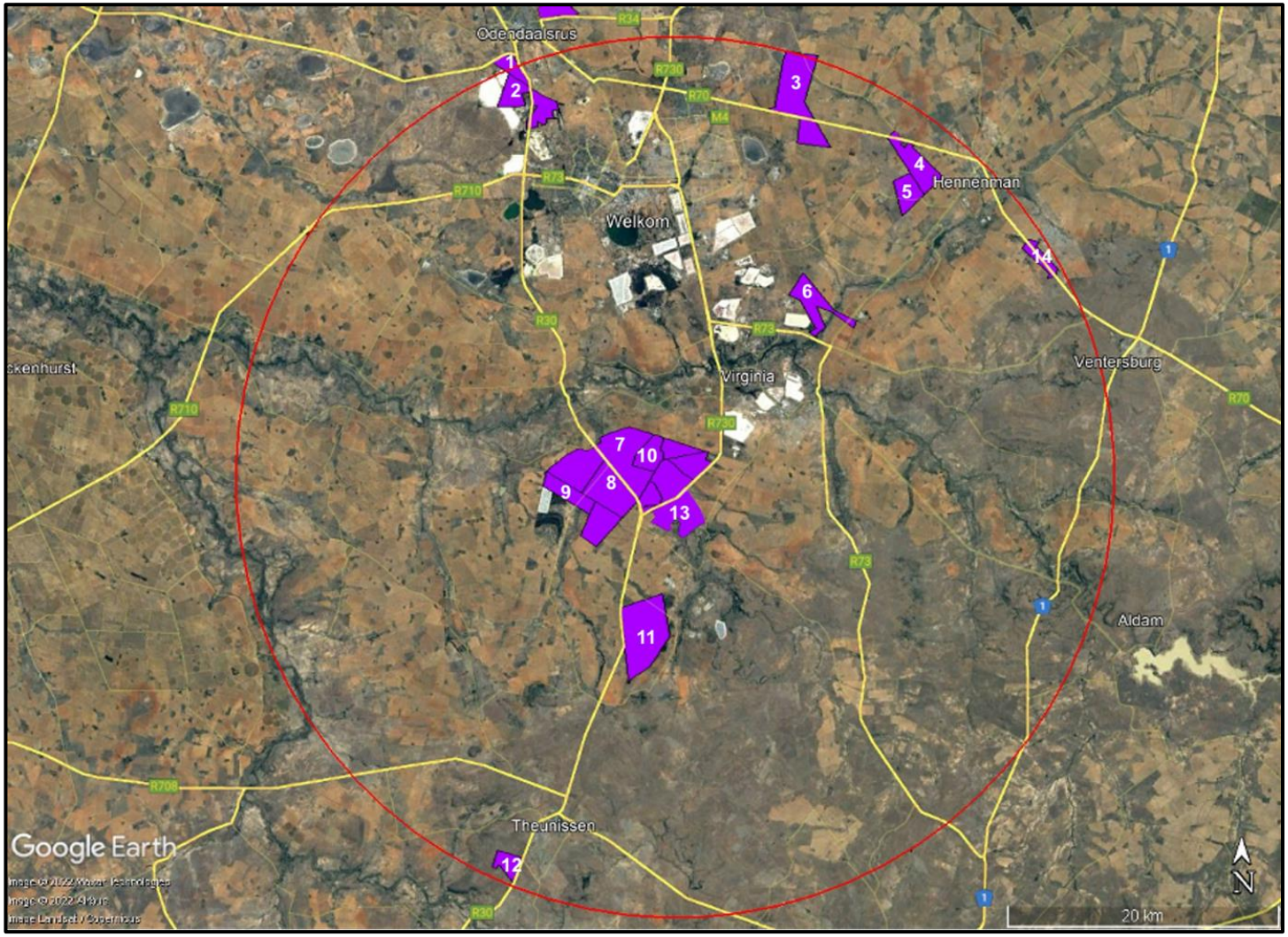


Figure 18. Solar PV projects within a 30 km radius (red circle) from Doorn River and the proposed Doringrivier 1, 2 & 3 Solar PV projects.

Table 4. List of solar PV applications within 30km of Doringrivier Solar 2. The remnant status was determined by inspection of the RLE Remnants (SANBI, 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 5 of Doorn Rivier 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, two vegetation types, Vaal-Vet Sandy Grassland (Endangered) and Highveld Alluvial Vegetation (Least Concern) are found on the property. The Vaal-Vet Sandy Grassland is restricted to the western corner of the property and only Highveld Alluvial Vegetation features prominently. The area of Vaal-Vet Sandy Grassland that would be lost (Preferred Alternative) is ~ 60 ha based on the maps presented above. However, it was difficult to see a difference between the Highveld Alluvial Vegetation and the Vaal-Vet Sandy Grassland in the west of Portion 5 of Doorn River 330. Since, the status of Highveld Alluvial Vegetation is of Least Concern, whereas the status of Vaal-Vet Sandy Grassland is Endangered, the sensitivity of the vegetation was evaluated by what was seen in the field. There was nothing to suggest that the area mapped as Vaal-Vet sandy Grassland was more or less sensitive than Highveld Alluvial Vegetation in the area concerned. Therefore, the direct and cumulative impacts would be **Low** to **Very Low** after mitigation for both the construction and operational phases.

Alien invasive cactus, *Echinopsis spachiana*, *Cylindropuntia imbricata* and *Opuntia engelmannii* (if encountered) as well as mesquite (*Prosopis glandulosa* subsp. *torreyana*) and *Yucca* sp. must be eradicated and care must be taken to ensure that construction activities do not promote the spread of these noxious species.

12. Conclusions

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

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 2 are suited to the purpose and the project is supported.

13. References

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Report submitted: 22 August 2022; amended 31 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 11
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 11
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 11
3.1.6.	a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Page 28
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 34—37
3.1.9.	the degree to which impacts and risks can be mitigated;	Page 37
3.1.10.	the degree to which the impacts and risks can be reversed;	Pages 34--37
3.1.11.	the degree to which the impacts and risks can cause loss of irreplaceable resources;	Pages 34--37
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 42
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
- Sixteen 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

any website: www.bergwind.co.za