

**The Improvement of National Route N2 Section
33 & 34 between KZN / Mpumalanga Provincial
Border and Camden**

ROAD

SECTION A (km 60 to km 87,4)

BIODIVERSITY ASSESSMENT

Terrestrial Ecological Assessment and Aquatic (Wetland) Assessment

**Compiled by
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**NOVEMBER 2016
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PROJECT INFORMATION

PROJECT TITLE: N2 Section 34 (**Section A**) - Road

STUDY NAME: Biodiversity Impact Assessment

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EXECUTIVE SUMMARY

Background

The South African National Roads Agency Soc Limited (SANRAL) is in the process of planning the proposed upgrade of the National Route N2 Sections 33 & 34 between the KZN / Mpumalanga Provincial Border and Camden in the Mpumalanga Province.

Flori Scientific Services cc was appointed as the independent consultancy to conduct the biodiversity assessments, which include a terrestrial ecological assessment and an aquatic (wetland) assessment.

Field investigations were conducted during July and November 2016.

The report was updated in August 2021, to ensure that any gaps were addressed and also to meet new legislative requirements for specialist reports.

Location of the study area

The study area for this report is only for the road of Section A. This is the National Route N2 Section 34 between Leiden (Km 59.0) and Camden (Km 87.4). The study site is located in the Mpumalanga Province.

TERRESTRIAL ECOLOGY

Vegetation

The natural vegetation of the study area is characteristic of Eastern Highveld Grassland and Wakkerstroom Montane Grassland. The area of Eastern Highveld Grassland in which the study area is situated is also often described as Chrissiesmeer Panveld.

No pristine vegetation is present.

Priority species

No Red Data fauna or flora species were observed during field investigations. The only floral species of conservation concern observed in the general area were *Boophone disticha* and *Hypoxis rigidula*.

Protected trees in the study area

No protected trees occur in the study area.

AQUATIC ECOLOGY

Watercourses in the study area

The study area route crosses over three major rivers, namely the Sandspruit, Vaal and Witpuntspruit. There are also a few drainage lines and wetland areas along the N2 National Route (Study area).

Drainage areas

The study area is situated within the Primary Drainage Area (PDA) of C and W and the Quaternary Drainage Areas (QDA) of C11B and W53A .

The study area is within the Usuthu to Mhlatuze Water Management Area (WMA 6) and Upper Vaal Water Management Area (WMA 8) and under the jurisdiction of the Inkomati / Usuthu / Pongola Catchment Management Agency (CMA 3) and the Vaal Catchment Management Agency (CMA 5).

PES of watercourses in the study area

Criteria	Identified Watercourses				
	Vaal River	Sandspruit	Witpunspruit	Drainage lines	Wetlands
Category:	C	C	D	D	D
Integrity (PES):	Medium	Medium	Low	Low	Low
PES Description	Moderately Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified
Recommended EMC	C	C	C	C	C

EIS of watercourses in the study area

Determinant	Vaal River	Sandspruit	Witpuntspruit	Drainage lines	Wetlands
Overall EIS	B	B	B	D	D
Description	High	High	High	Low	Low

Sensitivity analyses

The ecological sensitivity of the study area is determined by combining the sensitivity analyses of both the floral and faunal components. The highest calculated sensitivity unit of the two categories is taken to represent the sensitivity of that ecological unit, whether it is floristic or faunal in nature.

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Grassland	Medium/Low	Medium/Low	Medium/Low	Go-Slow
Watercourses	Medium/High	Medium/High	Medium/High	Go-But

According to the analyses there are no high sensitivity areas or habitats. However, the watercourses must be viewed and approached as sensitive.

Fatal flaws

There are no fatal flaws.

Priority areas

The study area is within Important Bird Areas (IBA) and National fresh water ecosystem priority areas (NFEPA). Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National fresh water ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas. The study area is within Important Bird Areas (IBA) and National fresh water ecosystem priority areas (NFEPA). Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National fresh water ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas.

Conclusions

- The study site is situated within the original extent of Eastern Highveld Grassland and Wakkerstroom Montane Grassland, within the Grassland Biome.
- Eastern Highveld Grassland is a threatened veldtype / ecosystem with a threat status of 'Vulnerable'.
- Almost the entire study area is transformed or highly degraded. There are no areas of pristine grassland or habitats in the study site.
- During field investigations no Red Data Listed (RDL) or Orange Data Listed (ODL) plants were observed in the study site. None are expected to occur.
- There are no 'high' sensitive habitats present on site, with the exception of the watercourse crossings.

- No red data listed (RDL) faunal species were observed to be present and / or breeding with the study area boundaries. It is also highly unlikely that any are or will be present, with the small chance along the main rivers only.
- Site investigations were conducted during the summer and winter months and the findings and availability of field data are sufficient to achieve acceptable findings and outcomes from the assessment.
- Due to the nature of the project (upgrade of an existing road) no further specialist environmental studies are required or recommended.
- There are no obvious fatal flaws in terms of the project on the natural environment.
- Impacts on the existing natural environment related to the project are '**LOW**'
- The levels of change (increase in negative cumulative impacts) arising from the activities of the proposed project are at acceptably low levels for the area and for the project to proceed and not create any related 'fatal flaws'.
- A General Authorisation (GA) process for work on watercourse crossings will be required.
- Taking all findings and recommendations into account the following are the reasonable opinions of the specialist, namely:
 - That the entire project, along with related construction activities, should be authorised. The project and related activities may proceed to the next phase.
 - The levels of impact and change to the natural environment along and within the study area are low to minimal. In fact, the upgrades of the road, along with storm water culverts and watercourse crossings, will have numerous positive impacts, such as preventing the impeding and impounding of water flow, siltation, and erosion. In other words, the levels of change are well within any acceptable means and expected outcomes. There is no need to drastically alter any project plans or cease / prevent any portion or area of the project from taking place.
 - The entire project should be authorised. However, all recommended mitigating measures put forward in this report, as well as other specialist reports and legal requirements should be included in the EMPr and must be implemented.

Recommendations

- Recommended mitigating measures as proposed in this study and report must be implemented. These include, but are not limited to:
 - The footprint of the project is small in relation to the area and mostly within an already disturbed and altered environment.
 - Three main rivers will be crossed i.e. Sandspruit, Vaal and Witpuntspruit, along with a few small semi-perennial streams and drainage lines. The long-term impact of the upgrade of the actual watercourse crossings is a positive impact, because it will improve water flow, remove blockages, stabilise stream banks, reduce existing erosion of stream banks and riparian areas.
 - Minimal riparian vegetation will be lost (need to be removed) as the project involves the upgrade of crossings and not new crossings. The upgrade will also not include the need to remove trees and other riparian vegetation.
 - Any temporary storage, lay-down areas or accommodation facilities to be setup in existing built-up areas or disturbed areas. No temporary storage areas, laydown areas or site offices are allowed within a **100m** of the edge of any river, stream or distinctive drainage line.
 - No temporary storage areas, laydown areas or site offices are allowed within a **100m** of the edge of any river, stream or distinctive drainage line. That is, a **100m buffer zone** (no-go zone) for these sites are required along all watercourses.
 - Ensure small footprint during construction phase
 - An Erosion Plan to be implemented and monitored during the construction phase, especially in the area of watercourses and steep gradients along escarpment edges. The erosion potential is moderate to low. This also to further reduce the potential of siltation of small watercourses. The plan need only be basic, but needs to be monitored.
 - All hazardous materials must be stored appropriately to prevent these contaminants from entering the water environment;
 - All excess materials brought onto site for construction to be removed after construction and their removal seen as part of the construction phase.
 - No open trenches or mounds of soils to be left.

- Rehabilitation plan for disturbed areas to be compiled and implemented as part of the construction phase.
- The most important recommendations arising from the study is the need for 100m buffer zones around watercourses in which no temporary laydown areas, site offices or campsites may be set up.
- An independent ECO is recommended to monitor operations and ensure that recommended mitigating measures, including buffer zones, are implemented and adhered to.

REPORT REQUIREMENTS

Below are the requirements for specialist reports as per Appendix 6 of the regulations (Gazette No.40772, 7 April 2017). A specialist report prepared in terms of these regulations must contain the following as highlighted in the table below:

Requirement	Page No
(a) details of—	
(i) the specialist who prepared the report;	x, 81
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	x, 81
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	x
(c) an indication of the scope of, and the purpose for which, the report was prepared;	2
(cA) an indication of the quality and age of base data used for the specialist report;	2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	63
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	4
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	5
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Entire Report
(g) an identification of any areas to be avoided, including buffers;	Entire Report
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Not included in this report
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	3
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities; ^[11] _[SEP]	Entire Report
(k) any mitigation measures for inclusion in the EMPr;	81
(l) any conditions for inclusion in the environmental authorisation;	81
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	81
(n) a reasoned opinion —	
(i) whether the proposed activity, activities or portions thereof should be authorised;	70
(iA) regarding the acceptability of the proposed activity or activities; and	70
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	70, 81
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	5
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
(q) any other information requested by the competent authority.	None

EXPERTISE, EXPERIENCE & DECLARATION OF SPECIALIST

EXPERTISE & EXPERIENCE

- Qualifications & Expertise in: Terrestrial, Aquatic & Avifaunal Assessments.
- 2 Masters degrees (MSc & MBA); 2 Diplomas (Business & Public Speaking); Certificate: SASS5 Macro Invertebrate Monitoring.
- Co-Authored Books: Cut Flowers of the World. 2010 (1st ed) & Cut Flowers of the World. 2020 (2nd ed), Briza, Pretoria.
- Registered with South African Council for Natural Scientific Professions (SACNASP). Registration number: 400077/91.
- SAQA accreditation in training, assessing & service provision (AgriSeta).
- 21 years experience in technical and managerial positions, project management and consultancy.
- 19 years experience in writing of articles, books, training material & presentations.
- 14 years direct experience in EIAs.
- Conducted hundreds of field investigations and specialist studies / reports for EIAs, including ecological assessments (fauna & flora), aquatic (wetland) assessments and avifauna impact assessments. Project types include power lines, roads, quarries, housing developments, mines and wind farms.

DECLARATION

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations (as amended on 7 April 2017).

I, **Johannes Oren Maree**, do hereby declare that I:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work; have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

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ACRONYMS

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DEA	Department of Environmental Affairs (Old name of DFFE)
DFFE	Department of Forestry, Fisheries and the Environment
DWA	Department of Water Affairs (Old name for DWS)
DWS	Department Water and Sanitation
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
HGM	Hydrogeomorphic
IBA	Important Bird Area(s)
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan (2014)
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
PES	Present Ecological State
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
REC	Recommended Ecological Category (or Class)
REMC	Recommended Ecological Management Category (or Class)
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Soc Limited
SOC	State Owned Company
SWSA	Strategic Water areas of South Africa
WMA	Water Management Areas
WUL	Water Use Licence
WULA	Water Use Licence Application

1 BACKGROUND

1.1 Project overview

The South African National Roads Agency Soc Limited (SANRAL) is in the process of planning the proposed upgrade of the National Route N2 Section 33 & 34 between the KZN / Mpumalanga Provincial Border and Camden in the Mpumalanga Province. The entire length of the project is 150 km and the project is divided up into 5 separate projects as follows:

- A. Project Nra N.002-340-2015/2: The Improvement of National Route N2 Section 34 between Leiden (Km 59.0) and Camden (Km 87.4)
- B. Project Nra N.002-340-2016/1: The Improvement of National Route N2 Section 34 from Verzameling (Km 30) to Leiden (Km 60) (30 Km)
- C. Project Nra N.002-340-2015/1: The Improvement of National Route N2 Section 34 from Piet Retief (Km 0) to Verzameling (Km 30) (30 Km)
- D. Project Nra N.002-330-2016/1: The Improvement of National Route N2 Section 33 between Bloemendal (Km34) to Piet Retief (63.3).
- E. Project Nra N.002-330-2015/1: The Improvement of National Route N2 Section 33 between KZN Border (Km 0.0) to Bloemendal (34.0).

The major aspects of the entire project include the following:

- The expansion of the existing 2-lane facility to a 4 lane, undivided dual carriageway facility.
- General widening of the existing road surfaced width from 7.4m to 21.0m. Two lanes per direction with 2.5m wide shoulders.
- Increasing road reserve width from 38m to 60m with associated land acquisition towards the left or right of the existing N2.
- Strengthening the existing pavement.
- Substantial vertical and/or horizontal geometric improvements.
- Rehabilitation and or improvement of the N2 in the town of Piet Retief.
- Possible consolidation of accesses to the N2.
- Replacement or widening of approximately 15 bridges.
- Widening and/or capacity improvement of approximately 13 major culverts.
- Opening of approximately 1 hard rock quarry and 4 borrow pits per section.

Flori Scientific Services cc was appointed as the independent consultancy to conduct the biodiversity assessments, which include a terrestrial ecological assessment and an aquatic (wetland) assessment.

Field investigations were conducted during July and November 2016.

The report was updated in August 2021, to ensure that it prescribes to any new legislation and to fill any previous gaps where possible.

1.2 Purpose for the Study

The purpose of the study is to assess the ecology of the site to determine if any sensitive habitats are present. To investigate the fauna and flora and determine if there are any priority species present. Furthermore, the purpose of the study is to identify any possible fatal flaws, assess impacts, delineated buffer zones (if required), and to recommend mitigating measures aimed at reducing any potential negative impacts the project may have on the natural environment.

1.3 Scope of Work

The scope of work was understood to be as follows:

- Conduct a biodiversity impact assessment for the study site, which includes terrestrial ecology (fauna & flora) and aquatic ecology;
- Conduct site visits and investigations;
- Compile a biodiversity report, which addresses potential impacts on the natural environment;
- Determine if there are any fatal flaws, high sensitive areas, no-go zones, etc.;
- Identify and delineate any sensitive areas / habitats, recommend buffers (if required); and
- Provide recommendations and mitigating measures, if and where necessary.

1.4 Quality, Source and Age of Base Data

The latest data sets were used for the report in terms of background information. The quality of the data from the sources shown below have been used extensively and have been shown to be of relatively high quality.

The source and age of data used includes the following:

- Screening Tool: Dept. of Forestry, Fisheries and the Environment (DFFE) – (www.screening.environment.gov.za).

- Threatened ecosystems: South African National Biodiversity Institute (SANBI) - (www.bgis.sanbi.org).
- Protected Areas: Protected Areas Register (PAR): DFFE – (<https://portal.environment.gov.za>).
- RDL species: Red List of South Africa Plants (latest update) – (www.redlist.sanbi.org).
- Veldtypes and ecosystems: Mucina & Rutherford, 2006, 2010. Updated 2012 & 2018. Source from SANBI on www.bgis.sanbi.org.
- National Wetland Map (Map 5) – SANBI & Water Research Commission (WRC).
- Endangered Wildlife Trust (EWT) – latest data sets – (www.ewt.org.za).
- SANBI data sets – latest updated website data (www.bgis.sanbi.org).
- Mpumalanga Biodiversity Sector Plan (2014).

1.5 Assumptions and Limitations

The assumptions and limitations for the study are as follows:

- All information regarding the proposed project and related activities as provided by the Client are taken to be accurate.
- Site investigations were conducted during July and November 2016. The site visits fall within the wet (summer) and dry (winter) seasons for the region.
- The report was updated in August 2021, to ensure that it adheres to new legislation and guidelines, and to fill in any knowledge gaps where possible. No additional field investigations were conducted for the update.
- During site investigations all areas were easily accessed. There were no areas that could not be investigated or accessed. Permission to private property was obtained prior to visits.
- The study site is very narrow with easy access. The study area consists almost entirely of the existing hard-surface (asphalt) road and road reserve, which are predominantly totally transformed and/or highly degraded environments. The field investigations conducted are therefore sufficient to reach informed conclusions and make informed recommendations for the proposed project. Notwithstanding that site investigations were limited to a few days only and it is therefore possible that some small aspects may have been missed.

- The site investigations and study are deemed adequate for the project and no further specialist environmental studies are considered necessary or recommended.
- Precise buffer zones, regulated zones, etc. or exact GPS positions cannot be made using generalised corridors or kml files on Google Earth. However, buffer zones and delineations drawn are accurate to within a few metres;
- The latest data sets were used as background information and desktop review for the project. The data sets were verified and refined during field investigations (ground-truthing).
- Equipment used: Standard soil augers; hand-held Garmin GPS instrument; EC & pH hand-held meters; iPhone for photographs, MacBook Pro and Epson PC Laptops; Google earth maps, 1:50 000 South African topographical maps.
- Computer packages used: MS Word; MS Excel; Adobe Photoshop, ARC GIS (10.2.2); Google Earth; and Garmin Base Maps

1.6 Duration, Season and relevance to Outcome of Assessment

The site investigations were conducted during both the summer (wet) and winter (dry) seasons. That is, during November 2016 and July 2016, respectively. The duration of the site visits were only two days per season (four days in total). However, the fairly short durations for the site visits were sufficient to collect the necessary information for the assessment and to be able to make informed decisions and come to informed conclusions. This is due to the fact that the Specialist has a good understanding and working knowledge of the ecosystems and veldtypes in which the study site is situated, having conducted numerous assessments for projects in the region. Furthermore, due to the nature of the project, that is, the upgrade of an existing hard-surface national road, which is a totally transformed and highly degraded environment, an extensive investigation is unnecessary. The seasons therefore had little to no significant relevance to the outcome of the assessment, conclusions and recommendations of the study and report, because both summer and winter site visits were conducted and the transformed nature of the project site (study site). The main growing season (wet season) for the study area and region is summer. During site investigations the environments encountered were expected and there were no unusual or unexpected habitats, species (fauna and flora), etc. encountered.

1.7 Consultation Process of the Study

Emails were exchanged and telephone conversations held with the lead EAP (Chameleon Environmental) regarding the project. Where necessary Landowners were contacted directly to arrange access to their private properties for site investigations. During site visits landowners did not accompany Specialists to the relevant sites.

2 METHODOLOGY

2.1 Desktop assessment

A literature review was conducted regarding the main vegetation types and fauna of the general region and of the specific study area. The primary guidelines used were those of Mucina & Rutherford (eds) (2006), Low & Rebelo (1996) and Acocks (1988). Background data regarding soils, geology, climate and general ecology were also obtained from existing datasets and relevant organisations. These are useful in determining what species of fauna and flora can be expected or possibly present within the different habitats of the study area.

Lists of plant species for the relevant 1:50 000 base map grid references within which the proposed project is situated, were obtained from the database of the South Africa National Biodiversity Institute (SANBI). The lists represent all plant species that have been identified and recorded within the designated grid coordinates. The main aim was to determine if any protected species or Red Data species were known to occur in the study area or in the immediate vicinity of the study area.

Red data and protected species listed by the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), as well as in other authoritative publications were consulted and taken into account. Alien invasive species and their different Categories (1, 2 & 3) as listed by the Conservation of Agricultural Resources Act (Act No. 43 of 1983) and the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) were also consulted.

2.2 Field surveys

During field surveys, cognisance was taken of the following environmental features and attributes:

- Biophysical environment;

- Regional and site specific vegetation;
- Habitats ideal for potential red data fauna species
- Sensitive floral habitats;
- Red data fauna and flora species;
- Fauna and flora species of conservation concern; and
- Water courses and water bodies.

Digital photographs and GPS reference points of importance where recorded and used throughout the report if and where necessary.

2.3 Floristic Sensitivity

The methodology used to estimate the floristic sensitivity is aimed at highlighting floristically significant attributes and is based on subjective assessments of floristic attributes. Floristic sensitivity is determined across the spectrum of communities that typify the study area. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics (human impacts, size, fragmentation, etc.) are important in assessing the floristic sensitivity of the various communities.

Criteria employed in assessing the floristic sensitivity vary in different areas, depending on location, type of habitat, size, etc. The following factors were considered significant in determining floristic sensitivity:

- Habitat availability, status and suitability for the presence of Red Data species
- Landscape and/or habitat sensitivity
- Current floristic status
- Floristic diversity
- Ecological fragmentation or performance.

Floristic Sensitivity Values are expressed as a percentage of the maximum possible value and placed in a particular class or level, namely:

- High: 80 – 100%
- Medium/high: 60 – 80%
- Medium: 40 – 60%
- Medium/low: 20 – 40%
- Low: 0 – 20%

High Sensitivity Index Values indicate areas that are considered pristine, unaffected by human influences or generally managed in an ecological sustainable manner. Nature reserves and well-managed game farms typify these areas. Low Sensitivity Index Values indicate areas of poor ecological status or importance in terms of floristic attributes, including areas that have been negatively affected by human impacts or poor management.

Each vegetation unit is subjectively rated on a sensitivity scale of 1 to 10, in terms of the influence that the particular Sensitivity Criterion has on the floristic status of the plant community. Separate Values are multiplied with the respective Criteria Weighting, which emphasizes the importance or triviality that the individual Sensitivity Criteria have on the status of each community.

Ranked Values are then added and expressed as a percentage of the maximum possible value (Floristic Sensitivity Value) and placed in a particular class or level, namely:

- High: 80% – 100%
- Medium/high: 60% – 80%
- Medium: 40% – 60%
- Medium/low: 20% – 40%
- Low: 0% – 20%

2.4 GO, NO - GO Criteria

The sensitivity analyses are also expressed in terms of whether the “Go Ahead” has or has not been given for development in a specific area or ecological unit, with regards to the ecological sensitivity along with mitigating measures. The criteria are directly linked to all the other analyses used in the study and can be expressed as follows:

- GO: Areas of low sensitivity

These would typically be areas where the veld as been totally or mostly transformed.

- GO-SLOW: Areas of medium/low sensitivity

These would typically be areas where large portions of the veld has been transformed and/or is highly infested with alien vegetation and lacks any real faunal component. Few mitigating measures are typically needed, but it is still always wise to approach these areas properly and slowly.

- GO-BUT: Areas of medium and medium/high sensitivity

These are areas that are sensitive and should generally be avoided if possible. But, with the correct implementation of mitigating and management measures can be entered if need be.

- NO-GO: Areas of high sensitivity

These are areas of high sensitivity and should be avoided at all cost. In these areas mitigating measures are typically futile in limiting impacts.

The Precautionary Principle is applied throughout this investigation.

2.5 Floral Assessment – Species of Conservation Concern

Baseline data for the quarter degree grids in which the study area is situated were obtained from the SANBI database and were compared to the Interim Red Data List of South African Plant Species (Raimondo D. *et.al.*, 2009) to compile a list of Floral Species of Conservation Concern (which includes all Red Data flora species) that could potentially occur within the study area.

A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data floral species. Therefore, particular emphasis is placed on the identification of habitats deemed suitable for the potential presence of Red Data species by associating available habitat to known habitat types of Red Data floral species. The verification of the presence or absence of these species from the study area is not perceived as part of this investigation as a result of project limitations.

2.6 Faunal Sensitivity

Determining the full faunal component of a study area during a short time scale of a few field trips can be highly limiting. Therefore, the different habitats within the study area and nearby surrounding areas were scrutinised for attributes that are deemed to be suitable for high diversity of fauna, as well as for Red Data species. Special consideration was given to habitats of pristine condition and high sensitivity.

Areas of faunal sensitivity were calculated by considering the following parameters:

- Habitat status – the status or ecological condition of the habitat. A high level of habitat degradation will often reduce the likelihood of the presence of Red Data species.

- Habitat linkage – Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area
- Potential presence of Red Data species – Areas that exhibit habitat characteristics suitable for the potential presence of Red Data species are considered sensitive.

The same Index Values, Sensitivity Values and Categories used for the floral sensitivity ratings are used for the faunal sensitivity ratings. The same Go, No-Go criteria and ratings used for the flora component are also used for the faunal component.

2.7 Faunal Assessment – Species of Conservation Concern

Literature was reviewed and relevant experts contacted to determine which faunal species of conservation concern (which include all Red Data species) are present, or likely to be present, in the study area.

A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data fauna species. Particular emphasis was therefore placed on the identification of habitat deemed suitable for the potential presence of Red Data fauna species by associating available habitat to known habitat types of Red Data species. The verification of the presence or absence of these species from the study area is not perceived as part of this investigation as a result of project limitations.

2.8 Biodiversity Impact Assessment

The impact assessment takes into account the nature, scale and duration of the effects on the natural environment and whether such effects are positive (beneficial) or negative (detrimental).

A rating/point system is applied to the potential impact on the affected environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each issue the following criteria are used and points awarded as shown:

- Extent: National - 4; Regional – 3; Local – 2; Site – 1.

- Duration: Permanent – 4; Long term – 3; Medium term – 2; Short term – 1.
- Intensity: Very high – 4; High – 3; Moderate – 2; Low – 1.
- Probability of Occurrence: Definite – 4; Highly probable – 3; Possible – 2; Impossible – 1.

2.9 Criteria for the classification of an impact

Nature

A brief description of the environmental aspect being impacted upon by a particular action or activity is presented.

Extent (Scale)

Considering the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact.

- Site: Within the construction site
- Local: Within a radius of 2 km of the construction site
- Regional: Provincial (and parts of neighbouring provinces)
- National: The whole of South Africa

Duration

Indicates what the lifetime of the impact will be.

- Short-term: The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase.
- Medium-term: The impact will last for the period of the construction phase, where after it will be entirely negated.
- Long-term: The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

Intensity

Describes whether an impact is destructive or benign.

- Low: Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
- Medium: Effected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way.
- High: Natural, cultural and social functions and processes are altered to extent that they temporarily cease.
- Very high: Natural, cultural and social functions and processes are altered to extent that they permanently cease.

Probability

Probability is the description of the likelihood of an impact actually occurring.

- Improbable: Likelihood of the impact materialising is very low.
- Possible: The impact may occur.
- Highly probable: Most likely that the impact will occur.
- Definite: Impact will certainly occur.

Significance

Significance is determined through a synthesis of impact characteristics. It is an indication of the importance of the impact in terms of both the physical extent and the time scale and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Using the scoring from the previous section, the significance of impacts is rated as follows:

- Low impact: 4-7 points. No permanent impact of significance. Mitigating measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
- Medium impact: 8-10 points. Mitigation is possible with additional design and construction inputs.
- High impact: 11-13 points. The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
- Very high impact: 14-16 points. The design of the site may be affected. Intensive remediation as needed during construction and/or operational

phases. Any activity, which results in a “very high impact”, is likely to be a fatal flaw.

Status

Status gives an indication of the perceived effect of the impact on the area.

- Positive (+): Beneficial impact.
- Negative (-): Harmful or adverse impact.
- Neutral Impact (0): Neither beneficial nor adverse.

It is important to note that the status of an impact is assigned based on the *status quo*. That is, should the project not proceed. Therefore not all negative impacts are equally significant. The suitability and feasibility of all proposed mitigation measures will be included in the assessment of significant impacts. This will be achieved through the comparison of the significance of the impact before and after the proposed mitigation measure is implemented.

3 RECEIVING ENVIRONMENT

3.1 Study Site Location

The study area for this report is only for the road of Section A. This is the National Route N2 Section 34 between Leiden (Km 59.0) and Camden (Km 87.4). The study site is located in the Mpumalanga Province (Figure 1).

3.2 GPS Coordinates of the Main Landmarks

The GPS coordinates of the main landmarks within the project area are as follows:

- Camden: 26°35'59.57"S; 30° 5'1.04"E.
- Sheepmoor: 30° 5'1.04"E; 30°17'58.36"E
- Start of route (KM 60,0): 2; 6°43'53.56"S; 30°17'7.41"E.
- End of route (KM 87,4): 26°35'33.27"S; 30° 5'41.83"E.
- 1:50 000 map grid references: 2630CA; 2630CB.

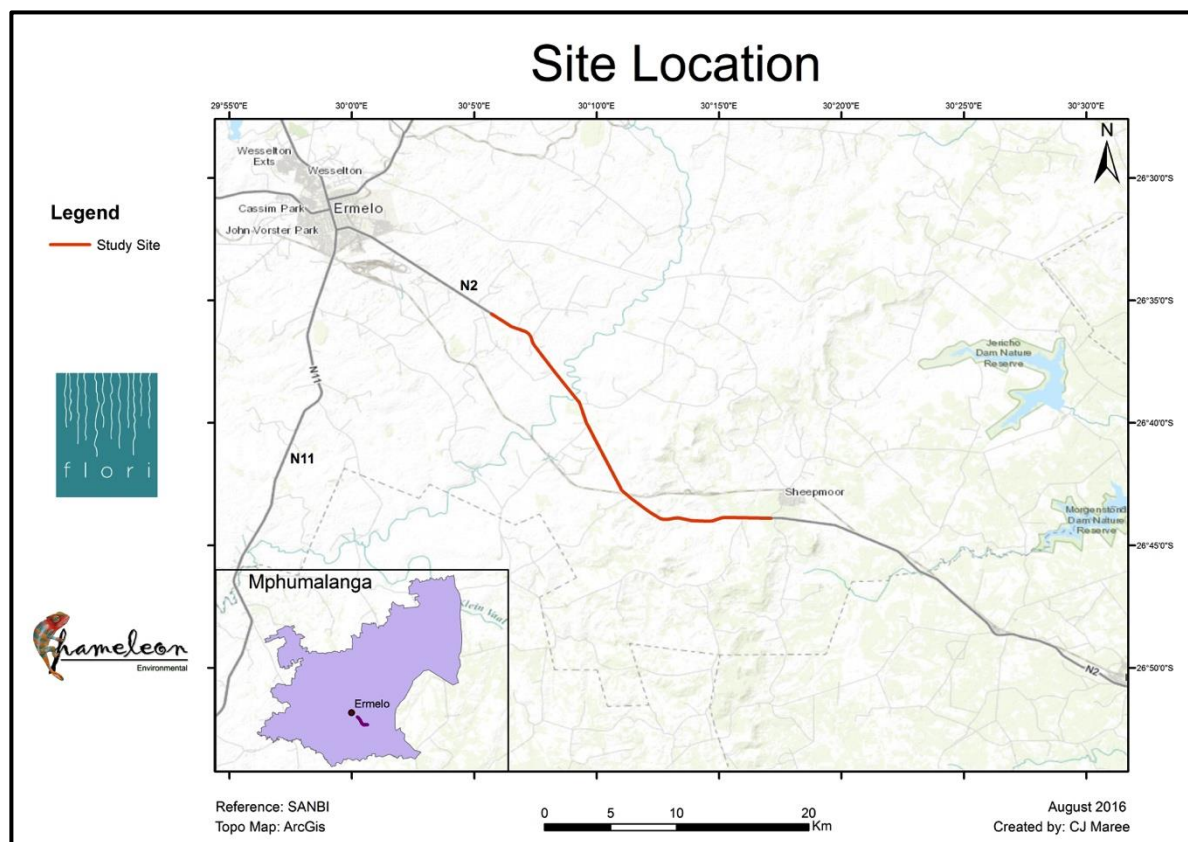


Figure 1: Site location

3.3 Topography

The topography is that of slight to moderately undulating plains, with some low hills and pan depressions scattered throughout the landscape. Rocky outcrops (koppies) and rocky ridges are rare in the region, with none occurring within the study area. Valleys, in which small streams flow or wetlands are found, tend to be shallow, flat and broad. The general first impression of the landscape is that of flat, open homogenous grasslands and farmlands, with few distinctive features such as koppies.

From Leiden to Camden the N2 route is relatively flat and tends to only climb from around 1 600m above sea level to around 1 660m above sea level. The route does however, have higher points along the way with elevations of 1 737m and 1 723m, which is approximately and area in the middle of the route.

3.4 Geology and Soils

The soils of the region and study area are predominantly red to yellow, sandy soils occurring on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Soil types (Land types) are predominantly Bb and Ba types (Mucina & Rutherford, 2006). Short descriptions of the land types or soil types are given in the table below (Table 1).

Approximately the northern 20% of the linear study area is within Rand Highveld Grassland. However, there is little distinctive difference between the veldtypes across the study area. The study area is more characteristic of Eastern Highveld Grassland, not just in terms of vegetation but soils as well.

The geology and soils of Rand Highveld Grassland areas are characterised by quartzite ridges of the Witwatersrand Supergroup and the Pretoria Group as well as the Selons River Formation of the Rooiberg Group (last two are of the Transvaal Supergroup), supporting soils of various quality (shallow Glenrosa and Mispah forms especially on rocky ridges), typical of Ba, Bc, Bb and Ib land types (Mucina & Rutherford, 2006).

Table 1: Description of the Land Types found in the Region

Code	Description
------	-------------

Ba & Bb	Plinthic catena: Upland duplex and marginalitic soils rare (Dystrophic and/or mesotrophic; red and/or yellow soils). Mainly red (Ba) or yellow (Bb), apedal (= structureless) soils, moderately (mesotrophic) to highly (dystrophic) leached (low to moderate fertility status), with a wide textural range, mostly sandy loam to sandy clay loam. Soils contain a greyish subsoil layer (plinthic) where iron and manganese accumulate in the form of mottles, due to a seasonally fluctuating water table. With time these mottles may harden (or even cement) to form concretions. These plinthic layers will cause restricted water infiltration and root penetration. In drier areas, however, they may help to hold water in the soil that plants can use.
Bc & Bd	Plinthic catena: Upland duplex and marginalitic soils rare (Eutrophic; red and/or yellow soils). Mainly red (Bc) or yellow (Bd), apedal (= structureless) soils, which are eutrophic (= high base status). They have a moderate to high fertility status and a wide textural range, mostly sandy loam to sandy clay loam. Soils contain a greyish subsoil layer (plinthic) where iron and manganese accumulate in the form of mottles, due to a seasonally fluctuating water table. With time these mottles may harden (or even cement) to form concretions. These plinthic layers will cause restricted water infiltration and root penetration. In drier areas, however, they may help to hold water in the soil that plants can use.
Ib	Miscellaneous land classes (Rock areas with miscellaneous soils). Areas where 60-80% of the surface is occupied by exposed rock and stones/boulders and the slopes are usually steep. The rest of the area comprises mostly shallow soils, directly underlain by hard or weathered rock.

3.5 Climate

The study area is situated within the higher rainfall regions of South Africa (601mm – 800mm per annum) as can be seen from the map below (Figure 2). Summer rainfall with a mean annual precipitation (MAP) of between 600mm+ is common in the region of the Mpumalanga Highveld’s moist grasslands. Frost is fairly common during the cold winter months of June to August, with early morning mist being a common occurrence.

The climate of the study area is similar to that of the close by town of Ermelo. Ermelo receives on average about 625mm of rainfall per year, with most rainfall occurring during summertime. The average midday temperatures for Ermelo range from 15,8°C in June, to 24.1°C in January. The region is the coldest during June/July with average night temperatures of around 0,2°C.

The study area is situated within the Cold Interior Climatic Zone of the country (Figure 3).

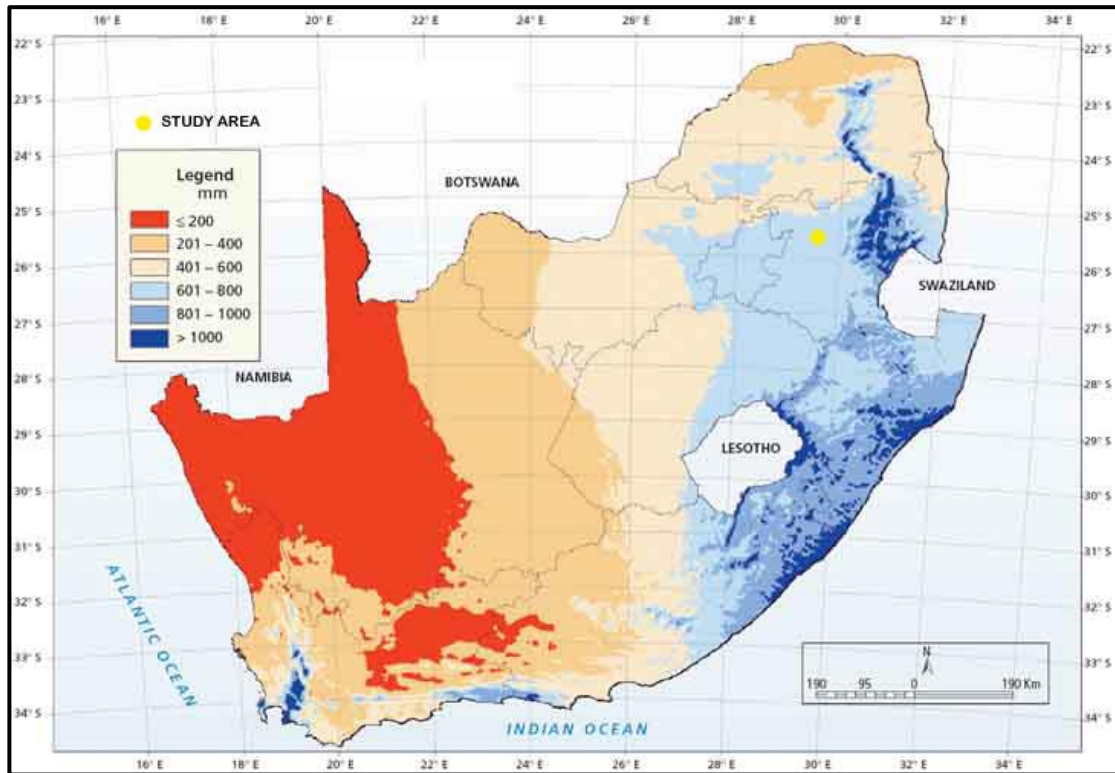


Figure 2: Rainfall averages for South Africa

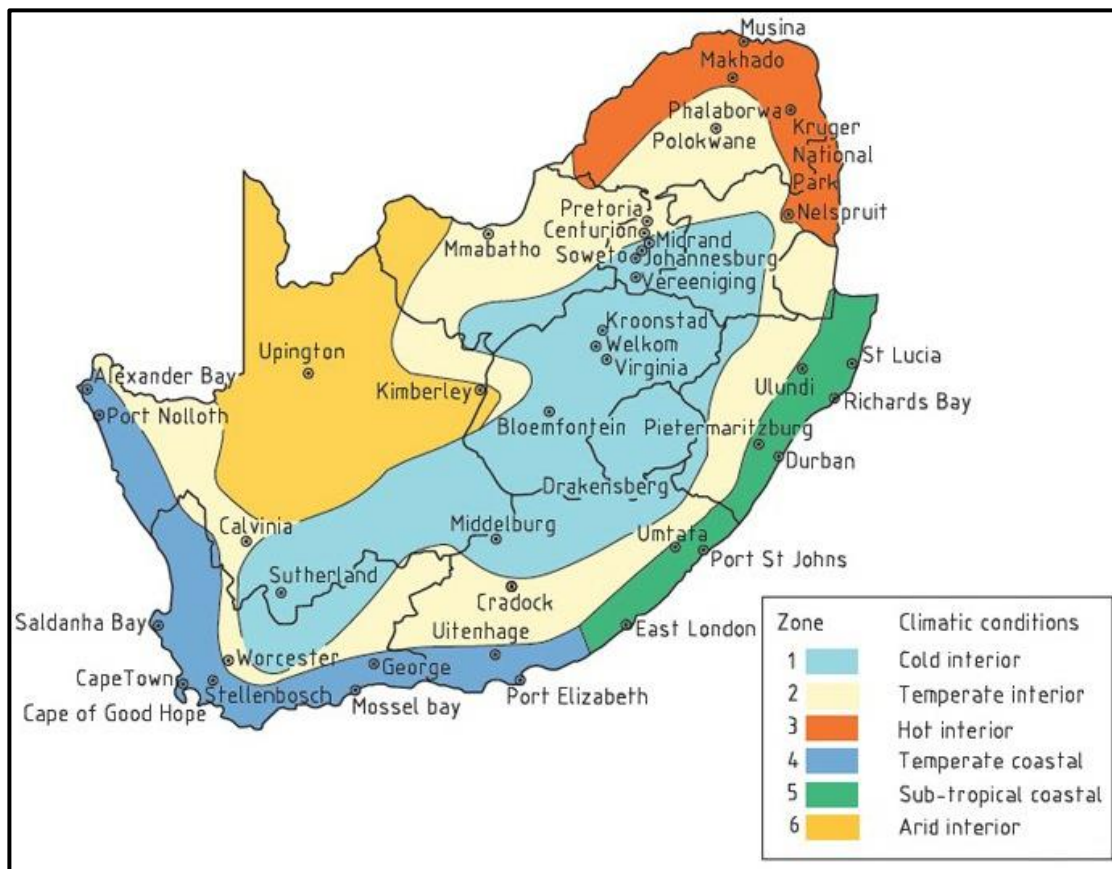


Figure 3: Broad climatic zones of South Africa

3.6 Landcover

The landcover or landuse along the length of the study area is predominantly cultivated farmlands, opencast coal mining and grasslands. The grasslands are typically used for cattle grazing. Cultivation in the area is predominantly dryland maize (mielie) production, which takes place in the summer months. The landcover tends to simply show the grazed grasslands as natural, which is not entirely accurate (Figure 4). It must also be kept in mind that the road reserve, is regularly mowed and as such tends to acquire certain characteristics of that of a lawn. No, to little, pristine grassland areas are found in the study area.

The areas mostly remaining as natural are the wetlands, pans, streams and moist grasslands, where it is usually too wet for maize production. However, even these areas are not pristine and are frequented and negatively impacted upon by cattle and other livestock. The level of urbanisation in the area is scattered and low-density.

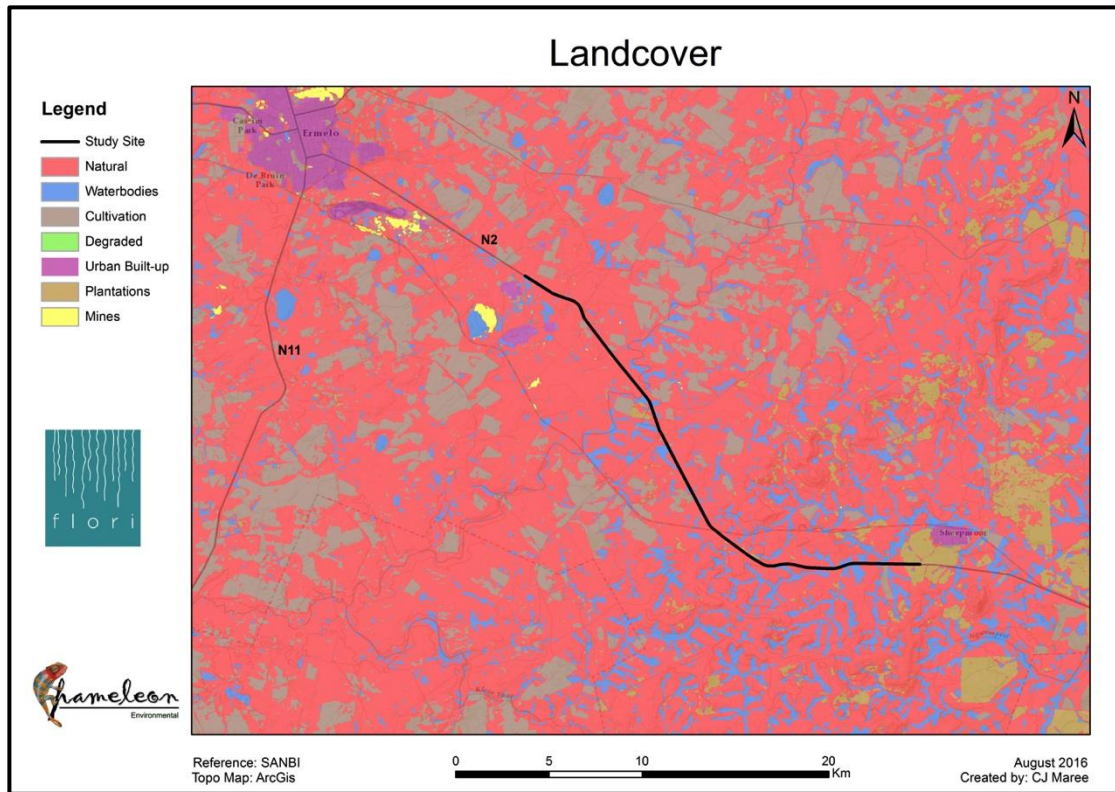


Figure 4: Landcover

4 TERRESTRIAL ECOLOGY

4.1 Vegetation

South Africa is divided up into nine Biomes. The study area is situated within the Grassland Biome (Figure 5).

The Grassland Biome can be naturally subdivided into dry and moist grassland regions. Grassland veldtypes with a rainfall of 600mm+ per annum tend to be dominated by sour, andropogonoid grasses. While in veldtypes with an average rainfall of below 600mm per annum, the sweet chloridoid grasses tend to be more common. Dry and moist grassland types are divided primarily on the basis of rainfall, with 500-700mm being the broad boundary. Historically, such as with the classification of veld types by JPH Acocks (1952) and AB Low & AG Rebelo (1998), these grasslands have been divided into sweet grasses (sweetveld) and sour grasses (sourveld) based primarily on agricultural or grazing criteria. In high rainfall areas (moist grasslands) sour grasses tend to dominate, while in low rainfall areas the sweet grasses (which are more palatable for livestock) tend to dominate. Grasslands (like any other vegetation type) are also influenced and shaped by numerous environmental factors such as temperature, soils and altitude.

Mucina and Rutherford (eds) (2006) subdivided the Grassland Biome into four main bioregions. Namely, Dry Highveld Grasslands; Drakensberg Grasslands; Mesic Highveld Grasslands; and Sub-Escarpment Grasslands. These subdivisions of the Grassland Biome are based on gradients of altitude (height above sea-level) and moisture (rainfall). Altitude has a strong influence on climatic variables and an increase in altitude usually corresponds with an increase in rainfall and a decrease in temperature. Grassland vegetation types are dominated by a single, lower layer of grasses, with the occurrence of a middle layer of shrub and upper layer of trees being rare to absent, except in a few localised habitats such as koppies (rocky outcrops) and rocky ridges.

The study area occurs within the Mesic Highveld Grassland Bioregion of the Grassland Biome of South Africa (Figure 6).

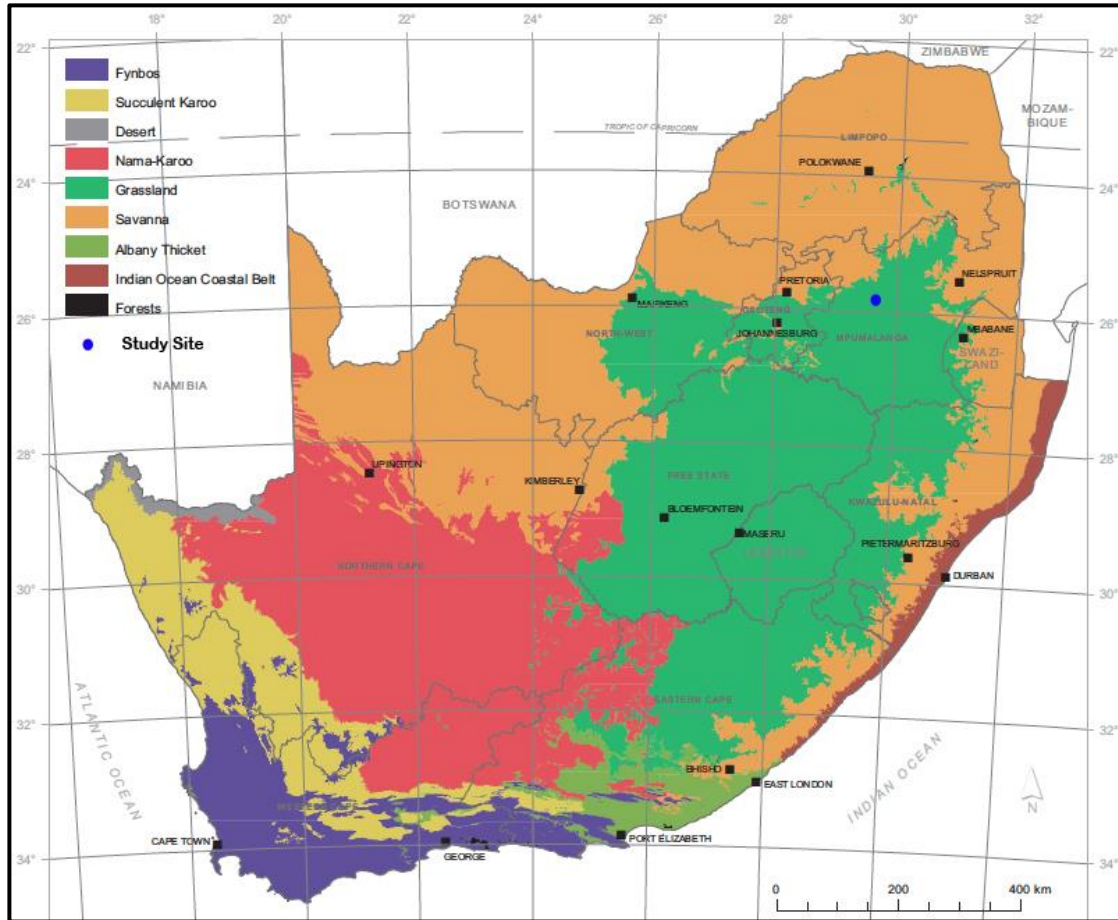


Figure 5: Biomes of South Africa

The study area is situated within the two veldtypes of Eastern Highveld Grassland and Wakkerstroom Montane Grassland (Figure 7). Table 2 shows the hierarchy of the vegetation, while Table 3 gives other classification names used for the same veldtypes. The study area is situated within high lying, high rainfall, sour grasslands of Mpumalanga.

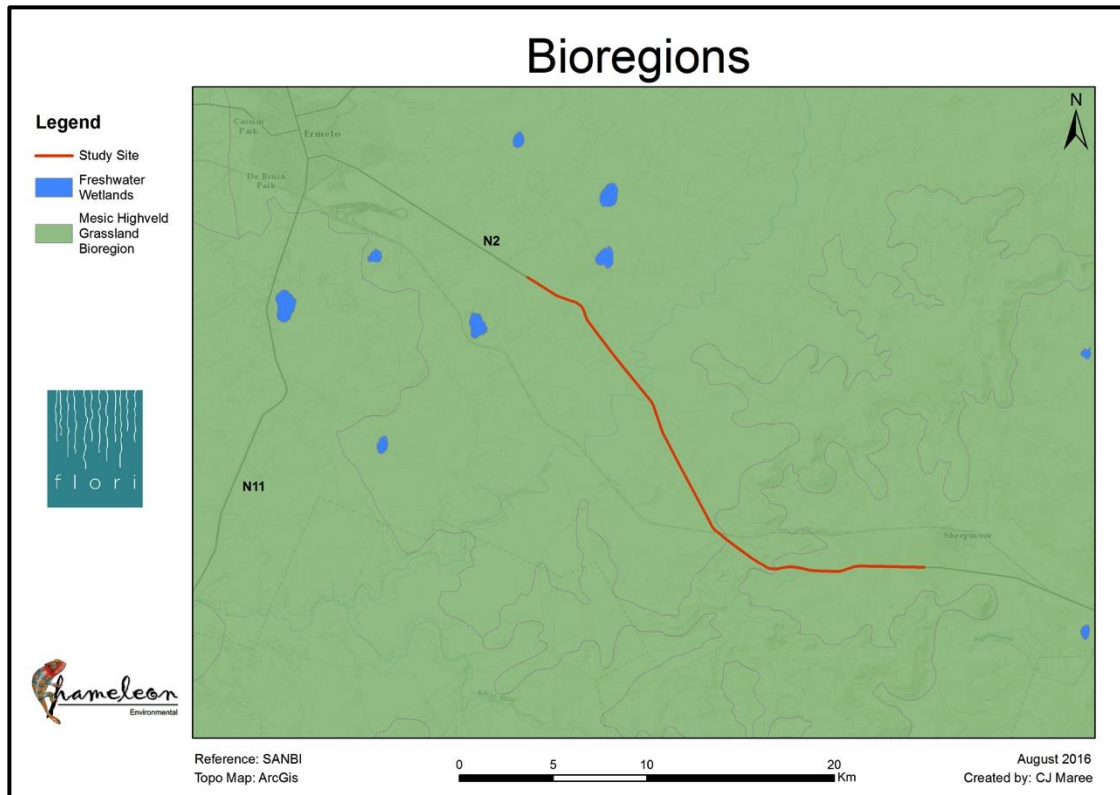


Figure 6: Bioregions

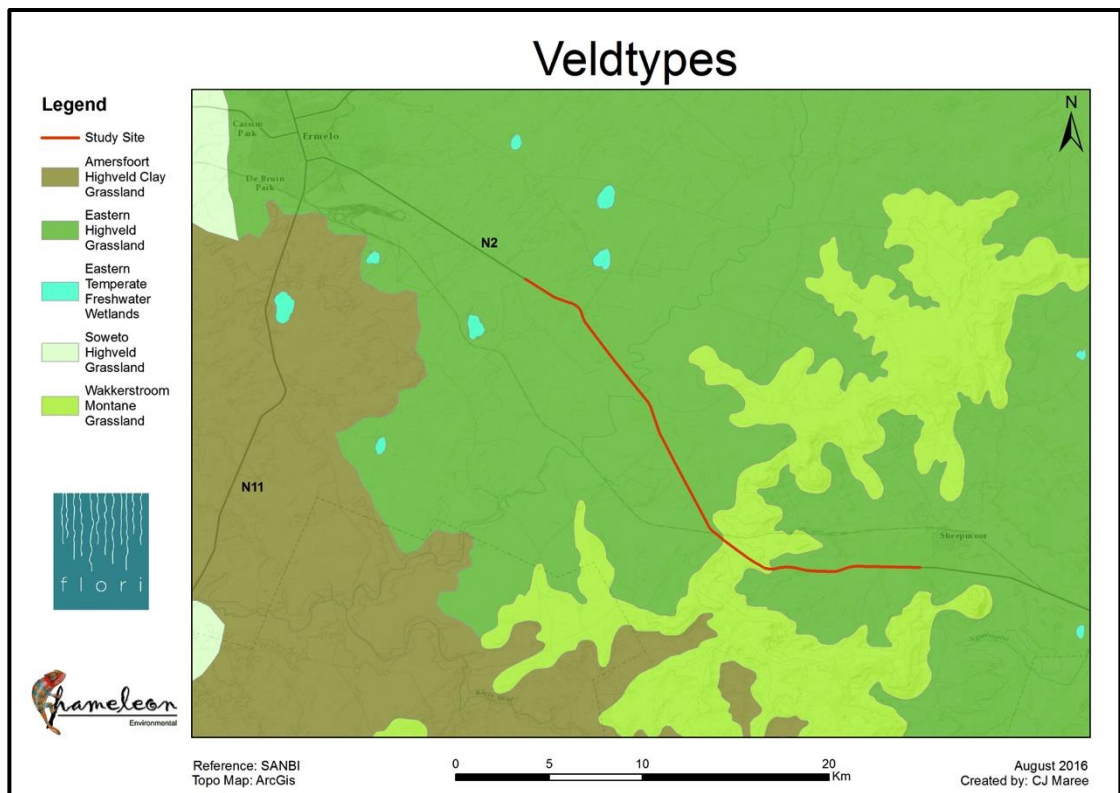


Figure 7: Veld types

Table 2: Vegetation classification of the study site

Category Description	Classification
Biome	Grassland
Bioregion	Mesic Highveld Grassland
Vegetation Types	Eastern Highveld Grassland; Wakkerstroom Montane Grassland

Table 3: Comparison of veldtype names

Mucina & Rutherford (2006)	Low & Rebelo (1996)	Acocks (1953)
Eastern Highveld Grassland (Chrissiesmeer Panveld)	-	-
Wakkerstroom Montane Grassland	Moist sandy highveld grassland	North eastern sandy highveld

4.1.1 Vegetation of the study area

The vegetation in the study area and in the general region is highly impacted upon. Most of the grasslands have been totally transformed or moderately- to highly-degraded, first from years of cultivation and later from opencast coal mining. There is no pristine grassland within the study area. Most of the area is impacted upon over the years by cultivation and grazing of cattle. There are no to few, indigenous trees within the study area, which is natural for these grassland veldtypes. There are also no sensitive rocky outcrops or ridges within the study area. Over-grazing has caused a reduction in specie-richness and mix. The study area consists mainly of the existing road reserve, which is regularly mowed, and thus tends to be highly modified as well.

The natural vegetation of the study area is characteristic of Eastern Highveld Grassland and Wakkerstroom Montane Grassland. The area of Eastern Highveld Grassland in which the study area is situated is also often described as Chrissiesmeer Panveld.

Numerous wetlands are scattered throughout the Mpumalanga Highveld grasslands. There are a number of valley-bottom wetlands, seepage wetlands and freshwater pans present in the region. Mucina & Rutherford (2006) felt that these open bodies of freshwater wetlands were distinct enough to be classified separately in terms of

veldtypes or ecosystems. None of these freshwater pans are present in or near to the quarry areas.

4.1.2 Priority Floral Species

No Red Data species (endangered, threatened or vulnerable) were observed during field investigations. According to the SANBI database a few Red Data species have been recorded in the region of the QDS quadrants, but it is unlikely that any of these species are present in the study area (Table 4). This however, is not to say for certain that none occur. The summaries of priority floral species per grid reference are tabled below (Table 4). Due to the regular cutting of the grass in the study area, as well as the grazing of free-roaming cattle, the species richness is low. The study area is mainly within the QDS 2630CA, with a small section in the south near Sheepsmoor in the QDS 2630CB.

Table 4: Priority Floral Species per 1:50 000 Grid Reference

Grid reference & Priority Category	No. of species	Name of species
2630CA		
Critically endangered (CR)	0	-
Endangered (EN)	0	-
Vulnerable (VU)	1	<i>Gladiolus malvinus</i>
Near threatened (NT)	0	-
2630CB		
Critically endangered (CR)	0	-
Endangered (EN)	0	-
Vulnerable (VU)	2	<i>Aspidoglossum xanthosphaerum</i> ; <i>Aloe kniphofioides</i>
Near threatened (NT)	0	-

4.2 Conservation status

SANBI's datasets record Eastern Highveld Grassland as Vulnerable (VU), but according to the latest Mpumalanga Biodiversity Sector Plan (2014) and Mucina & Rutherford (2010), Eastern Highveld Grassland is endangered (EN). However, the official status of Eastern Highveld Grassland is 'Vulnerable' and can be approached as such. Wakkerstroom Montane Grassland is classified as Least Threatened (LT) (Table 5).

Table 5: Veldtype status

Veldtype	Status	Info
Eastern Highveld Grassland	Vulnerable (VU)	Only a very small fraction conserved in statutory reserves (Eg. Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Some 44% transformed primarily through cultivation, opencast coalmines, plantations and urbanisation.
Wakkerstroom Montane Grassland	Least Threatened (LT) / Least Concern (LC)	Least threatened. Less than 1% is statutorily protected in the Paardeplaats Nature Reserve. There are 10 South African Natural Heritage Sites in this unit, although very little of it is formally protected. Land use pressures from agriculture are low (5% cultivated) probably owing to the colder climate and shallower soils. The area is also suited to afforestation, with more than 1% under <i>Acacia mearnsii</i> and <i>Eucalyptus</i> plantations. The black wattle (<i>Acacia mearnsii</i>) is an aggressive invader of riparian areas.

Table 6 below gives a basic description of each of the status categories, while Figure 8 shows the categories in a hierarchical format (IUCN Redlist, 2010).

A general overview map of the threatened ecosystems of South Africa is shown below in Figure 9. From the map in Figure 9 it can be seen that the study area is situated within threatened ecosystems or veldtypes. The map in Figure 9 is taken from SANBI's website (www.bgis.sanbi).

The Biodiversity Act (Act 10 of 2004) provides for listing of threatened or protected ecosystems, in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or protected. The main purpose for the listing of threatened ecosystems is an attempt to reduce the rate of ecosystem and species destruction and habitat loss, leading to extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI).

Table 6: Ecosystem Status: Simplified explanation of categories used

STATUS	% Transformed	Effect on Ecosystem
Least Threatened (LT)	0-20% (<20% loss)	No significant disruption of ecosystem functions
Vulnerable (VU)	20-40% (>20% loss)	Can result in some ecosystem functions being altered
Endangered (EN)	40-60% (>40% loss)	Partial loss of ecosystem functions
Critically Endangered (CR)	>60% or BT Index for that specific veldtype	Species loss. Remaining habitat is less than is required to represent 75% of species diversity

Source: South African National Spatial Biodiversity Assessment Technical Report. Volume 1: Terrestrial Component. 2004. SANBI. Mucina & Rutherford (eds) (2010).

Note: BT stands for the Biodiversity Threshold and is an index value that differs for each veldtype. In other words, because the composition, recovery rate, etc. differs for each veldtype there will be a different threshold (in this case percentage transformed) at which species become extinct and ecosystems breakdown. That is, at which point the veldtype is critically endangered. For the grassland vegetation units discussed the index value (BT) is broadly given as 60% and greater.

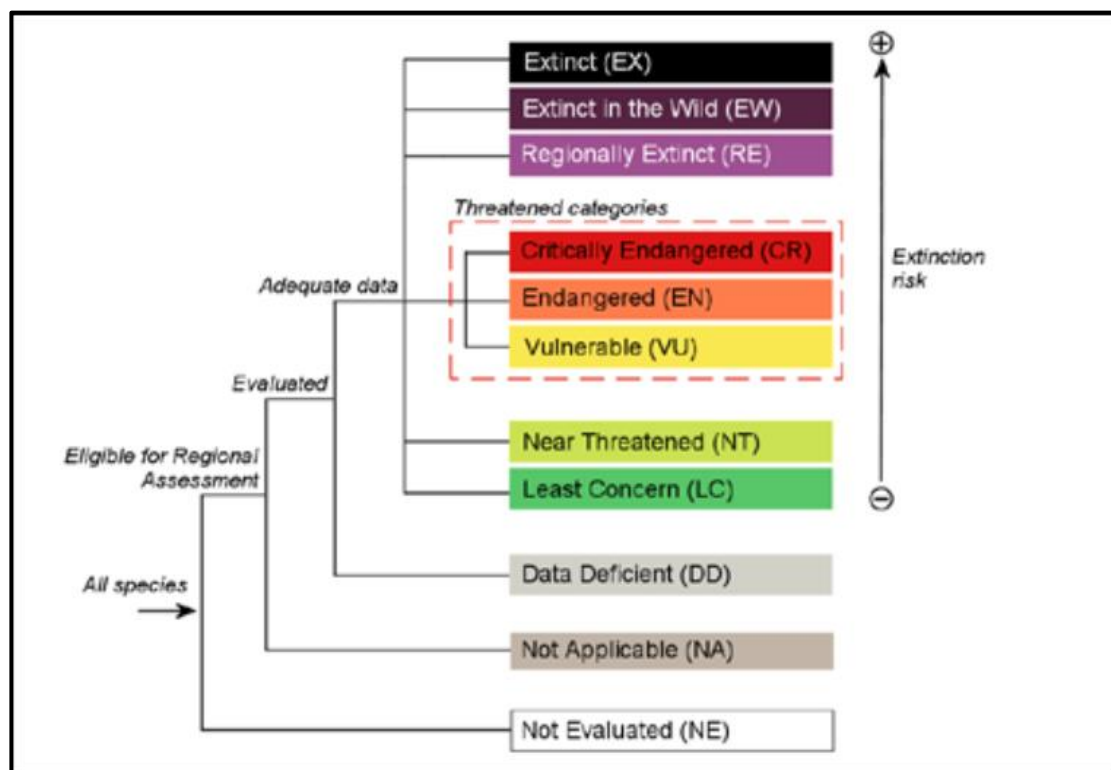


Figure 8: Structure of categories used at the regional level

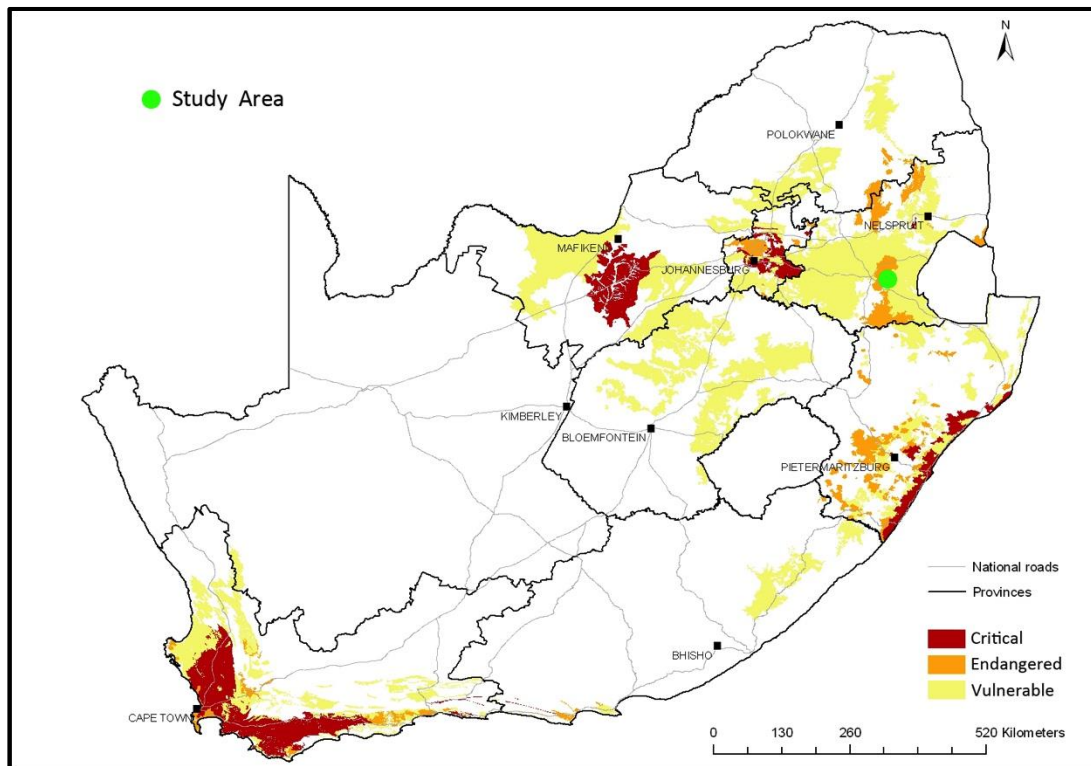


Figure 9: Threatened ecosystems of South Africa

The map in Figure 10 gives a close-up of the region, showing which threatened ecosystems the study area is within. The study area is within the threatened ecosystems of Eastern Highveld Grassland and Chrissiesmeer Panveld. These two ecosystems (or veldtypes) are generally classified as one and the same. Wakkerstroom Montane Grassland is not a threatened ecosystem (veldtype).

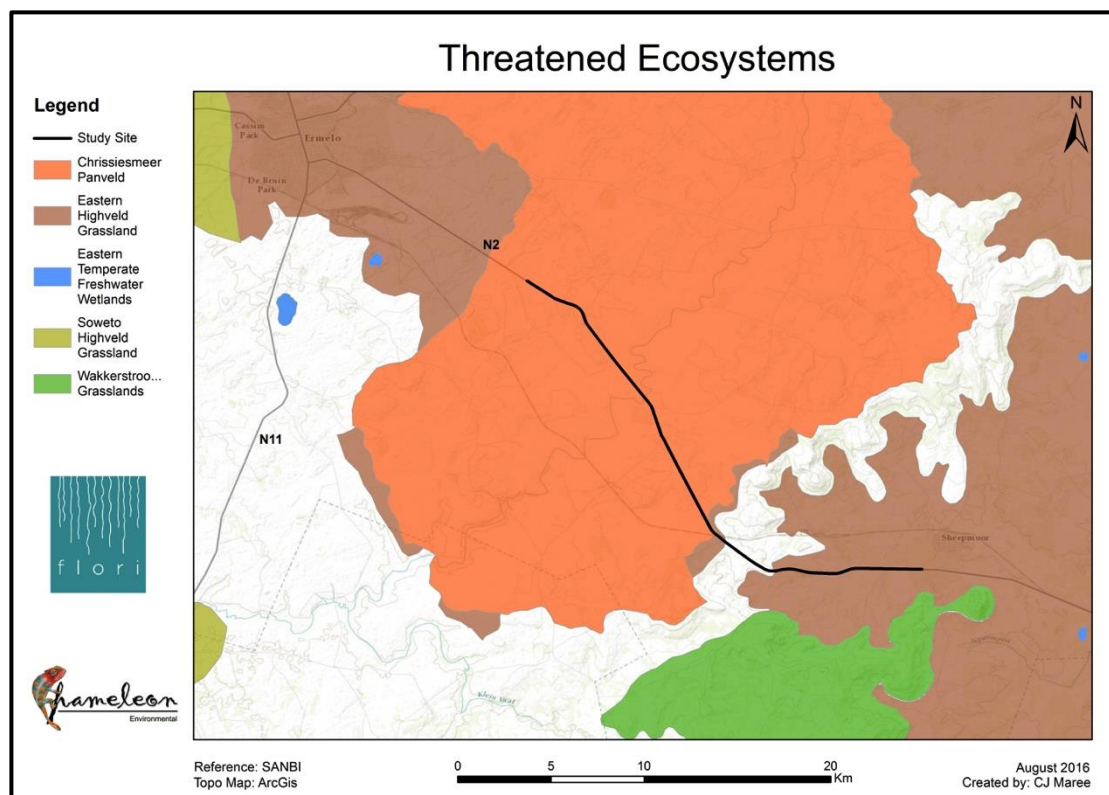


Figure 10: Threatened ecosystems of the region

4.3 Plants identified during field investigations

The dominant plant species identified during field investigations are listed in the appendices. Field investigations were limited to a few days only and plant lists can therefore not be considered comprehensive.

No Red Data species were observed during field investigations. No Orange Data species were found within the study area corridor, but some were found in the wetter grassland areas and wetland / stream areas such as *Boophane disticha*, while others such as *Haemanthus humilis* in the drier areas.

4.3.1 Alien plants identified in the Study Area

There are a number of alien plants in the study area. The herbaceous plants are especially prevalent in disturbed areas and rehabilitated mining areas. Tree species present tend to be mainly blackwattle (*Acacia mearnsii*) and gum trees (*Eucalyptus* spp.), with indigenous trees been rare to absent. Alien plant species, some of which are invasive, occur scattered throughout the area, especially in disturbed areas, rehabilitated mine areas and along road curbs. The alien plant species encountered in the study area are recorded, along with their category rating, in Table 7. The

categories are as set out in the Conservation Act of Agricultural Resources Act, 1983 (CARA) (Act 43 of 1983).

Table 7: Alien plants identified in the study area

Botanical Name	Common Name	Category
<i>Acacia mearnsii</i>	Blackwattle	2
<i>Argemone ochroleuca</i>	White-flowered Mexican poppy	1
<i>Bidens pilosa</i>	Blackjacks	-
<i>Caesalpinia decapetala</i>	Mauritius thorn	1
<i>Chromolaena odorata</i>	Triffid weed	1
<i>Conyza canadensis</i>	Horseweed fleabane	-
<i>Datura ferox</i>	Large thorn-apple	1
<i>Eucalyptus</i> spp & cultivars	Gum trees; Eucalyptus	2
<i>Guilleminea densa</i>	Mat weed	-
<i>Melia azedarach</i>	Syringa	3
<i>Malva verticillata</i>	Mallow	-
<i>Onopordum acanthium</i>	Scotch thistle	-
<i>Oxalis corniculata</i>	Sorrel	-
<i>Pinus pinaster</i>	Pine	2
<i>Solanum elaeagnifolium</i>	Silverleaf bitter apple	1
<i>Tagetes minuta</i>	Khakibos, kahki weed	-
<i>Tarazacum officinale</i>	Common dandelion	-
<i>Verbena bonariensis</i>	Vervain	-
<i>Xanthium strumarium</i>	Large cocklebur	-

4.4 Protected tree species identified in the study area

No protected tree species were found in the study area during field investigations.

4.5 Fauna

Field observations were limited to a few days, which always limits the observation and identification of fauna in the field. Due to the transformed nature of the study area the species richness will be low. Ideal habitats for most large or priority faunal species are rare to non-existent, with the exception of the pans, wetlands and streams. However, even these are under pressure with lack of adequate bufferzones and corridors and none are in a pristine condition.

4.5.1 Mammals

No large- or medium-sized mammals were observed during field investigations, with the exception of some common bird species and a few signs of porcupine, field mice, hares and mongoose. Larger mammals are known to occur in the region, but are not easily observed during quick, daytime field investigations.

4.5.2 Avifuna

A few common bird species were observed during field investigations such as laughing dove, cape turtle dove, pied crow, black-capped bulbul and common waxbill. A few black-shouldered kites (*Elanus caeruleus*) were observed during field investigations. This species is a priority species. The study area is within a region that is home to a number of priority bird species. Most of these species are dependent on good quality grassland and wetland areas. For example, African grass owl (*Tyto capensis*) or Blue cranes (*Anthropoides paradiseus*). There is however, little ideal or pristine habitat within the study area itself, except possibly in those areas where the route crosses over watercourses. There are more ideal habitats deeper into the grasslands, away from the N2 National road, which is the main study area. Care should still be taken to avoid contact with large bird species such as cranes and storks as they are obviously very mobile and will most likely come into the study area from time to time. Greater flamingoes (*Phoenicopterus roseus*) and lesser flamingoes (*Phoenicopterus minor*) are priority birds that have been seen in the region on numerous occasions. These large, pink and white-coloured birds forage in some of the large pans in the region. None of which are in the study area.

4.5.3 Reptiles

No reptiles were observed during field investigations. The maps below show the hotspots for priority snake and lizard species for South Africa (Figure 11 & Figure 12). The study area is not within snake or lizard hotspots, although it is possible that rock python (*Python natalensis*) could occur although rarely. Lizards tend to prefer rocky habitats and there are no rocky outcrops (koppies), rocky ridges or areas of large rock sheets within the study area. The likelihood is rare that any priority lizard species will be present in the study area.

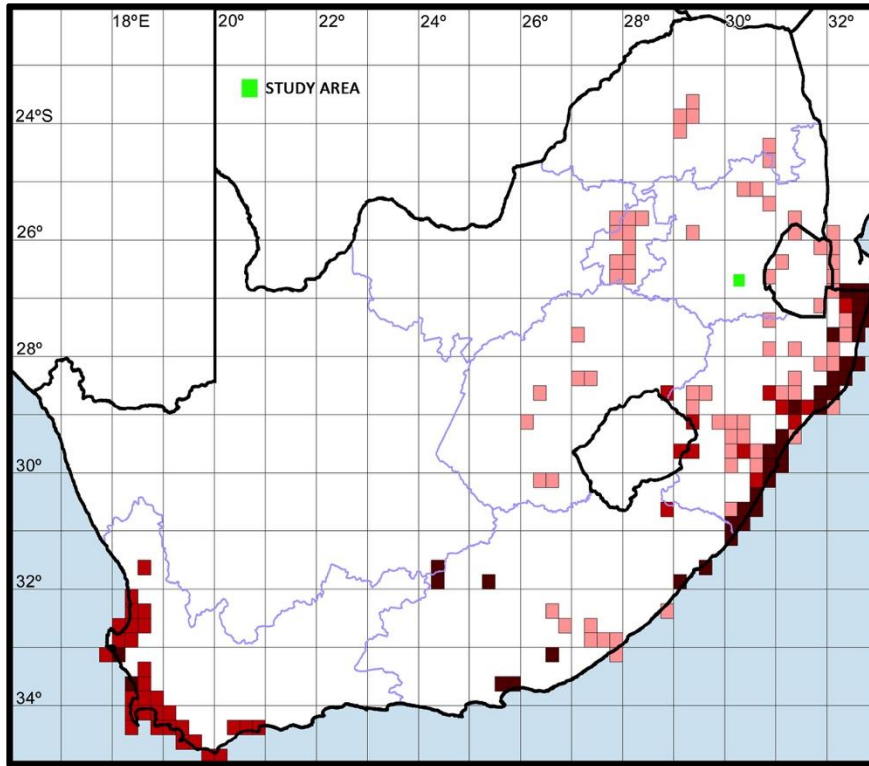


Figure 11: Snake hotspots

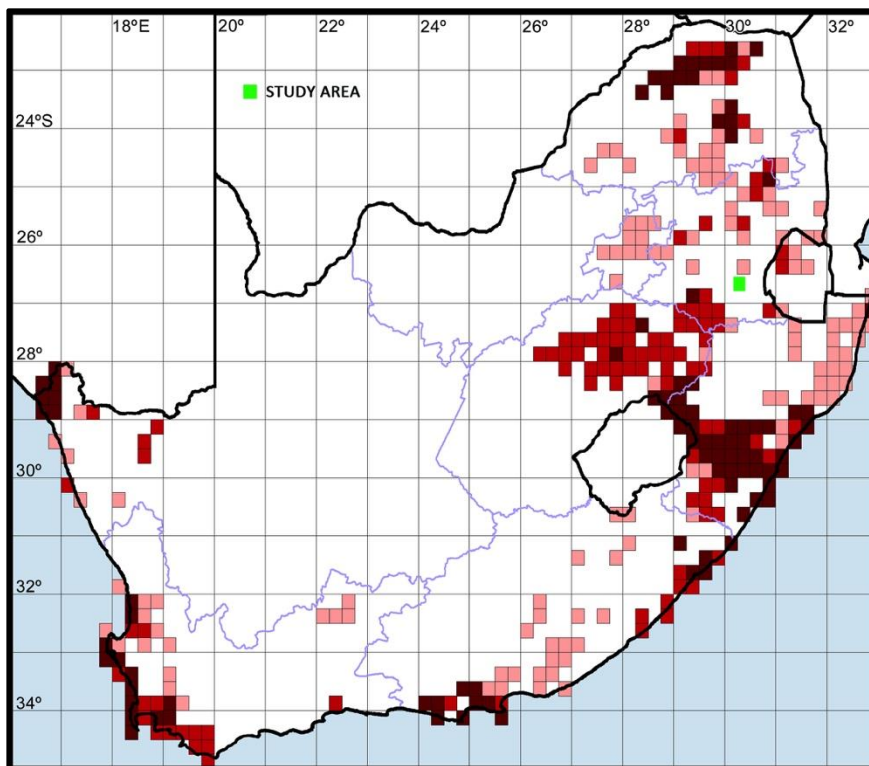


Figure 12: Lizard hotspots

4.5.4 Invertebrates

Invertebrates such as spiders, scorpions and butterflies are important faunal groups, but are difficult to fully assess in a short time period. During field investigations specific attention was given to priority species such as Mygalomorphae arachnids (Trapdoor and Baboon spiders) and red data butterflies. Fortunately, the nature and scope of the project is such that it will have very little negative impact, if any, on these species. No priority species were observed.

The map below shows the hotspots for priority butterflies and species-rich areas for South Africa (Figure 13). The study area is not within any of these known hotspots. The most likely red data butterfly to potentially occur in the region is the Marsh sylph (*Metisella meninx*), which is vulnerable (VU). The Marsh Sylph is endemic to the wet vleis of highland grasslands in northern KwaZulu-Natal, Mpumalanga, Gauteng and the northern part of the Orange Free State.

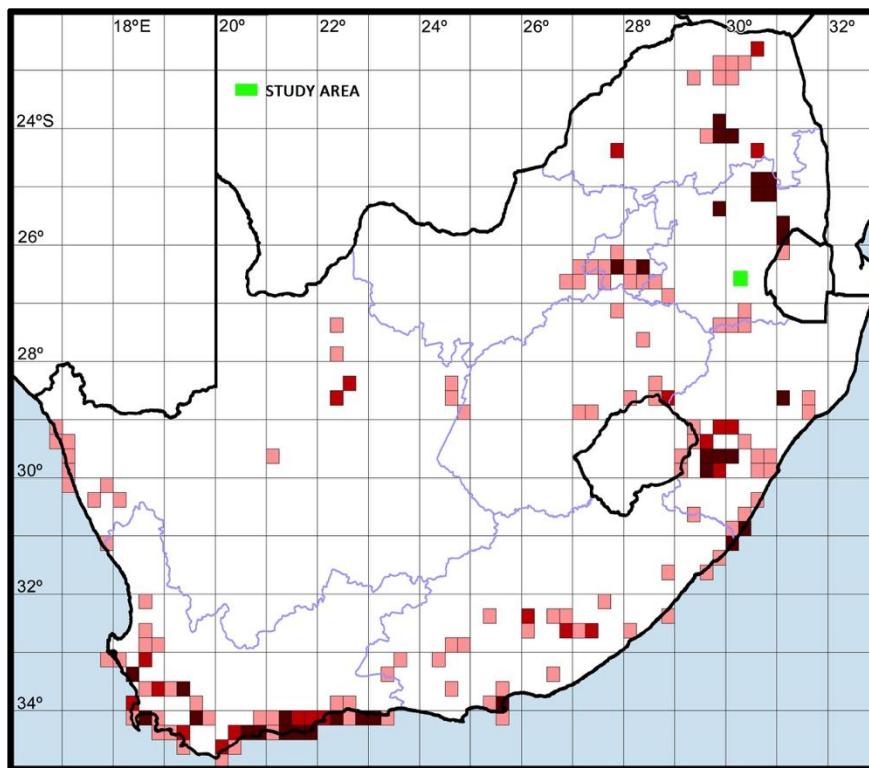


Figure 13: Butterfly hotspots

4.5.5 Faunal species of conservation concern

The general habitats present in the study area, with the exception of the wetlands and some open moist grassland, are not ideal for most potentially occurring Red

Data faunal species. Care should however still be taken to avoid impacting on any animals encountered.

The table below highlights the faunal species of conservation concern (which includes Red Data species) that potentially might occur in the study area and surrounding areas from time to time (Table 8).

Table 8: Red Data Faunal Species likely to occur in the area

Scientific Name	Common Name	Conservation Status	Preferred Habitat	Habitat Restrictions
Birds				
<i>Anthropoides paradiseus</i>	Blue crane	VU	Grasslands, cultivated lands	Grasslands, moist areas
<i>Asio capensis</i>	Marsh owl	LC	Grasslands, wetlands, vleis	Grassy Wetlands
<i>Balearica regulorum</i>	Grey crowned crane	EN	Grasslands, cultivated lands	Grasslands, moist areas
<i>Bugeranus carunculatus</i>	Wattled crane	EN	Grasslands, cultivated lands	Grasslands, moist areas
<i>Ciconia nigra</i>	Black stork	NT	Broad, open waterbodies	Cliff ledges for breeding
<i>Phoenicopterus minor</i>	Lesser flamingo	NT	Broad, pans	Pans or shallow water areas, food
<i>Phoenicopterus roseus</i>	Greater flamingo	LC	Broad, pans	Pans or shallow water areas, food
<i>Tyto capensis</i>	Grass owl	LC	Grasslands, wetlands.	Wetland areas
Butterflies				
<i>Metisella meninx</i>	Marsh sylph	VU	Wetlands, moist grassy areas	Wetlands, Montane
Frogs				
<i>Pyxicephalus adspersus</i>	Giant bullfrog	LC	Grassland, Savanna	Temporary floodplains, pans
Mammals				
<i>Atelerix frontalis</i>	SA hedgehog	NT	Most, broad	None

Snakes				
<i>Python natalensis</i>	Rock python	VU	Ridges, wetlands	Rocky areas, open water

5 AQUATIC ECOLOGY

The aquatic ecology focuses on the open waterbodies within the study area. These watercourses include wetlands, rivers, streams, pans, lakes and manmade dams. In reality a pan is actually a type of wetland and must be approached as such. The focus is to delineate watercourses and limit any impact the project might have on these watercourses.

5.1 Wetlands

'Wetland' is a broad term and for the purposes of this study it is defined according to the parameters as set out by the Department of Water & Sanitation (DWS) in their guideline (A practical field procedure for identification and delineation of wetlands and riparian areas, 2005). The classification of wetlands (which is a type of watercourse) is summarised below (Figure 14).







According to the DWS document and the National Water Act (NWA) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*"

Furthermore, the guidelines stipulate that wetlands must have one or more of the following defining attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50cm of the soil.

During the site investigations the following indicators were used to determine whether an area needed to be defined as a wetland or not, namely:

- Terrain unit indicator;
- Soil form indicator;
- Soil wetness indicator; and
- Vegetation indicator.

Hydrogeomorphic types		Description	Source of water maintaining the wetland	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

† Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small
 *** Contribution usually large
 */*** Contribution may be small or important depending on the local circumstances
 */*** Contribution may be small or important depending on the local circumstances.

Figure 14: Classification of wetlands

5.2 Riparian zones

Riparian vegetation is typically zonal vegetation closely associated with the course of a river or stream and found in the alluvial soils of the floodplain. According to the National Water Act (NWA) riparian habitat is defined as including “*The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or*

flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.”

It is important to note that the NWA states that the riparian zone has a floral composition distinct from those of adjacent areas. The NWA also defines riparian zones as areas that “*commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments.*”

5.3 Rivers and streams

A stream or river is a watercourse that is characterised by a very distinct channel. Most, but not all streams and rivers have an associated floodplain and / or riparian zone. Although wetlands and rivers are both watercourses, the legal implications differ in terms of development, buffer zones, etc.

5.4 Watercourses in the study area

The study area route crosses over three major rivers, namely the Sandspruit, Vaal and Witpuntspruit (Figure 15). There are also a few drainage lines and wetland areas along the N2 National Route (Study area). The GPS coordinates of these watercourses as shown in the table below (Table 9) and their location along the study area (red line) are shown in Figure 16. The pin numbers correspond with the ID numbers in Table 9.

Table 9: List of watercourses in the study area

ID	Watercourse	Coordinates	Comments
671	Unnamed wetland area	S26 43 52.7 E30 16 13.9	A small wetland area that has formed from along a small stream
672	Unnamed stream	S26 43 52.6 E30 16 02.9	Small drainage line / stream
673	Unnamed stream	S26 43 51.8 E30 15 21.1	Small stream. Isolated standing pools of water on eastside of N2. Westside dry. Stream choked with blackwattle
674	Sand River	S26 44 01.0 E30 14 30.9	Water, rocks and bedrock. Deep channel. No distinctive

			riparian zone. Grassy banks.
676	Wetland area	S26 40 32.9 E30 09 52.4	Wetland area both sides of N2 road. More like moist grassland than true open wetland.
677	Small drainage line	S26 39 37.7 E30 09 27.5	Small drainage line with associated moist grassland / wetland areas.
678	Vaal River	S26 38 53.9 E30 09 04.6	Important river.
679	Wetland	S26 38 00.8 E30 08 21.3	Small wetland / moist grassland area both sides of N2 road.
680	Drainage line	S26 36 19.6 E30 07 10.9	Between hills. Dry. Seasonal.
681	Wetland	S26 35 39.2 E30 05 51.6	A small wetland / moist grassland area.
682	Witpuntspruit (Stream)	S26 35 36.1 E30 05 47.2	Important river in the region.

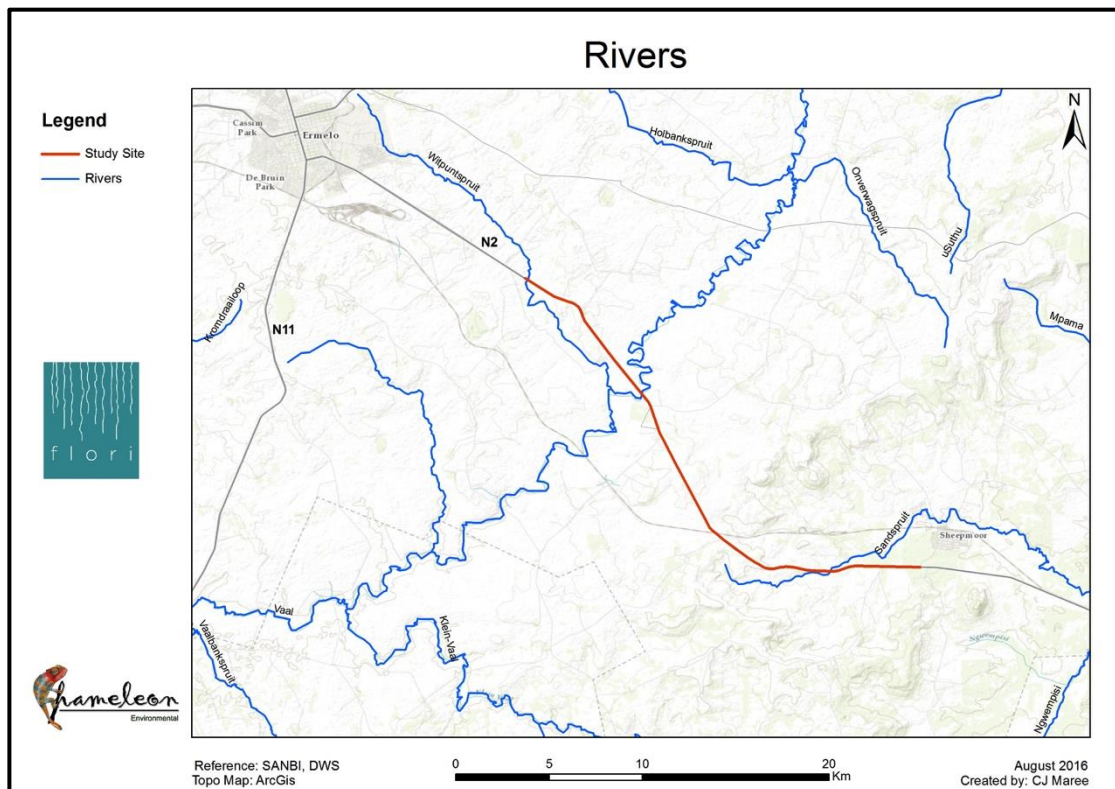


Figure 15: Main Rivers in the region

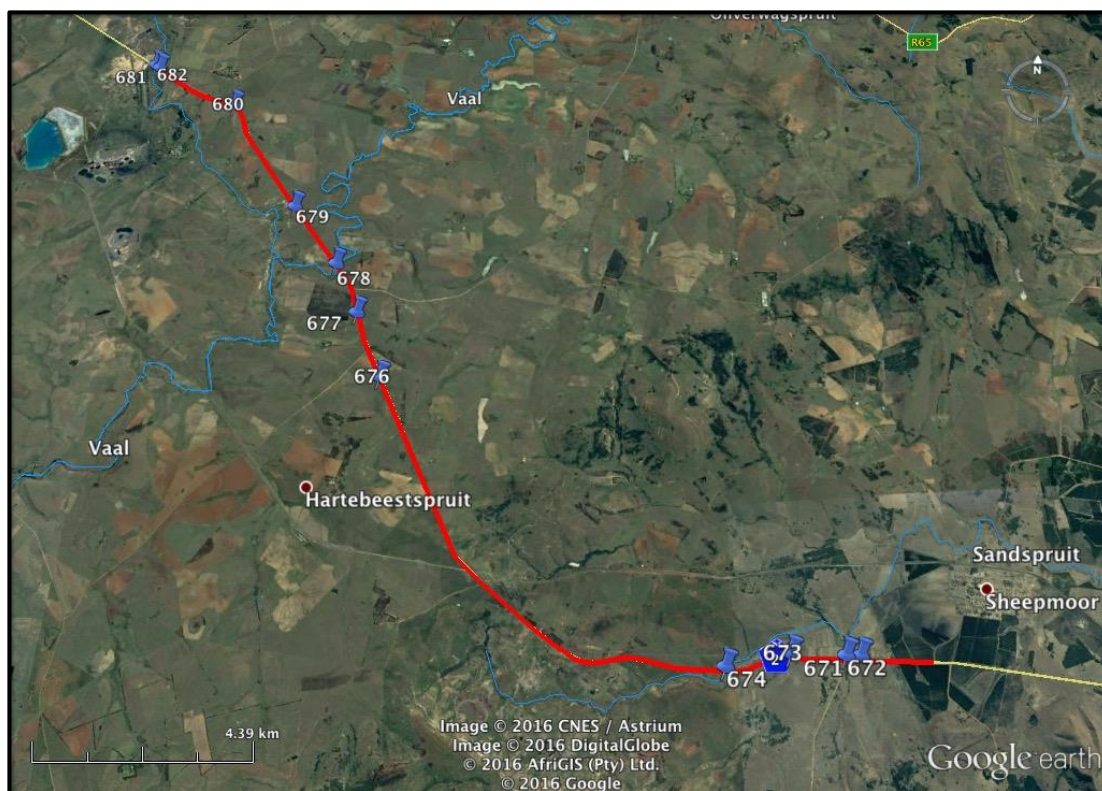


Figure 16: Location of watercourses

5.5 Classification of watercourses in the study area

The watercourses of the study area were classified along different hydrogeomorphic (HGM) types or units, up to Level 4, in terms of various levels as refined for South Africa by Kleynhans, *et. al.* (2005) and used in the Classification System for Wetlands user manual – SANBI Series 22 (Ollis *et. al.* 2013). See tables below (Table 10 & Table 11). This in addition to the classification system used above for wetlands (Figure 14).

Table 10: Classification levels 1 - 4

LEVEL 1 System	LEVEL 2 Regional setting (Ecoregion)	LEVEL 3 Landscape Unit	LEVEL 4 HGM Unit	
			HGM Type	Landform
Inland	SA Ecoregions according to DWS and/or NFEPA	<ul style="list-style-type: none"> • Valley floor • Slope • Plain 	River	<ul style="list-style-type: none"> • Mountain headwater stream • Mountain stream • Transitional stream

		<ul style="list-style-type: none"> Bench 		<ul style="list-style-type: none"> Upper foothill Lower foothill Lowland Rejuvenated foothill Upland floodplain
			Channelled valley bottom wetland	
			Unchannelled valley bottom wetland	
			Floodplain Wetland	
			Depression	<ul style="list-style-type: none"> Exorheic Endorheic Dammed
			Seep	<ul style="list-style-type: none"> With channel outflow (connected) Without channel outflow (disconnected)
			Wetland flat	

Table 11: HGM Level 4: Watercourses in study area

Delineated systems	Level 1 System	Level 2 Regional Setting (Ecoregion)	Level 3 Landscape Unit	Level 4 HGM Unit
Sandspruit (Stream)	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowland)
Vaal River	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowland)
Witpuntspruit (Stream)	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowland)
Unnamed Streams / Drainage lines	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowland)
Wetland areas	Inland	Mesic Highveld	Plain	Seeps and/or

		Grassland Group 4		Unchannelled valley bottom wetland
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5.6 Delineated Watercourses

The major rivers, small drainage lines and wetland areas, through which the study area crosses, were delineated (Figure 17 to Figure 25).



Figure 17: 671 & 672



Figure 18: 673



Figure 19: 674 (Sandspruit)



Figure 20: 676



Figure 21: 677

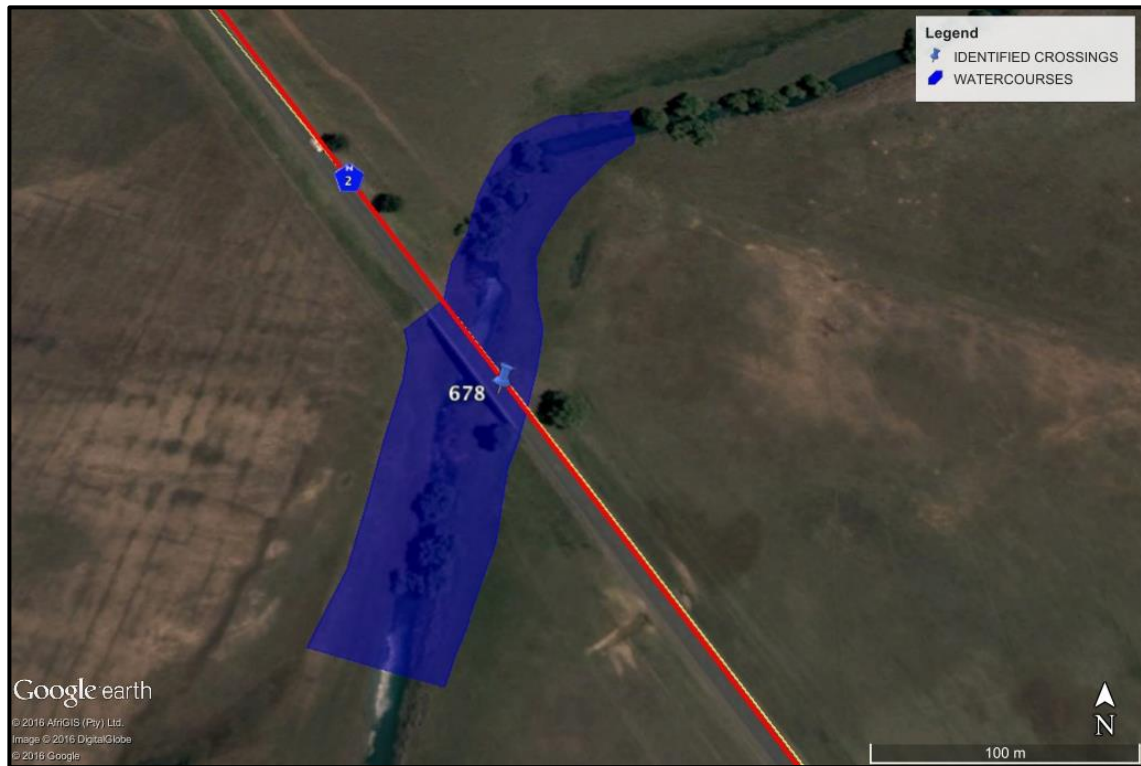


Figure 22: 678 (Vaal River)



Figure 23: 679



Figure 24: 680



Figure 25: 681 & 682 (Witpuntspruit)

5.7 Drainage areas

South Africa is geographically divided up into a number of naturally occurring Primary Drainage Areas (PDA) and Quaternary Drainage Areas (QDA) (Figure 26). The different areas fall under the authority of different Water Management Areas (WMA) and Catchment Management Agencies (CMA) (Figure 27 & Figure 28). Until fairly recently there were 19 WMAs and 9 CMAs. As of September 2016, these were revised and there are now officially only nine WMAs, which correspond directly in demarcation to the nine new CMAs (Government Gazette, 16 September 2016. No.1056, pg. 169-172).

The study area is situated within the Primary Drainage Area (PDA) of **C** and **W**, and in the Quaternary Drainage Areas (QDA) of **C11B** and **W53A** (Figure 29).

The study area is within the Usuthu to Mhlatuze Water Management Area (WMA 6) and Upper Vaal Water Management Area (WMA 8) and under the jurisdiction of the Inkomati / Usuthu / Pongola Catchment Management Agency (CMA 3) and the Vaal Catchment Management Agency (CMA 5) (Figure 28).

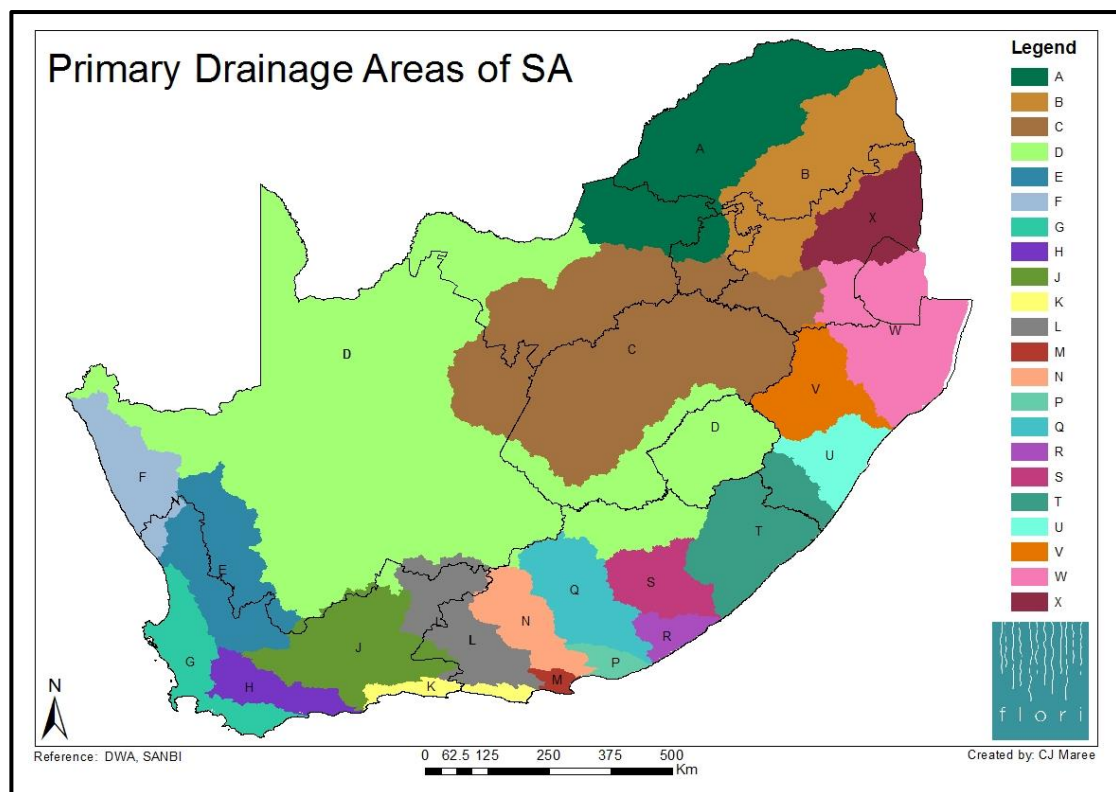


Figure 26: Primary drainage areas of South Africa

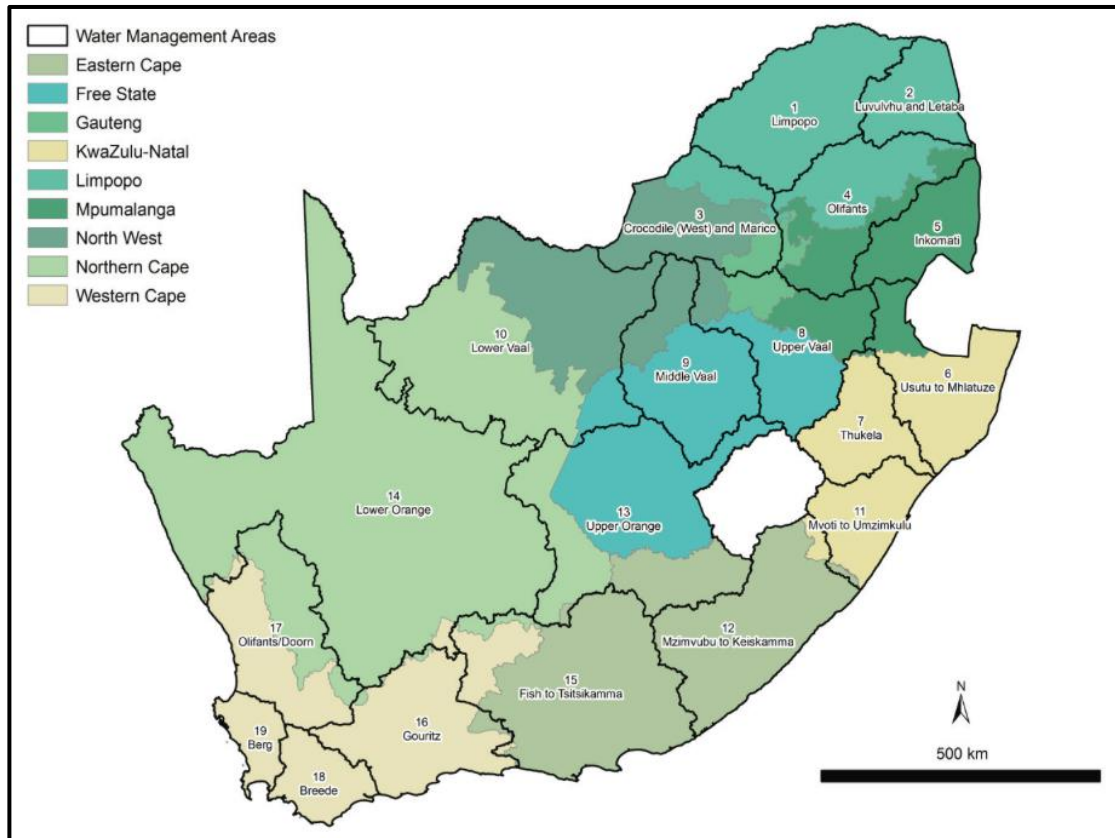


Figure 27: Old Water Management Areas (WMAs) of South Africa

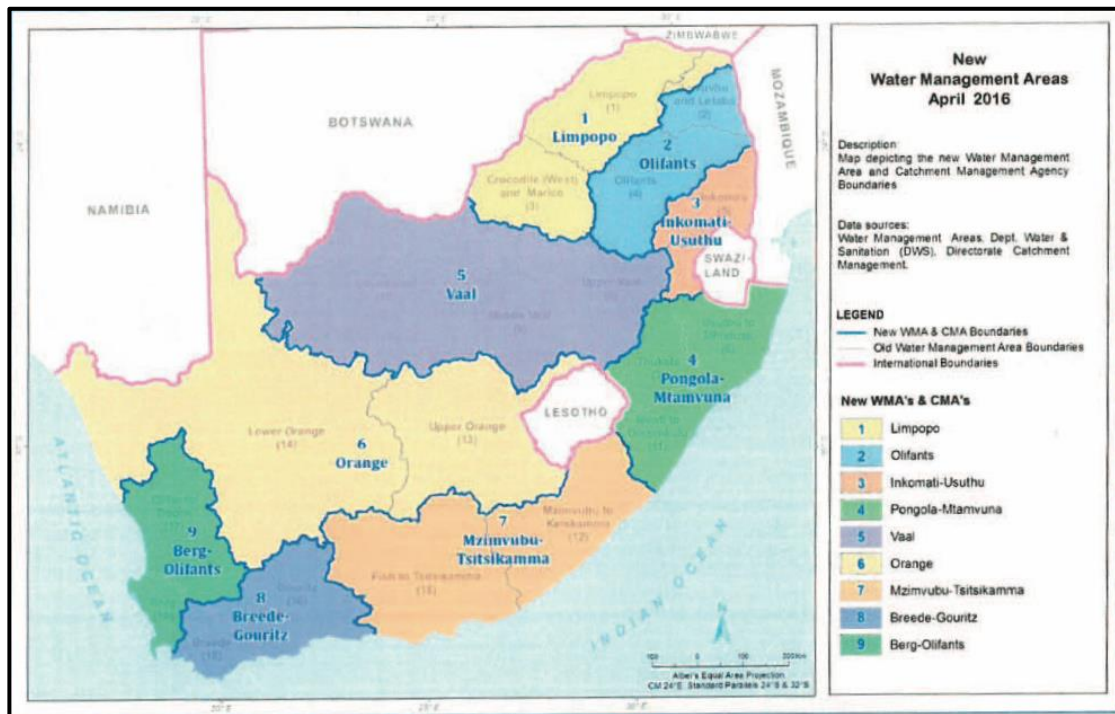


Figure 28: New WMAs & CMAs of South Africa

In terms of the water environment the study area is situated within a single Wetland Vegetation Ecoregion, namely Mesic Highveld Grassland (Group 4) (Figure 30).

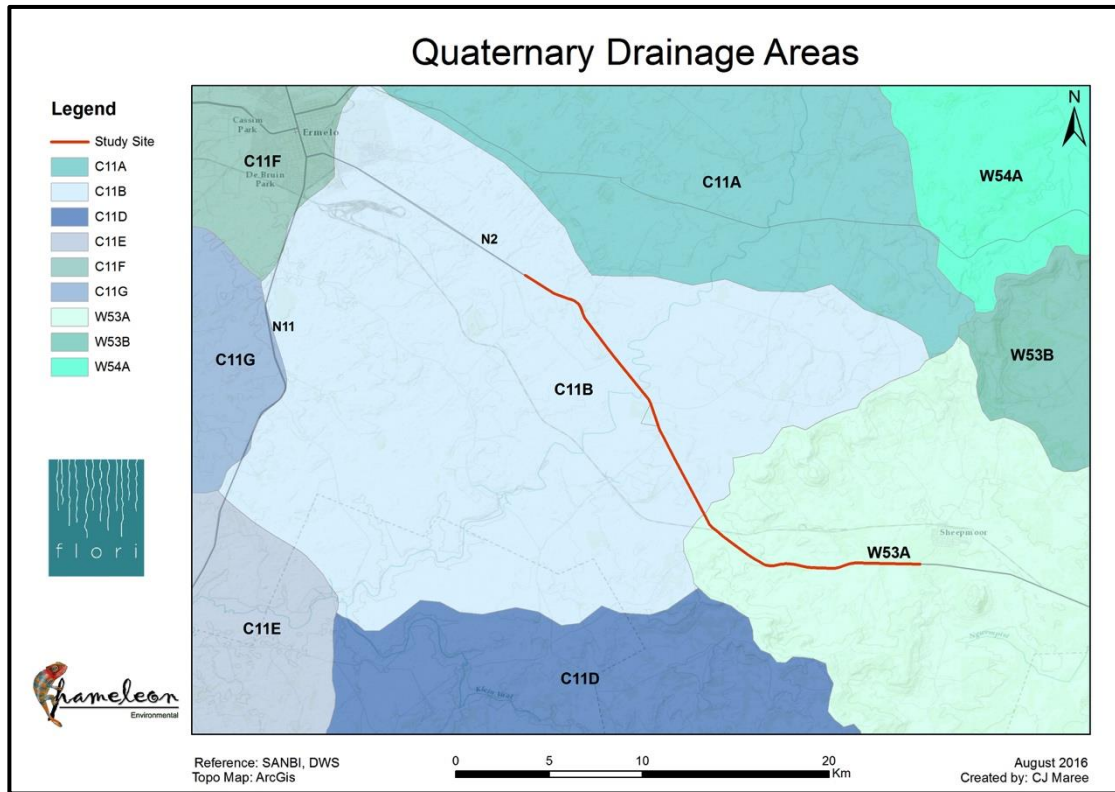


Figure 29: Quaternary drainage areas (QDAs)

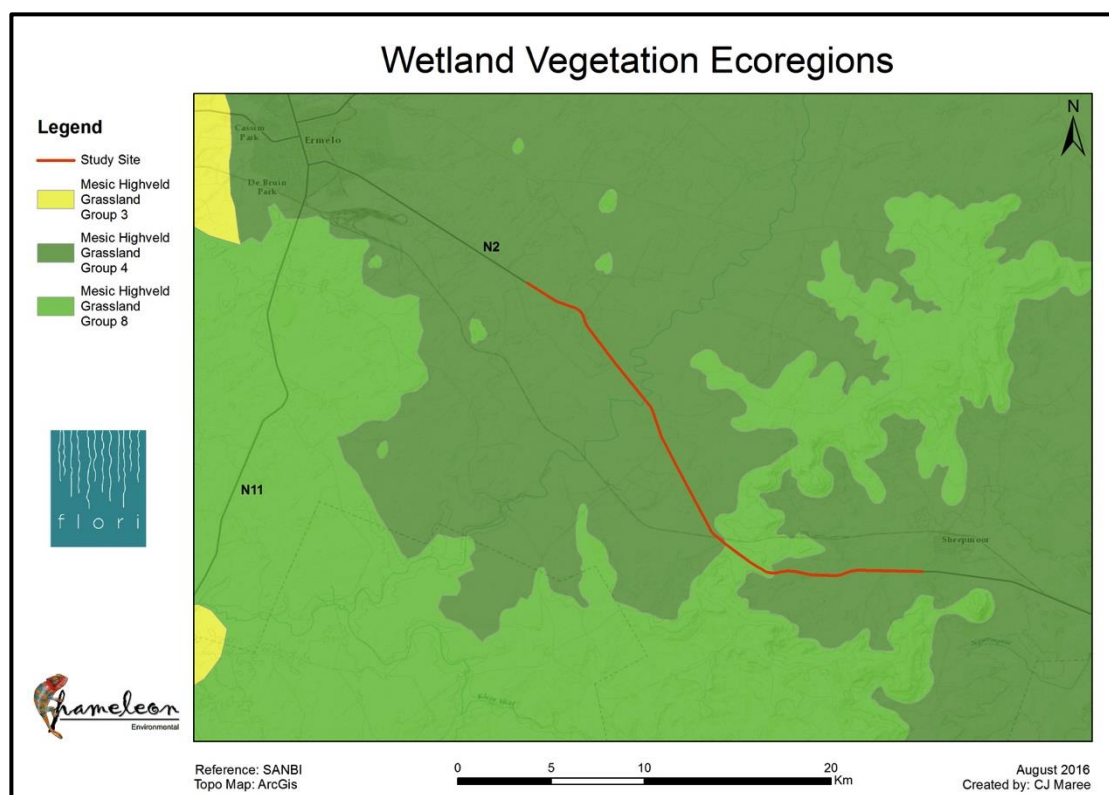


Figure 30: Wetland Vegetation Ecoregions

5.8 Strategic water source areas (SWSA) of South Africa

The Strategic Water Source Areas of South Africa (SWSA) are those areas that supply a disproportionate amount of mean annual runoff compared to the actual size of the geographical area. These areas are important because they have the potential to contribute significantly to the overall water quality and supply of the country, supporting growth and development needs that are often a far distance away. These areas make up 8% of the land area across South Africa, Lesotho and Swaziland but provide 50% of the water in these countries.

At a national level, Strategic Water Source Areas form the foundational ecological infrastructure on which a great deal of built infrastructure for water services depends. Investing in Strategic Water Source Areas is also an important mechanism for long-term adaptation to the effects on climate change on water provision growth and development (SANBI). The study area is not situated within any Strategic Water Source Areas (SWSA) of South Africa. However, it is within a region known for its many freshwater pans, moist grasslands and high rainfall regime (Figure 31).

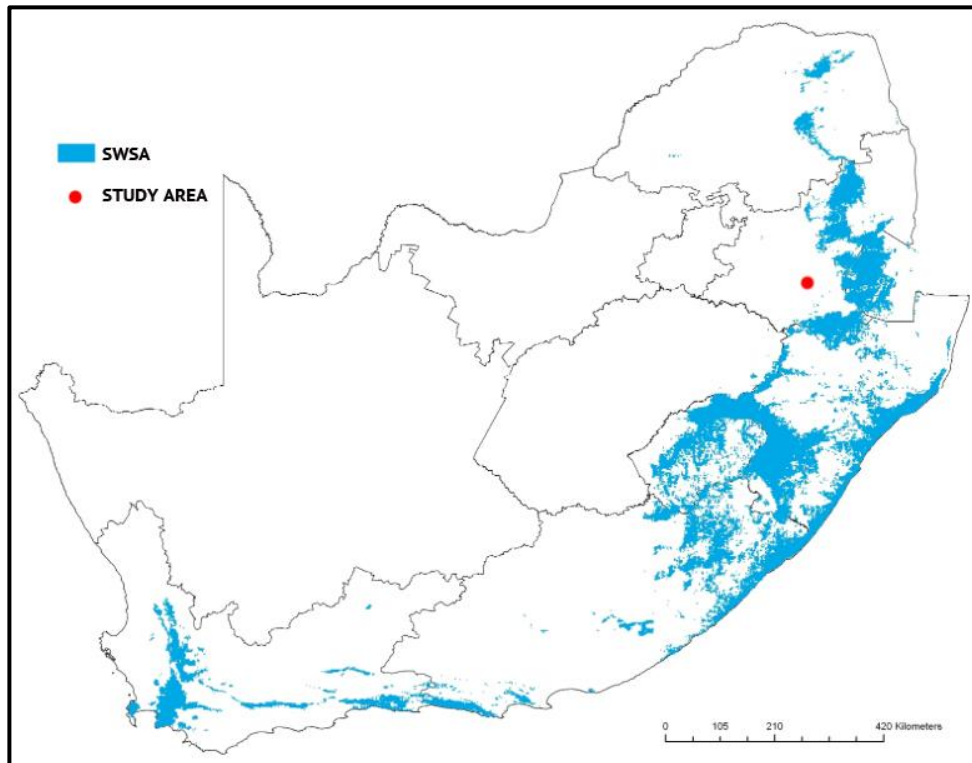


Figure 31: SWSA of South Africa

5.9 Methodology (PES)

The Present Ecological State (PES) is the current (present) ecological condition (state) in which the watercourse is found, prior to any further developments or impacts from the proposed project. The PES ratings of watercourses found in the study area are just as important to determine, as are the potential impacts of the proposed development. The PES of a watercourse is assessed relative to the deviation from the Reference State (also known as the Reference Condition).

The reference state is the original, natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES Method (DWA, 2005) was used to establish the present state (integrity) of the unnamed drainage line in the study area. The methodology is based on the modified Habitat Integrity approach of Kleynhans (1996, 1999).

Table 12 shows the criteria used for assessing the habitat integrity (PES) of wetlands and other watercourses, along with Table 13 describing the allocation of scores to the various attributes. These criteria were selected based on the assumption that

anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 12: Habitat assessment criteria

Rating Criteria	Relevance
Hydrology	
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural lands. Changes in flow regime (timing, duration, frequency), volumes, and velocity, which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water quality	
Water Quality Modification	From point or diffuse sources. Measured directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Geomorphology & Hydraulics	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities, which reduce or changes wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change

	from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation of Biota	Overgrazing, over fishing, over harvesting of plant material, etc.

Table 13: Scoring guidelines for habitat assessment

Scoring guidelines per criteria	
Natural / unmodified	5
Mostly natural	4
Moderately modified	3
Largely modified	2
Seriously modified	1
Critically modified (totally transformed)	0

Table 14 provides guidelines for the determination of the Present Ecological Status Category (PESC), based on the mean score determined for the assessments. This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the PESC (DWA, 2005).

Table 14: Wetland integrity categories

Category	Mean Score	Description
A	>4	Unmodified, natural condition.
B	>3 to 4	Largely natural with few modifications, but with some loss of natural habitats.
C	>2,5 to 3	Moderately modified, but with some loss of natural habitats.
D	2 to 2,5	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
E	>0	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
F	0	Critically modified. Modifications have reached a critical level and the

		system has been modified completely with an almost complete loss of natural habitat.
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The integrity of watercourses with a category rating of F,E & D were deemed to be Low. Category rating of C was deemed to be Medium, while Category ratings of B & A were deemed to be High.

5.10 PES of watercourses in the study area

All of the watercourses identified during field investigations in the study area were assessed (Table 15). The small streams and drainage lines are in reality and functionality the same. They have therefore been assessed as a group. The assessment criteria and structure is based on the modified Habitat Integrity approach of Kleynhans (1996, 1999). The PES is calculated by looking at the hydrology, geomorphology, water quality and biota of each watercourse. Of importance is the overall PES of the system.

Table 15: PES of watercourses in the study area

Criteria	Identified Watercourses				
	Vaal River	Sandspruit	Witpun-spruit	Drainage lines	Wetlands
HYDROLOGY					
Flow modification	3	3	2	2	2
Permanent inundation	2	3	1	1	1
WATER QUALITY					
Water Quality Modification	3	3	2	2	2
Sediment Load Modification	2	2	2	2	2
GEOMORPHOLOGY					
Canalisation	3	3	2	2	2
Topographic Alteration	2	2	2	2	2
BIOTA					
Terrestrial Encroachment	2	2	2	2	2
Indigenous Vegetation Removal	2	2	2	2	2
Invasive Plant Encroachment	3	3	3	3	3
Alien Fauna	3	3	3	3	3

Over utilisation of Biota	1	1	1	1	1
Total:	27	27	22	22	22
Average:	2,7	2,7	2,0	2,0	2,0
Category:	C	C	D	D	D
Integrity (PES):	Medium	Medium	Low	Low	Low
PES Description	Moderately Modified	Moderately Modified	Largely Modified	Largely Modified	Largely Modified
Recommended EMC	C	C	C	C	C

5.11 Methodology (EIS)

Ecological importance and sensitivity (EIS) looks at the importance of the wetland, watercourse or water ecosystem in terms of biodiversity and maintenance. The determination is not just based on the identified watercourse in isolation, but also its' importance in terms of supplying and maintaining services to the larger catchment and water systems up and downstream.

The ecological sensitivity (ES) part of the EIS looks at how sensitive the system is to changes in services and environmental conditions. The Recommended Environmental Management Class (REMC) is the recommended state to which the watercourse should be returned to or maintained at. The EIS categories and descriptions are outlined in the table below (Table 16).

A high REMC relates to ensuring a high degree of sustainability and a low risk of ecosystem failure occurring. A low REMC would ensure marginal sustainability, but with a higher risk of ecosystem failure. The REMC is based on the results obtained from assessing the ecosystem or watercourse in terms of EIS, PES and function. The ideal would be that with realistic recommendations and mitigating actions, to return the system to a certain level of functionality and original state. The determination of the Environmental Importance and Sensitivity (EIS) of the identified watercourses in the study area are shown below (Table 17).

Table 16: EIS Categories and Descriptions

EIS Categories	Median Range	Category
Wetlands that are considered ecologically important and sensitive on a national or international level. The biodiversity of these wetlands is usually very sensitive to flow & habitat modifications. They play a major role in	Very high 3 - 4	A

moderating the quantity and quality of water of major rivers.		
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	High 2 - 3	B
Wetland that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	Moderate 1 - 2	C
Wetlands that are not ecologically important and sensitive on any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	Low 0 - 1	D

5.12 EIS of watercourses in the study area

The EIS values of the watercourses were determined using the above methodology.

The calculations and categories are shown below (Table 17).

Table 17: EIS and EMC values of watercourses

Determinant	Vaal River	Sand-spruit	Witpunt-spruit	Drainage lines	Wetlands	Confidence
PRIMARY DETERMINANTS						
1. Rare & Endangered Species	3	3	3	1	1	4
2. Populations of Unique Species	2	2	2	1	1	4
3. Species/taxon Richness	2	2	2	1	1	4
4. Diversity of Habitat Types or Features	2	2	2	1	1	4
5. Migration route/breeding and feeding site for wetland species	3	3	3	1	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3	3	1	1	3
7. Sensitivity to Water Quality Changes	3	3	3	1	1	3

8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	3	1	1	3
MODIFYING DETERMINANTS						
9. Protected Status	1	1	1	1	1	4
10. Ecological Integrity	3	3	3	1	1	4
TOTAL	25	25	25	10	10	-
AVERAGE	2,5	2,5	2,5	1,0	1,0	-
Overall EIS	B	B	B	D	D	-
Description	High	High	High	Low	Low	-

The Vaal, Witpunspruit and Sandspruit Rivers are the main watercourses in the area and are therefore viewed as having a High EIS (Category B). The drainage lines have a low EIS (Category D) because they are mostly small, insignificant and moderately to highly disturbed. Wetlands are normally important in terms of species richness and uniqueness and important for many faunal species. However, the wetlands within the study area are not such typical wetlands. Oftentimes many of these wetland areas are classified as moist grasslands and do not have the same uniqueness and importance as large, open water body wetlands. They cannot be compared on the same level as most, typical wetlands.

5.13 Drivers of ecological change on the watercourses

The main drivers of ecological change on the watercourses and water ecosystems in the study area are:

- Cultivation;
- Opencast coalmining;
- Impoundment by means of in-channel farm dams; and
- Over-utilisation of natural resources.

6 SENSITIVITY ASSESSMENT

The sensitivity assessment identifies those areas and habitats within the study site that have a high conservation value and that may be sensitive to disturbance. All watercourses, including seasonal streams and drainage lines are always deemed to be sensitive, even if they are badly degraded. Areas or habitats have a higher conservation value (or sensitivity) based on their threatened ecosystem status, ideal habitat for priority species (including Red Data species), species-richness, distinctive habitats, etc.

The natural environment within the study area is uniform and consists of only two natural habitats, namely grassland and watercourses. The watercourses are similar to one another in nature. Most of the natural habitat along the route of the study area has been totally transformed due to cultivation and mining. Such areas are not viewed as sensitive at all. Pristine grassland areas would be viewed in this area as sensitive, but none occur. The floral and faunal sensitivity analyses are shown in the tables below (Table 18 & Table 19).

6.1 Floristic Sensitivity Analysis

Table 18: Floristic sensitivity analysis

Criteria	Distinctive habitats in the study area	
	Grassland	Watercourses
Red Data Species	2	5
Habitat Sensitivity	2	7
Floristic Status	3	7
Floristic Diversity	3	6
Ecological Fragmentation	5	8
Sensitivity Index	30%	66%
Sensitivity Level	Medium/Low	Medium/High
Development Go Ahead	Go-Slow	Go-But

6.2 Faunal Sensitivity Analysis

Table 19: Faunal sensitivity analysis

Criteria	Distinctive habitats in the study area	
	Grassland	Watercourses
Red Data Species	2	5
Habitat Sensitivity	2	7
Faunal Status	3	7
Faunal Diversity	3	7
Ecological Fragmentation	5	8
Sensitivity Index	30%	68%
Sensitivity Level	Medium/Low	Medium/High
Development Go Ahead	Go-Slow	Go-But

6.3 Ecological Sensitivity Analysis

The ecological sensitivity of the study area is determined by combining the sensitivity analyses of both the floral and faunal components. The highest calculated sensitivity unit of the two categories is taken to represent the sensitivity of that ecological unit, whether it is floristic or faunal in nature (Table 20).

Table 20: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Grassland	Medium/Low	Medium/Low	Medium/Low	Go-Slow
Watercourses	Medium/High	Medium/High	Medium/High	Go-But

According to the analyses there are no high sensitivity areas or habitats. However, the watercourses must be viewed and approached as sensitive.

6.4 DEA Desktop Screening Tool

The Department of Forestry, Fisheries and the Environment (DFFE) (Previously DEFF and DEA) has developed a desktop screening tool that is to be used as a guideline in an initial desktop assessment of a project site (www.screening.environment.gov.za). The screening tool incorporates most datasets produced by DWS, DFFE, SANBI and Provincial Conservation Plans. However, it is important to keep in mind that the screening tool is a broad, desktop guideline that needs to be verified during site investigations (ground truthing). Depending on the

levels of sensitivity shown in the screening assessment certain criteria in terms of assessments, studies, etc. can be required by relevant authorities. According to the screening tool (accessed August 2021) the various sensitivities for the study site and immediate surroundings are as follows:

- Terrestrial biodiversity theme: Very High Sensitivity.
- Aquatic biodiversity theme: Low (northern section) & Very High (southern section) Sensitivity.
- Plant species theme: Mix of Low & Medium Sensitivity.
- Animal species theme: Mix of Medium & High Sensitivity.

During site investigations the accuracy of the DEA Screening Tool was verified (ground-truthed). The demarcations of all of the Themes are very inaccurate, broad and very basic. For example, large areas shown as having high aquatic sensitivity have no actual aquatic ecosystems within them. Furthermore, large areas shown as having very high biodiversity sensitivity are totally transformed agricultural lands and alien tree plantations (afforestation).

Finally, it is important to stress that the project involves the upgrade of an existing hard-surfaced road and related infrastructure. Therefore, the main project and related activities will only take place within a transformed, highly degraded, 'Low' sensitivity environment.

6.5 Priority areas

The study area is within Important Bird Areas (IBA) and National fresh water ecosystem priority areas (NFEPA). Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National fresh water ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas (Figure 32).

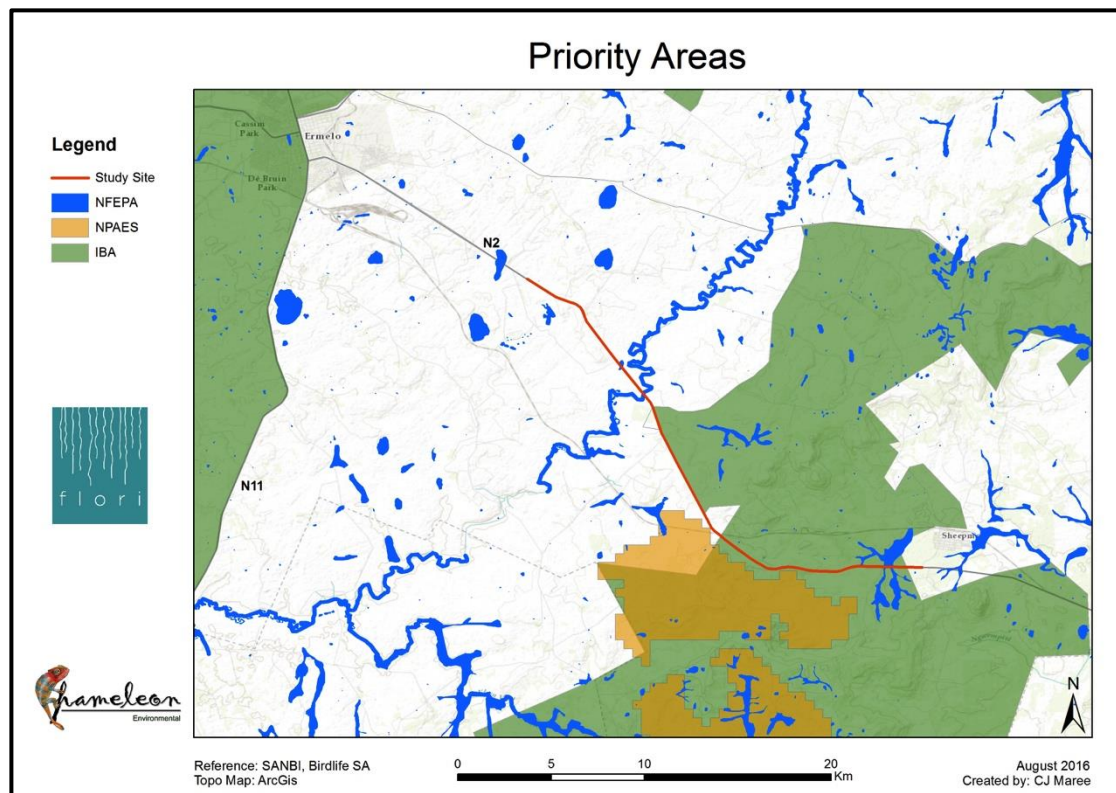


Figure 32: Priority areas

6.6 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan 2014 (MBSP) was developed by updating and revising the earlier Mpumalanga Biodiversity Conservation Plan (MBCP, 2006). The revised plan incorporates significant technical improvements, including more recent landcover data and better biodiversity data. Figure 33 highlights the extent of the Critical Biodiversity Areas (CBA) that the study area potentially impacts on, or is situated within. Table 21, as taken directly from the MBSP (2014) handbook, gives descriptions of the different categories used in the MBSP map in Figure 33. Although CBAs are very important in terms of guiding development and protecting the environment, they are not necessary fatal flaws or 'No-Go' Areas.

Table 21: Description of categories for the MBSP (2014) maps

MAP CATEGORY	DESCRIPTION	SUB-CATEGORY	DESCRIPTION
Protected Areas	Areas that are formally protected by law and recognised in terms of the Protected Areas Act, including contract protected areas declared through the biodiversity stewardship programme.	National Parks & Nature Reserves	Includes formally proclaimed National Parks, Nature Reserves, Special Nature Reserve, and Forest Nature Reserves.
		Protected Environments: Natural	Includes Protected Environments, declared in terms of Protected Areas Act (Act 57 of 2003, as amended).
		Protected Environments: Modified	Heavily modified areas in formally proclaimed Protected Environments.
Critical Biodiversity Areas (CBA)	All areas required to meet biodiversity pattern and process targets; Critically Endangered ecosystems, critical linkages (corridor pinch-points) to maintain connectivity; CBAs are areas of high biodiversity value that must be maintained in a natural state.	CBA: Irreplaceable	This category includes: (1) Areas required to meet targets and with irreplaceability values of more than 80%; (2) Critical linkages or pinch-points in the landscape that must remain natural; (3) Critically Endangered Ecosystems.
		CBA: Optimal	The CBA Optimal Areas (previously called 'important and necessary' in the MBSP) are the areas optimally located to meet both the various biodiversity targets and other criteria defined in the analysis. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all biodiversity targets and design criteria.
Ecological Support Areas (ESA)	Areas that are not essential for meeting targets, but that play an important role in supporting the functioning of CBAs and that deliver important ecosystem services	ESA: Landscape Corridor	The best option to support landscape-scale ecological processes, especially allowing for adaptation to the impacts of climate change.
		ESA: Local Corridor	Finer-scale alternative pathways that build resilience into the corridor network by ensuring connectivity between climate change focal areas, reducing reliance on single landscape-scale corridors.
		ESA: Species Specific	Areas required for the persistence of particular species. Although these may be production landscapes, a change in land-use may result in loss of this species from the area. (Only one species-specific ESA was included in the analysis — an over-wintering site for blue cranes).
		ESA: Protected Area Buffers	Areas surrounding protected areas that moderate the impacts of undesirable land-uses that may affect the ecological functioning or tourism potential of PAs. Buffer distance varies according to reserve status: National Parks — 10 km; Nature Reserves — 5 km buffer; Protected Environments — 1 km buffer.
Other Natural Areas (ONA)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.		
Moderately or Heavily Modified Areas	Areas in which significant or complete loss of natural habitat and ecological function has taken place due to activities such as ploughing, hardening of surfaces, open-cast mining, cultivation and so on.	Heavily Modified	All areas currently modified to such an extent that any valuable biodiversity and ecological functions have been lost.
		Moderately Modified: Old lands	Old cultivated lands that have been allowed to recover (within the last 80 years), and support some natural vegetation. Although biodiversity pattern and ecological functioning may have been compromised, the areas may still play a role in supporting biodiversity and providing ecosystem services.

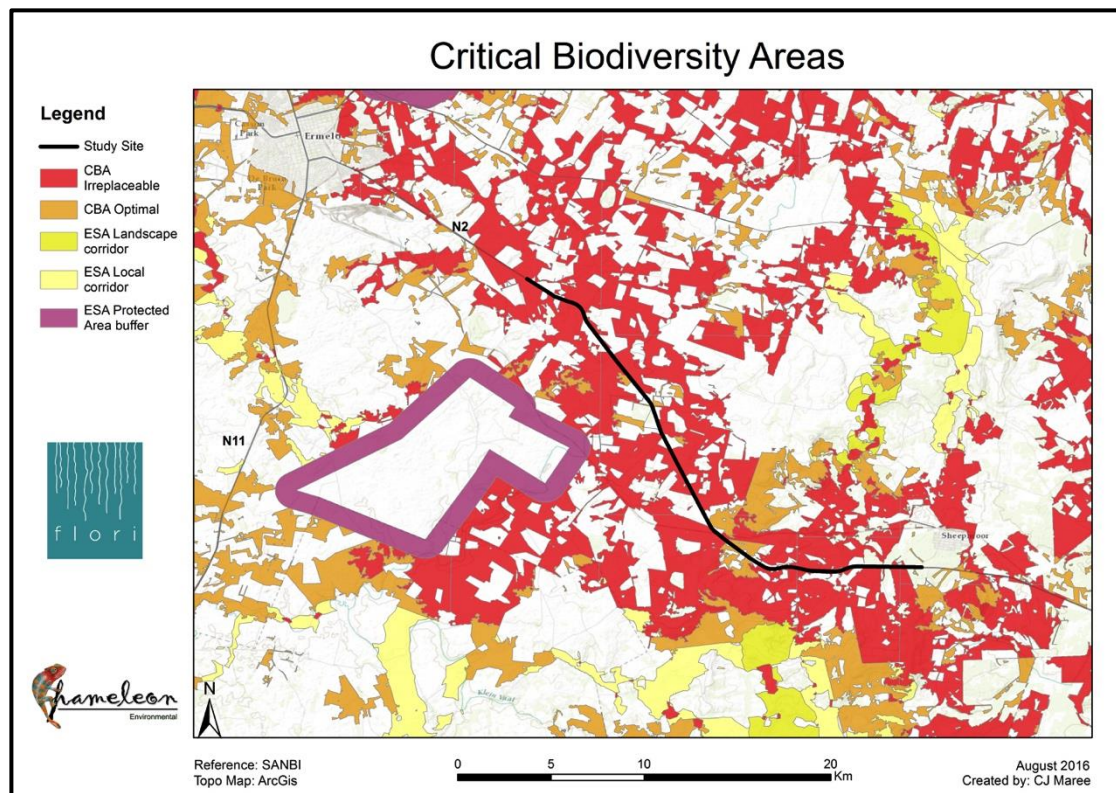


Figure 33: CBAs

6.7 Sensitive areas identified during field investigations

Most of the study area is transformed or degraded grassland. No to little pristine grassland is present in the study area. Keeping in mind that the study area is mainly the existing N2 National Road and road reserve. There are no sensitive grassland areas in the study area. However, the route does cross over a few watercourses and watercourses are always view as sensitive habitats, despite the level of degradation.

Even with this in mind there are no highly sensitive, or 'no-go' areas within the study area.

7 THE GO, NO-GO OPTION

7.1 Classification criteria

The term 'fatal flaw' is used in the pre-application planning and screening phases of a project to evaluate whether or not an impact would have a 'no-go' implication for the project. In the scoping and impact assessment stages, this term is not used. Rather impacts are described in terms of their potential significance.

A potential fatal flaw (or flaws) from a biodiversity perspective is seen as an impact that could have a "no-go" implication for the project. A 'no-go' situation could arise if residual negative impacts (i.e. those impacts that still remain after implementation of all practical mitigatory procedures/actions) associated with the proposed project were to:

- a) Conflict with international conventions, treaties or protocols (e.g. irreversible impact on a World Heritage Site or Ramsar Site);
- b) Conflict with relevant laws (e.g. clearly inconsistent with NEMA principles, or regulations in terms of the Biodiversity Act, etc.);
- c) Make it impossible to meet national or regional biodiversity conservation objectives or targets in terms of the National Biodiversity Strategy and Action Plan (BSAP) or other relevant plans and strategies (e.g. transformation of a 'critically endangered' ecosystem);
- d) Lead to loss of areas protected for biodiversity conservation;
- e) Lead to the loss of fixed, or the sole option for flexible, national or regional corridors for persistence of ecological or evolutionary processes;
- f) Result in loss of ecosystem services that would have a significant negative effect on lives (e.g. loss of a wetland on which local communities rely for water);
- g) Exceed legislated standards (e.g. water quality), resulting in the necessary licences/approvals not being issued by the authorities (eg. WULA);
- h) Be considered by the majority of key stakeholders to be unacceptable in terms of biodiversity value or cultural ecosystem services.

7.2 Potential Fatal Flaws for the Project

There are no obvious fatal flaws and the project may go ahead. There are no 'No-Go' areas within the study site. However, mitigating measures need to be implemented and care must be taken specifically in the areas of watercourse crossings.

8 IMPACT ASSESSMENT

The impacts of the activities related to the proposed project were rated. There are existing and potential impacts and mitigating measures are recommended to help reduce the sum of these impacts. The rated impacts of the proposed project before and after the implementation of mitigating measures are shown in the matrix below (Table 22).

Besides the direct impacts of the project, a number of other general impacts can occur during the construction phase that needs to be taken into account. The significances of these are highlighted in the table below (Table 23).

Table 22: Impact Rating Matrix

N2 NATIONAL ROUTE FOR N2 SECTION 33 & 34 (SECTION A)					
SECTION A (N2-34: KM 60,0 to KM 87,4)					
Ref	Position	Description / Comments	Impact Rating	Mitigating Measures	Sensitivity
Road	N2 Sec 34. KM 60,0 to KM 87,4	Lots of open grassland. But mostly over-grazed. None to little pristine grassland present in actual study area. Cattle, maize, little plantations	Before Mitigation: Medium Total = 9 Extent: (Local) 2 Duration: (Short-term) 1 Intensity: (High) 3 Probability: (Highly probable) 3 With Mitigation: Low Total = 7 Extent: (Site) 1 Duration: (Short-term) 1 Intensity: (Moderate) 2 Probability: (Highly probable) 3	Use existing roads where possible. Monitor erosion and rehabilitate regularly during construction. Maintain haul roads & access roads in good condition. Set up temporary base camps, offices, storage facilities in exiting, disturbed grassland, not in pristine grassland. Not on rocky ridges, not within 100m of any watercourses, including wetlands and moist grassland	LOW

<p>Watercourse crossings</p>	<p>Various spots along the route</p>	<p>No to little distinctive riparian zones. Trees in riparian zone almost always alien, invasive species. Rivers, streams, drainage lines typically very narrow. Wetlands typically moist grassland or seepage areas with no or little distinctive aquatic flora. Not typical wetlands. No permanent zones.</p>	<p>Before Mitigation: Medium Total = 9 Extent: (Local) 2 Duration: (Short-term) 1 Intensity: (High) 3 Probability: (Highly probable) 3</p> <p>With Mitigation: Low Total = 7 Extent: (Site) 1 Duration: (Short-term) 1 Intensity: (Moderate) 2 Probability: (Highly probable) 3</p>	<p>Use existing roads where possible. Monitor erosion and rehabilitate regularly during construction. A 50m bufferzone each side of watercourse to be maintained, except in actual construction footprint. Erosion & siltation to be carefully monitored. Stream banks to be monitored for erosion and maintained during construction phase, not just after. Vehicles, machinery and staff must be kept out of bufferzone areas as not to impact on the watercourses. Removing of invasive trees in watercourse will be a positive impact. Clearing of rubbish and debris out of watercourse will be a positive impact.</p>	<p>LOW</p>
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Table 23: General impacts of the project in the study area

Issue	Significance rating before and after mitigation	
	Before	After
Farming Related & Other Issues		
Access to properties	Medium	Low
Access roads (damage, blocking)	Medium	Low
Loss of agricultural potential	Low	Low
Loss of cultivation potential	Low	Low
Loss of grazing potential	Low	Low
Impact on airstrips	Low	Low
Impacts on seasonal activities	Low	Low
Natural Environment		
Erosion	Low	Low
Impact on flora	Low	Low
Impact on fauna	Low	Low
Impact on wetlands	Medium	Low
Impact on watercourses	Medium	Low
Importation of alien vegetation	Low	Low
Impact of herbicides	Low	Low
Impact on conservation areas	Low	Low

8.1 Levels of acceptable change

The cumulative negative impacts will most likely remain neutral. Small negative impacts will be corrected (rehabilitated) and off set with the positive impacts of upgrading culverts, bridges and road surfaces along with improved and upgraded stormwater management systems and existing erosion along road surface edges. Therefore, the levels of change (increase in negative cumulative impacts) arising from the activities of the proposed project are at acceptably low levels for the area and for the project to proceed and not create or result in any related 'fatal flaws'.

9 MITIGATION OF IMPACTS

The following mitigating measures are recommended to help reduce the potential negative impacts of the project on the natural environment. The implementation of recommended mitigating measures are necessary if the conclusions and assessments of the report are to remain pertinent.

9.1 Construction & Operation Phase

- No temporary accommodation or temporary storage facilities may be setup within 100m of the any river, stream, drainage line, wetland or farm dam.
- No temporary accommodation or temporary storage facilities may be setup within 500m of the outer boundary of any pans in the area.
- No temporary facilities (including portable toilets) to be positioned within a 50m bufferzone of the edge of any watercourses.
- Only existing roads to be used by vehicles during construction as far as possible. Especially in terms of crossing over watercourses.
- No vehicles may drive through wetland areas and no new service road may be made through wetland areas.
- Upgrade activities close to watercourses to be carefully monitored in terms of erosion and possible resulting siltation of watercourses. Weekly inspection of work areas around watercourses to be conducted. Any signs of new erosion and siltation to be rectified immediately.
- Disturbed surface areas in the construction phase to be rehabilitated. No open trenches to be left. No mounds of soils created during construction to be left.
- All construction material, equipment and any foreign objects brought into the area by contractors to be removed immediately after completion of the construction phase.
- Proper rubbish/waste bins to be provided. These to be emptied weekly and the waste to be removed to an official waste disposal site.

9.2 Maintenance phase (to be implemented in defect liability period for 1 year)

- Mechanical control of alien plants around disturbed areas caused by construction need to be implemented within three months of completion of construction. Thereafter every six months. Mechanical control to be of such a nature as to allow local, indigenous grasses and other pioneers to colonise the previously disturbed areas, thereby assisting in keeping out invasive weed species.
- No chemical control (herbicides) of alien plants to be used within 100m of any watercourses.
- Areas around foundations, culverts, gabions, etc. need to be check before and after the summer rainy season for signs of soil erosion due to stormwater run-off. Such sites need to be modified and rehabilitated to prevent ongoing erosion. These sites need to be monitored more closely than other sites which show no or minimal signs of erosion.
- Inspection of road shoulders in areas of steep topography to be inspected after the summer rainy season for signs of erosion and rehabilitated and rectified as required.

10 CONCLUSIONS & RECOMMENDATIONS

The following are the conclusions of the study, along with recommendations.

10.1 Conclusions

- The study site is situated within the original extent of Eastern Highveld Grassland and Wakkerstroom Montane Grassland, within the Grassland Biome.
- Eastern Highveld Grassland is a threatened veldtype / ecosystem with a threat status of 'Vulnerable'.
- Almost the entire study area is transformed or highly degraded. There are no areas of pristine grassland or habitats in the study site.
- During field investigations no Red Data Listed (RDL) or Orange Data Listed (ODL) plants were observed in the study site. None are expected to occur.
- There are no 'high' sensitive habitats present on site, with the exception of the watercourse crossings.
- No red data listed (RDL) faunal species were observed to be present and / or breeding with the study area boundaries. It is also highly unlikely that any are or will be present, with the small chance along the main rivers only.
- Site investigations were conducted during the summer and winter months and the findings and availability of field data are sufficient to achieve acceptable findings and outcomes from the assessment.
- Due to the nature of the project (upgrade of an existing road) no further specialist environmental studies are required or recommended.
- There are no obvious fatal flaws in terms of the project on the natural environment.
- Impacts on the existing natural environment related to the project are '**LOW**'
- The levels of change (increase in negative cumulative impacts) arising from the activities of the proposed project are at acceptably low levels for the area and for the project to proceed and not create any related 'fatal flaws'.
- A General Authorisation (GA) process for work on watercourse crossings will be required.
- Taking all findings and recommendations into account the following are the reasonable opinions of the specialist, namely:

- That the entire project, along with related construction activities, should be authorised. The project and related activities may proceed to the next phase.
- The levels of impact and change to the natural environment along and within the study area are low to minimal. In fact, the upgrades of the road, along with storm water culverts and watercourse crossings, will have numerous positive impacts, such as preventing the impeding and impounding of water flow, siltation, and erosion. In other words, the levels of change are well within any acceptable means and expected outcomes. There is no need to drastically alter any project plans or cease / prevent any portion or area of the project from taking place.
- The entire project should be authorised. However, all recommended mitigating measures put forward in this report, as well as other specialist reports and legal requirements should be included in the EMPr and must be implemented.

10.2 Recommendations

- Recommended mitigating measures as proposed in this study and report must be implemented. These include, but not limited to:
 - The footprint of the project is small in relation to the area and mostly within an already disturbed and altered environment.
 - Two main rivers will be crossed (Letsitele & Thabina), along with a few small semi-perennial streams and drainage lines. The long-term impact of the upgrade of the actual watercourse crossings is a positive impact, because it will improve water flow, remove blockages, stabilise stream banks, reduce existing erosion of stream banks and riparian areas.
 - Minimal riparian vegetation will be lost (need to be removed) as the project involves the upgrade of crossings and not new crossings. The upgrade will also not include the need to remove trees and other riparian vegetation.
 - Any temporary storage, lay-down areas or accommodation facilities to be setup in existing built-up areas or disturbed areas. No temporary storage areas, laydown areas or site offices are allowed within a **100m** of the edge of any river, stream or distinctive drainage line.

- No temporary storage areas, laydown areas or site offices are allowed within a **100m** of the edge of any river, stream or distinctive drainage line. That is, a **100m buffer zone** (no-go zone) for these sites are required along all watercourses.
- Ensure small footprint during construction phase
- An Erosion Plan to be implemented and monitored during the construction phase, especially in the area of watercourses and steep gradients along escarpment edges. The erosion potential is moderate to low. This also to further reduce the potential of siltation of small watercourses. The plan need only be basic, but needs to be monitored.
- All hazardous materials must be stored appropriately to prevent these contaminants from entering the water environment;
- All excess materials brought onto site for construction to be removed after construction and their removal seen as part of the construction phase.
- No open trenches or mounds of soils to be left.
- Rehabilitation plan for disturbed areas to be compiled and implemented as part of the construction phase.
- The most important recommendations arising from the study is the need for 100m buffer zones around watercourses in which no temporary laydown areas, site offices or campsites may be set up.
- An independent ECO is recommended to monitor operations and ensure that recommended mitigating measures, including buffer zones, are implemented and adhered to.

11 APPENDICES

11.1 List of floral species identified on site

Trees

Acacia caffra, *Acacia mearnsii**, *Eucalyptus spp.**, *Pinus pinaster**, *Populus alba**,
*Salix bablylonica**

* = Alien species.

Shrubs & Herbaceous plants

Berkheya radula, *Berkheya setifera*, *Boophone disticha*, *Centella asiatica*,
*Cheilanthes*¹¹~~setifera~~*hirta*, *Diospyros lycioides* subsp. *lycioides*, *Haemanthus humilis*,
Haplocarpha scaposa, *Helichrysum aureonitens*, *Helichrysum caespititium*,
Helichrysum rugulosum, *Hypoxis rigidula*, *Oxalis corniculata*, *Parinari capensis*,
Searesia (=Rhus) magalismontanum, *Senecio coronatus*.

Grasses

Aristida aequiglumis, *Aristida congesta*, *Aristida junciformis*, *Brachiaria serrata*,
Cynodon dactylon, *Digitaria monodactyla*, *Elionurus muticus*, *Eragrostis chloromelas*,
Eragrostis curvula, *Eragrostis plana*, *Eragrostis racemosa*, *Eragrostis sclerantha*,
Heteropogon contortus, *Loudetia simplex*, *Microchloa caffra*, *Monocymbium*
ceresiiforme, *Panicum natalense*, *Pennisetum thunbergii*, *Setaria sphacelata*,
Sporobolus africanus, *Sporobolus pectinatus*, *Themeda triandra*, *Trachypogon*
spicatus, *Tristachya leucothrix*, *Tristachya rehmannii*.

Aquatic species

Aponogeton junceus, *Ceratophyllum demersum*, *Cyperus congestus*, *Cyperus*
cyperoides, *Lagarosiphon major*, *Phragmites australis*, *Marsilea capensis*,
Schoenoplectus corymbosus, *Typha capensis*

Red Data species present

None.

Priority Species (Species of conservation concern)

Boophone disticha. *Hypoxis rigidula*.

11.2 Photographs



Photo 1: Section A at KM60,0 looking west along N2 Route



Photo 2: Wetlands or moist grassland areas along N2 route typical of the study area



Photo 3: Small stream (673) choked with blackwattle and poplar alien invasive trees



Photo 4: General Wakkerstroom Montane Grassland areas within study area



Photo 5: Dry, seasonal stream with no distinctive riparian zone and only alien invasive blackwattle trees along the stream banks.



Photo 6: Sand River. Small narrow and no riparian zone.



Photo 7: Typical seepage wetlands within the study area. Dry during winter. No permanent zone



Photo 8: Grassland undulating plains and low to medium hills, typical of the study area



Photo 9: The study area is mostly flat to slight undulating, but there are a few hilly areas. Trees are mainly alien, invasive blackwattle



Photo 10: Flat, treeless grassland with prominent maize cultivation is a typical feature of the landscape of the study area.



Photo 11: Vaal River. Narrow channel and no distinctive riparian zone



Photo 12: Vaal River



Photo 13: Witpuntspruit



Photo 14: End of Section A at KM87,4. Looking SE back along the study area route

11.3 Conditions for inclusion in the Environmental Authorisation (EA)

The mitigation measures in the report are to be included in the EMPr for the project that will be approved together with the BAR. The EMPr for the project must therefore be strictly implemented by the applicant. There are no additional or special conditions required.

11.4 Monitoring requirements

Environmental monitoring by an independent ECO, as required by law, industry standards, etc. should take place. Part of the monitoring must include the mitigating measures as per this report as well as the conditions of the EMPr.

Special attention must be given to watercourse crossings. Upstream and downstream monitoring, over a minimum distance of 100m each way, must be conducted.

11.5 Short CV of Specialist

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QUALIFICATIONS

- 2000 MBA, Oxford Brookes University (England)
- 1998 Diploma in Small Business Management (Damelin College)
- 1988 MSc (Rand Afrikaans University)
- 1987 BSc (Hons.) (Rand Afrikaans University)
- 1986 BSc (Rand Afrikaans University)

FURTHER TRAINING AND DEVELOPMENT

- Diploma in Public Speaking & Communications Ambassador College (USA)
- SAQA Accreditation and Qualifications in Training, Assessing & Service Provision (AgriSeta)
- SASS 5 Training Course

PUBLICATIONS

- Co-Authored Book: Cut Flowers of the World. 2010. Briza, Pretoria.
- Co-Authored Book: Cut Flowers of the World, 2ed. 2020. Briza, Pretoria.
- 100s of articles for popular magazines such as Farmer's Weekly & SA Landscape

PROFESSIONAL MEMBERSHIPS

- SA Council of Natural Scientific Professions (SACNASP)
 - Reg. No. 400077/91
- South African Wetland Society
 - Reg. No: 998061
- Society of Wetland Scientists

PROFESSIONAL CAREER

Position: Director / Owner
Employer: Flori Scientific Services
Period: 2000 to current

Scope of Work Done:

- Conduct specialist studies and reasearch for EIA projects.
- Specialist studies and consultancy includes
- Ecological studies
- Aquatic and Wetland assessments
- Avifaunal impact assessments
- Risk Matrices for water use licences
- Specialist Environmental Consultant
- Environmental Control Officer (ECO) work
- Specialist work involves field investigations and report writing.

Position: **Technical Manager**

Employer: Sunbird Flowers (Pty) Ltd

Period: 1997 - 2000

Scope of Work Done:

- Consulted on and managed projects in the agricultural & floricultural industries.
- Managed existing and new projects.
- Involved in all aspects of project management from managing, planning; costing; marketing; budgeting, technical and training.
- Assisted emerging rural farmers in most aspects of agriculture (i.e. Cut flower and vegetable production) including setting up of business plans, marketing, training and costings.
- Conducted “turn-key” projects in most agriculture related fields. This included – Tunnel and greenhouse production; Hydroponics; vegetables, cut flowers; field crops.

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