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

ROAD
SECTION B
Verzameling (km 30,0) to Leiden (km 60,0)

BIODIVERSITY ASSESSMENT

Terrestrial Ecological Assessment and Aquatic (Wetland) Assessment for the existing N2 National Route from Verzameling to Leiden located in the Mkondo and Msukaligwa Local Municipalities of the Gert Sibande District Municipality, Mpumalanga Province

Compiled by

FLORI SCIENTIFIC SERVICES

JANUARY 2017

PROJECT INFORMATION

PROJECT TITLE: N2 Section 34 (Section B) - 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 Section 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 October 2016. The report was updated and edited again in October 2022.

Location of the study area

The study area for this report is only for the road of Section B. This is the National Route N2 Section 34 from Verzameling (km 30) to Leiden (Km 60,0). The study site is located in the Mpumalanga Province.

TERRESTRIAL ECOLOGY

Vegetation

The vegetation all along the study area and in the general region is highly impacted upon. Most of the grasslands have been totally transformed from years of cultivation and plantations, and to a degree also from opencast coal mining. The open areas of natural grassland are characteristic of Eastern Highveld Grassland, but no pristine examples of grassland are present in the study area.

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 only one main river or stream, namely the Ngwempisi River, and another small, unnamed stream. Besides the two streams

there are only a few minor and small drainage lines and stormwater culverts along the study area route of the study area.

Drainage areas

The study area is situated within the Primary Drainage Area (PDA) of W and the Quaternary Drainage Areas (QDA) of W52B and W53A.

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

PES of watercourses in the study area

Criteria	Identified Watercourses			
	Ngwempisis River	Unnamed stream	Drainage lines	Wetlands
Category:	D	D	D	D
Integrity (PES):	Low	Low	Low	Low
PES Description	Largely Modified	Largely Modified	Largely Modified	Largely Modified
Recommended EMC	C	C	C	C

EIS of watercourses in the study area

Determinant	Ngwempisi River	Unnamed stream	Drainage lines	Wetlands
Overall EIS	B	D	D	D
Description	High	Low	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
Plantations	Low	Low	Low	Go
Cultivated lands	Low	Low	Low	Go
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 does not fall within any priority areas, except those of NFEPA areas. Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National freshwater ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas.

The study area is within CBA areas of CBA: Optimal and CBA: Irreplaceable, according to the Mpumalanga Biodiversity Plan (2014).

Conclusions & recommendations

The following conclusions and recommendations were reached after desktop studies, field investigations and expert opinions of field investigators:

- There are no 'No-Go' zones in the study area.
- There are no 'fatal flaws'.
- No priority faunal species were encountered, although some will visit the area or be present in the area. However, the nature of the project is that any disturbances will be temporary (only last during the construction phase).
- No protected trees and no red data plant species were observed during field investigations.
- All watercourses should be viewed as sensitive.
- There are no actual areas of High Sensitivity in the study area (eventhough watercourses are approached as sensitive).
- 32m wide buffers to be implemented along the outer edge of all watercourses. For rivers, streams and drainage lines this is from the top edge of the stream bank. Note that buffers do not apply at the work site at watercourse crossings.
- Additional negative impacts arising from the activities of the project will be either temporary (during the construction phase) and/or insignificant (not measurable). This includes the potential impacts on watercourse crossings.

- Some positive impacts from the project include the replacement and cleaning of culverts, pipe, etc. that will positively impact on the flow of small streams and seasonal drainage lines.
- Recommended mitigating measures must be implemented.
- Taking all findings into account, along with mitigating measures and proposed project activities there should be no need for a Water Use Licence Application process as there will be no significant or measurable negative impacts on the watercourses in terms of Section 21 (c) & (i) water uses. Some of the upgrades to the culverts, bridges and stormwater pipes will have a positive impact on watercourses as these activities will reduce current impoundments and deviations of water flow from debris; broken and deteriorating infrastructure; siltation, etc.
- A rating matrix was compiled which determined the total impacts to of a Risk Rating Class of Low, which qualifies the project for a General Authorisation (GA) Process, at the very most.

Buffer Zones

Standard 32m wide buffer zones are required along the edges of all watercourses. These buffer zones are to be approached as 'no-go' zones with regards to the movement of vehicles, machinery, workers, and materials in and through them.

No temporary laydown areas, site offices, parking of vehicles, and storage of goods may be setup within a 100m of the edge of any and all watercourses, including rivers, seasonal streams, seasonal drainage lines and wetlands. It is impractical to delineate and map every single watercourse in the area of the project footprint within a report. Therefore, it is essential that SANRAL / Contractors are aware of the required buffer widths and implement them on the ground during each and all activities. For example, when setting up a temporary laydown area, or setting up a site office, or parking of vehicles and heavy machinery at the work site.

There are no required buffer zones for grasslands, farmlands, roads, etc.

Part of the scope of the project is the upgrade / widening / repair / rehabilitation of existing road surface and watercourse crossings (bridges, culverts, etc.). At this work points there is no buffer zone. However, the footprint of activities must be kept as small as possible and the buffer still applies at these work points for laydown areas, site offices, parking of heavy machinery that is not in use, general movement of vehicles and workers.

The summary of buffers is as follows:

- 32m wide along the outer edge of all watercourses including wetlands. For rivers and streams this is from the edge of the stream bank.
- 100m wide with regards to all temporary laydown areas and site offices.
- 50m wide for portable toilets along the study area.
- No other buffers required.

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;	ix
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	73
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	ix
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;	59
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	4
(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;	Entire Report
(k) any mitigation measures for inclusion in the EMPr;	62
(l) any conditions for inclusion in the environmental authorisation;	62
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	62
(n) a reasoned opinion —	
(i) whether the proposed activity, activities or portions thereof should be authorised;	65
(ii) regarding the acceptability of the proposed activity or activities; and	65
(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;	65
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	4
(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 of Specialist

Qualifications & Expertise in: Terrestrial Ecology, Aquatic Ecology and Avifaunal Assessments.

- 2 Masters Degrees (MSc & MBA); 2 Diplomas (Business & Public Speaking).
- Co-Authored two books: Cut Flowers of the World. 2010 (1st ed) & 2020 (2nd ed), Briza, Pretoria.
- SAQA accreditation and qualifications in training, assessing & service provision (AgriSeta).
- Professional Memberships:
    - SA Council of Natural Scientific Professions (Reg. No. 400077/91)
    - South African Wetland Society (Reg. No: 998061)
    - Society of Wetland Scientists
- 21 years' experience in technical and managerial positions, project management and consultancy.
- 19 years' experience in writing of articles, books, training material, training & presentations.
- 14 years direct experience in EIAs.
- Has conducted hundreds of field investigations and compiled hundreds of technical specialist reports for EIAs, including ecological assessments (fauna & flora), wetland assessments and avifauna impact assessments.
- Projects involved in 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:

- Act as an independent specialist in compiling this report;
- Do not have any financial interests, or stand to gain in any way in the undertaking of this activity, other than remuneration for work performed;
- Do not have, nor will have, any vested interest in the proceeding activity or project;
- Have no, neither will engage in, conflicting interests in the undertaking of this activity;
- Undertake to disclose, to the competent authority, any material information that has, or may have, the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required; and
- Will provide competent authority access to my information regarding the report and investigations, whether such information is favourable to the applicant or not.

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FIGURES

TABLES

PHOTOGRAPHS

ACRONYMS

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DEA	Department of Environmental Affairs (Old name for DFFE)
DFFE	Department of Forestry, Fisheries & the Environment
DWS	Department of Water and Sanitation
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
ESA	Ecological Support Area
HGM	Hydrogeomorphic
IBA	Important Bird Area(s)
MAP	Mean Annual Precipitation
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
ODL	Orange Data Listed
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
RDL	Red Data Listed
RDSIS	Red Data Sensitivity Index Score
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
SCC	Species of conservation concern
SWSA	Strategic Water areas of South Africa
TOPS	Threatened or Protected Species
WMA	Water Management Areas

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 150km 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 60.0) 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 October 2016.

1.2 Scope of the Project

- 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.
- Possible consolidation of accesses to the N2.
- Replacement or widening of some 15 bridges.
- Widening and/or capacity improvement of some culverts.

1.3 Purpose for the Study

The purpose of the study is to conduct a biodiversity impact assessment that consists of a terrestrial and an aquatic ecological assessment to determine the ecological sensitivities and habitats of the study area. To investigate the fauna and flora and determine if there are any priority species present. To investigate the presence of watercourses and, if present, to delineate and assess them. Furthermore, the purpose of the study is to identify any potential 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.

1.4 Quality and Age of the Base Data Used

The latest data sets were used for the report in terms of background information. The data are the same data sets that are nationally used and approved by consultants and relevant government departments.
The source and age of the data used included the following:

- Threatened ecosystems: SANBI (www.bgis.sanbi.org) and NEMBA (G 34809, GoN 1002), 9 December 2011).

- 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, 2010. Updated 2012, 2018.
- SANBI data sets – latest updated website data (www. bgis.sanbi.org).
- Environmental Screening Tool – DFFE - (www.environment.gov.za).
- National Freshwater Ecosystem Priority Areas (NFEPA) – DWS & SANBI databases.
- National Wetland Map 5 (2018) – CSIR, SANBI (www.bgis.sanbi.org).
- Mpumalanga Biodiversity Sector Plan (2014).

1.5 Assumptions and Limitations

The assumptions and limitations for the assessment were as follows:

- All information regarding the project as provided by the Client is taken to be accurate.
- This study focuses on the biodiversity (terrestrial and aquatic ecology) of the study site.
- Field investigations were conducted in July and October 2022, which includes the wet and dry seasons for the region.
- No additional field investigations or studies are deemed necessary.
- Precise buffer zones or exact GPS positions cannot be made using generalised corridors or KML files on Google Earth. However, the buffer zones, delineations, etc. drawn on maps and obtained in kml files, shapefiles, etc. are accurate to within 2-3m;
- Standard and acceptable methodologies were used, as required and used in South Africa.
- The latest data sets were used in terms of obtaining and establishing background information and desktop reviews for the project. The data sets were taken to be accurate but were verified and refined during field investigations (ground-truthing). This includes the important DEA Screening Tool assessment.
- **NOTE**: Recommendations put forward in the report are based on actual biodiversity and specialist findings, but this does not mean that legal requirements do not still apply. In other words, recommendations do not negate legal requirements as set out in various acts such as NEMA (Act 107

of 1998) and NEMBA (Act 10 of 2004). For example, a buffer zone of 15 m from the edge of a watercourse might be recommended as adequate, but this does not negate the fact that such activities still trigger regulations such as the 32m from a watercourse, as set out in Listed Activities.

- No specific or highly specialised scientific equipment were used except standard soil augers, hand-held Garmin GPS instruments, relevant computer programmes, etc.
- There were no limitations encountered that hindered the project or potentially impacted on any outcomes of the study. All areas could be accessed with the full assistance and cooperation of landowners.

1.6 Consultation process for the study

Emails were exchanged and telephone conversations held with the lead EAP (Chameleon Environmental) regarding the project. Information regarding the project was obtained from SANRAL via Chameleon Environmental, including authorisation to conduct the studies and access the necessary areas.

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 know 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.

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 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.

2.5 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.

2.6 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.

2.7 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.

2.8 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 B. This is the National Route N2 Section 34 from Verzameling (km 30) to Leiden (Km 60,0). 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:

- Sheepmoor: 26°43'1.55"S; 30°17'57.54"E
- Start of route (KM 30,0): 26°51'15.85"S; 30°32'32.12"E.
- End of route (KM 60,0): 26°43'53.56"S; 30°17'7.41"E.
- 1:50 000 map grid references: 2630CB, 2630CD, 2630DC.

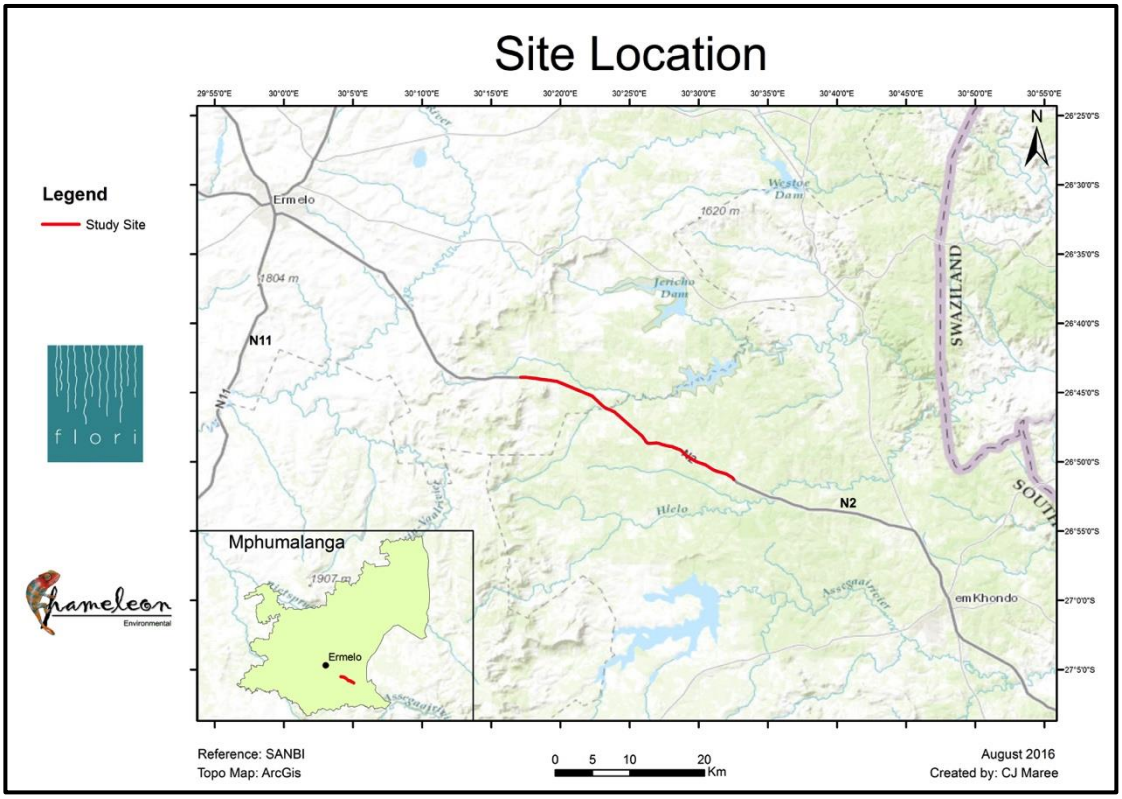

Figure 1: Site location

3.3 Topography

The topography is that of very flat 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, although the streams themselves tend to be very narrow. The general first impression of the landscape is that of flat, open homogenous grasslands or farmlands, with few distinctive features such as koppies (this in open areas where there are no plantations of eucalypt and pine trees).

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 margalitic 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 margalitic 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).

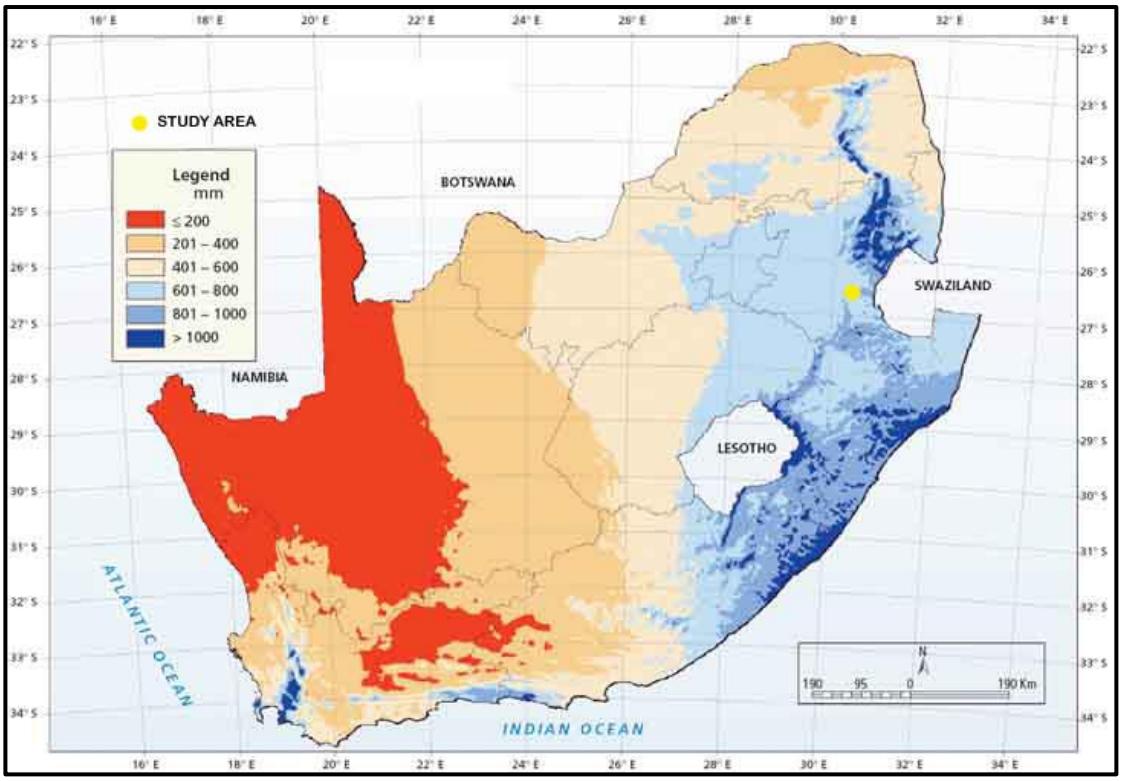

Figure 2: Rainfall averages for South Africa

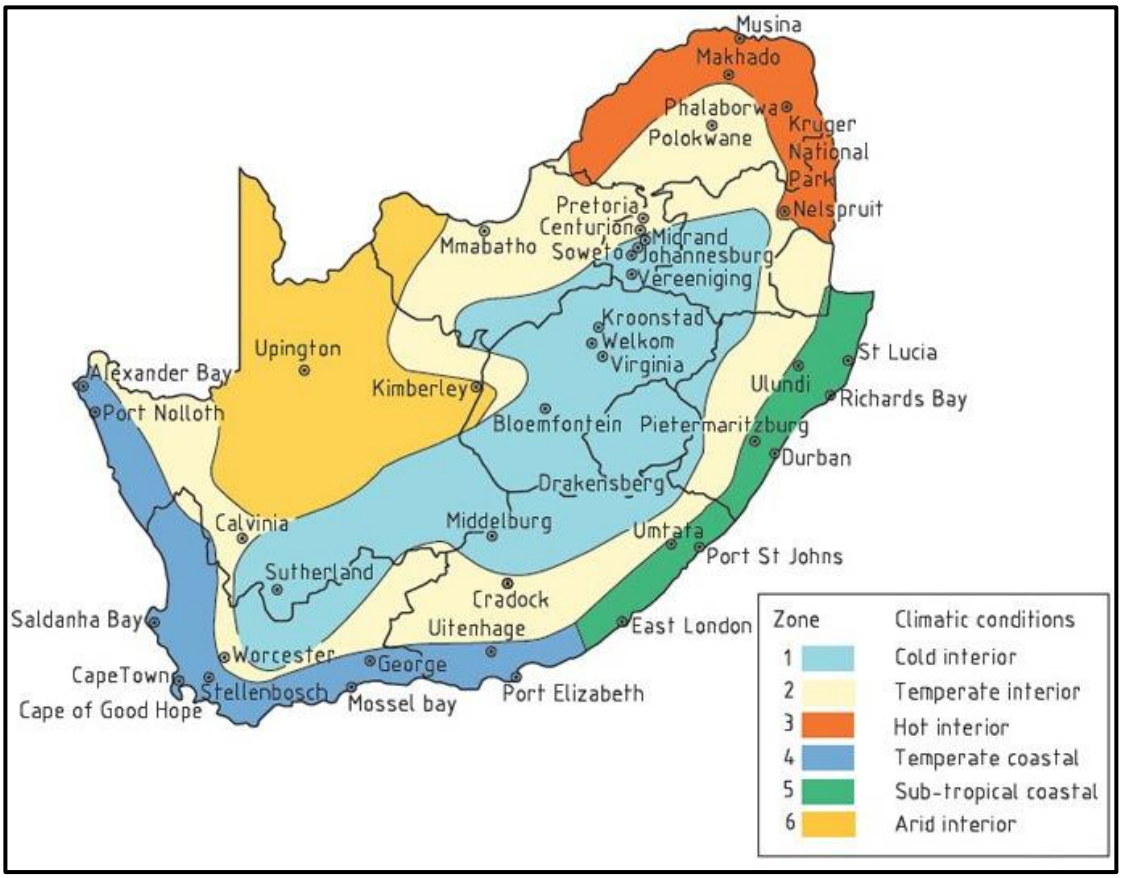

Figure 3: Broad climatic zones of South Africa

3.6 Landcover

The landcover or landuse along the length of the study area is predominantly that of plantations in the south / southeast and farming in the north / northwest. The main forms of farming are dryland maize cultivation and cattle, where the open grassland fields are intensely grazed. Opencast coal mining has become another major landuse in the north / northwest of the study area. The landcover as of 2009 is shown in the map below (Figure 4). However, most of the land that is shaded red (natural) in Figure 4 is either cultivated or grazed and does not constitute true, natural open and pristine grasslands anymore. Figure 5 is a Google Earth image showing the landuse of the study area and region. The dark green patches are plantations, which are mainly eucalypts (gum trees) and pine trees. The plantations are totally transformed grasslands. It must also be kept in mind that the road reserve area is regularly mowed and as such tends to acquire certain characteristics of that of a lawn. No 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 farmers

ploughing through them, cattle and other livestock. The level of urbanisation in the area is scattered and low-density.

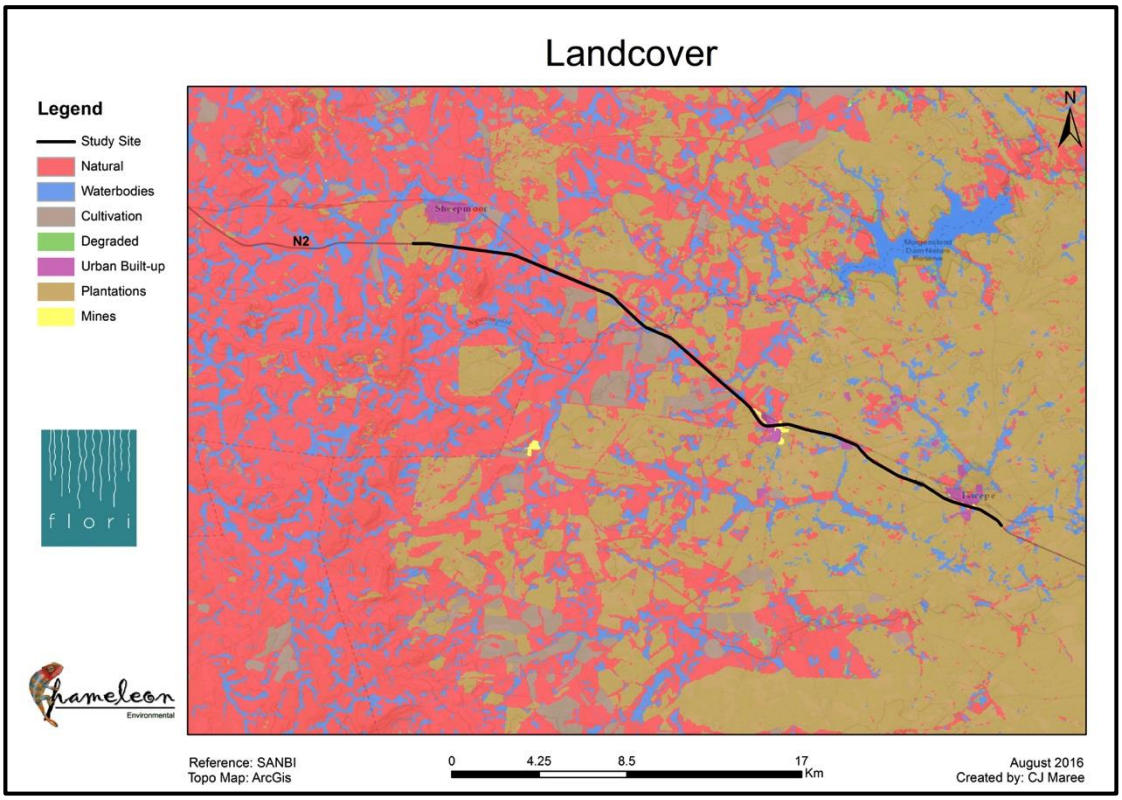

Figure 4: Landcover

Figure 5: Landcover (Google Earth)

4 TERRESTRIAL ECOLOGY

4.1 Vegetation

South Africa is divided up into nine Biomes. The study area is situated within the Grassland Biome (Figure 6).

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; Meisic 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 occurance 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 (Figure 7).

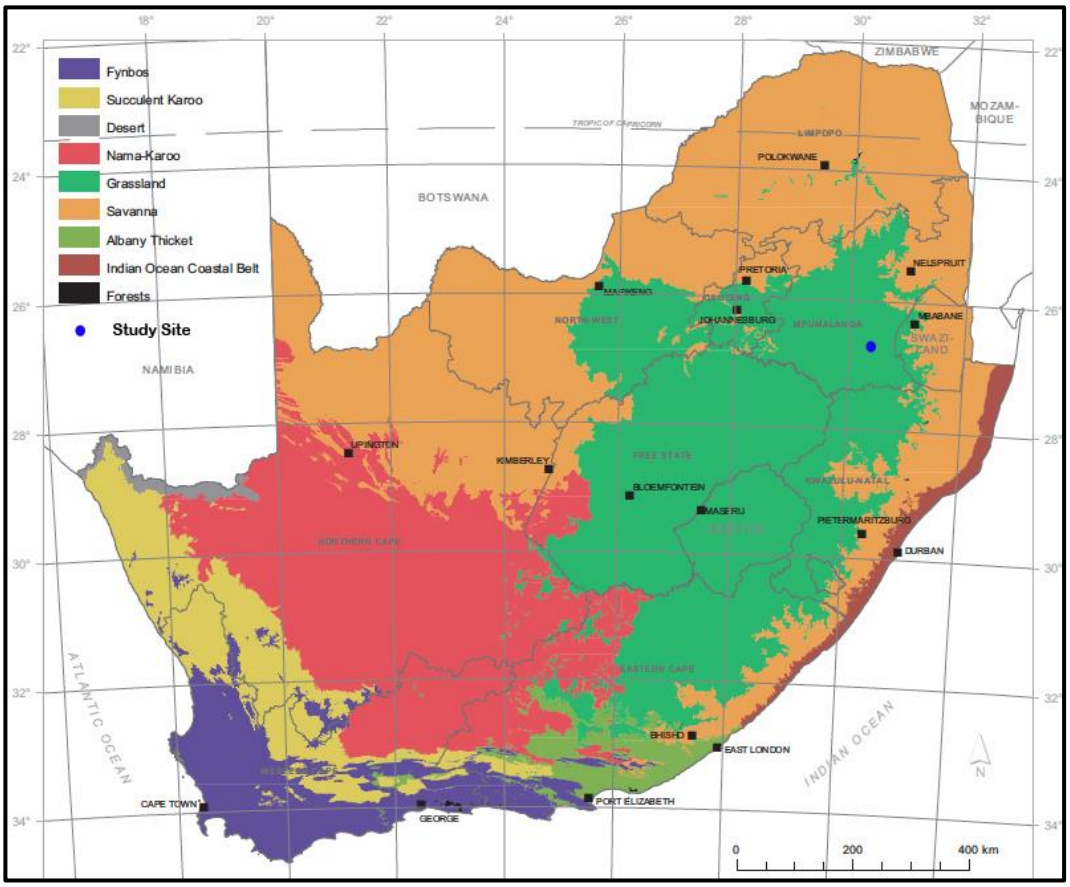

Figure 6: Biomes of South Africa

The study area is situated within Eastern Highveld Grassland (Figure 8). Table 2 shows the hierarchy of the vegetation. The study area is situated within high lying, high rainfall and sour grasslands of Mpumalanga Province.

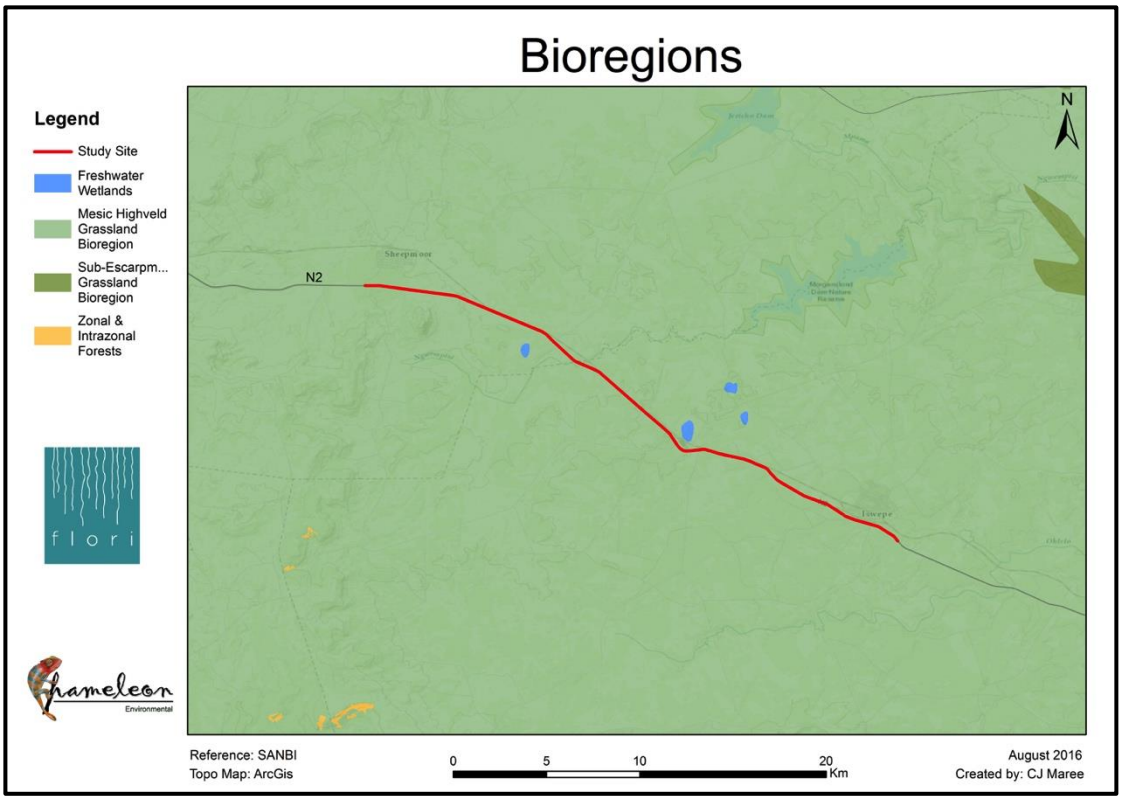

Figure 7: Bioregions

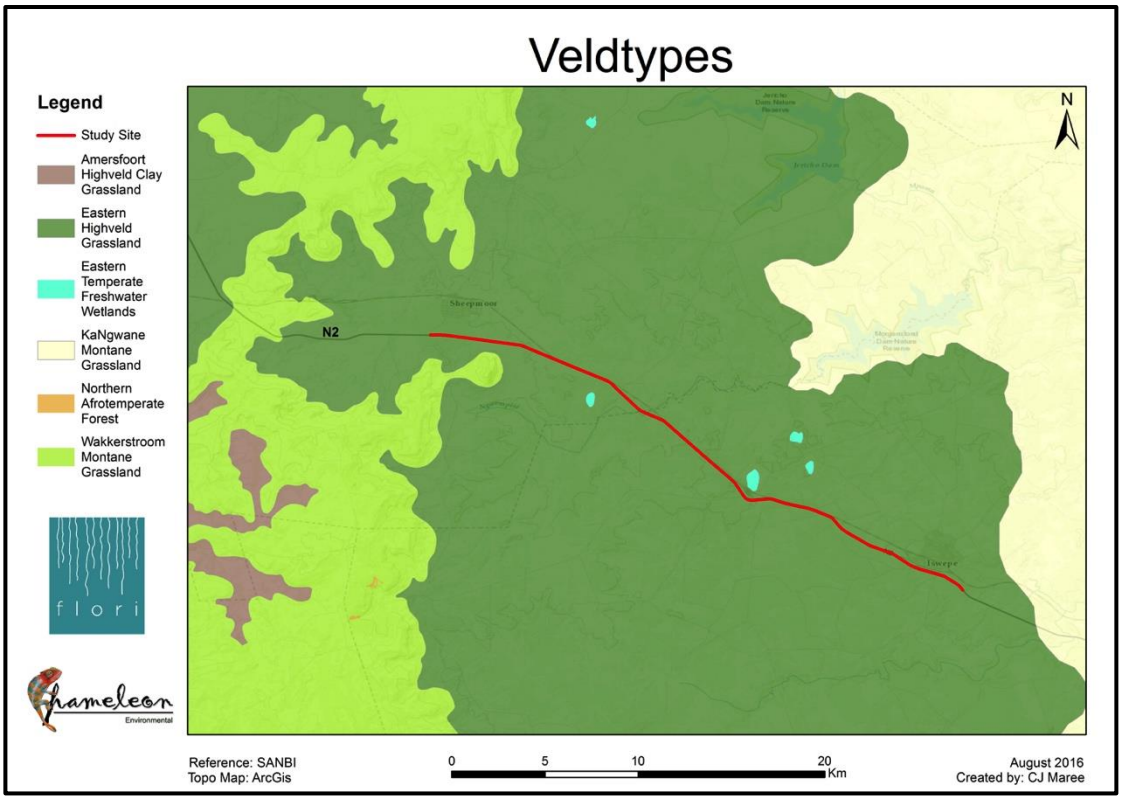

Figure 8: Veld types

Table 2: Vegetation classification of the study site

Category Description	Classification
Biome	Grassland
Bioregion	Mesic Highveld Grassland
Vegetation Types	Eastern Highveld Grassland

4.1.1 Vegetation of the study area

The vegetation all along the study area and in the general region is highly impacted upon. Most of the grasslands have been totally transformed from years of cultivation and plantations, and to a degree also from opencast coal mining. No pristine Eastern Highveld Grassland areas exist within or immediately adjacent to the study area.

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. This can be seen in the map on veldtypes of the study area (Figure 8). These Eastern Temperate Freshwater Wetlands are not in pristine condition, but are all viewed as sensitive and important. The proposed project does not impact on any of these freshwater wetlands or freshwater pans.

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 3). This, however, is not to say for certain that none occur. The summaries of priority floral species per grid reference are tabled below (Table 3). Due to the regular cutting of the grass in the study area, as well as the grazing of free-roaming cattle and the total transformation of large areas by plantations, the species richness is low in and around the study area.

Table 3: Priority Floral Species per 1:50 000 Grid Reference

Grid reference & Priority Category	No. of species	Name of species
2630DC		
Critically endangered (CR)	0	-
Endangered (EN)	0	-
Vulnerable (VU)	1	*Aloe kniphofioides;* *Indigofera hybrida*

Near threatened (NT)	0	-
2630CD		
Critically endangered (CR)	1	*Asclepias bicuspis*
Endangered (EN)	0	-
Vulnerable (VU)	0	-
Near threatened (NT)	0	-
2630CB		
Critically endangered (CR)	0	-
Endangered (EN)	0	-
Vulnerable (VU)	2	*Aspidoglossum xanthosphaerum; Aloe kniphofioides*
Near threatened (NT)	0	-

4.2 Conservation status

Eastern Highveld Grassland is a threatened veldtype / ecosystem with a status of 'Vulnerable' (VU), according to the latest terrestrial ecosystem threat status assessment of 2018 (Skowno, et. al., 2019, SANBI) (Table 4).

Table 4: 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.

Table 5 below gives a basic description of each of the status categories, while Figure 9 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 10. From the map in Figure 10 it can be seen that the study area is situated within threatened ecosystems or veldtypes of South Africa. The map in Figure 10 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 5: 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.

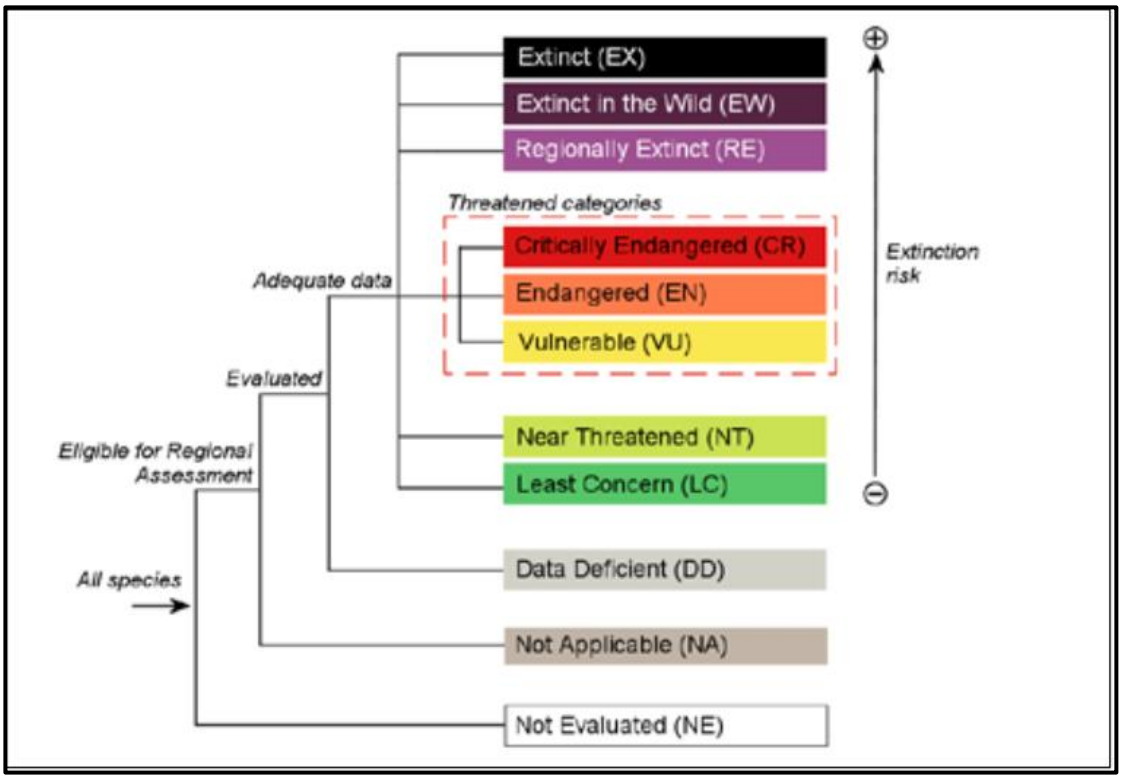

Figure 9: Structure of categories used at the regional level

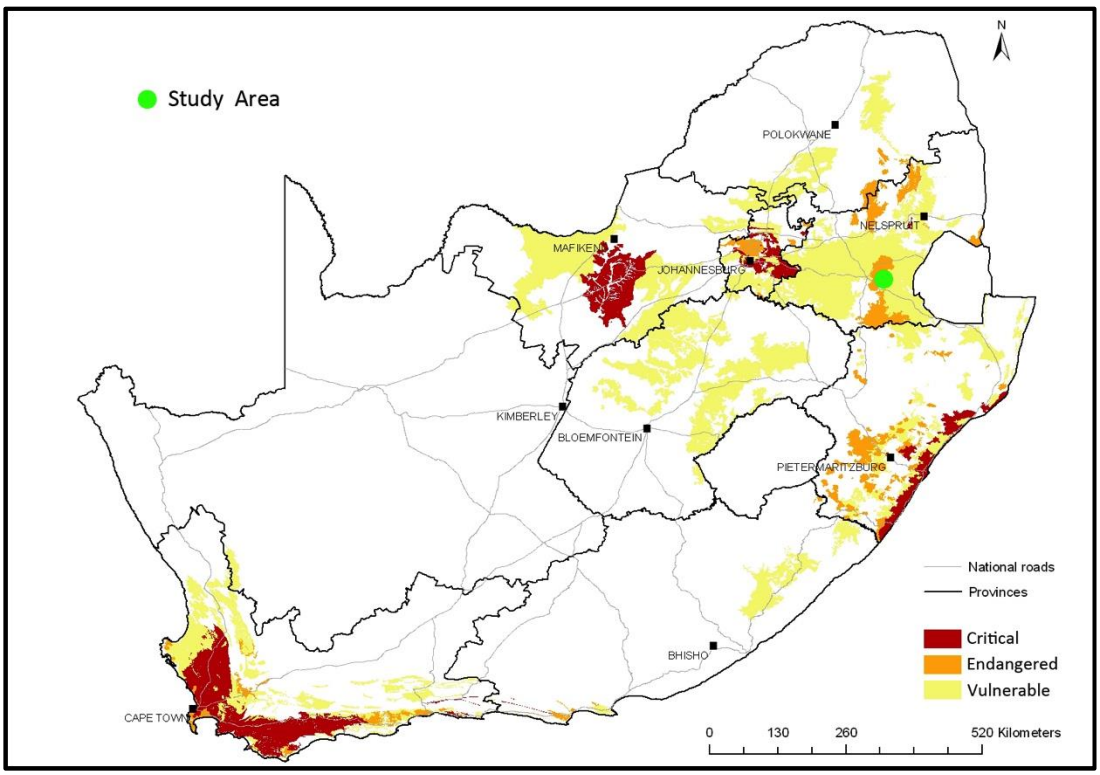

Figure 10: Threatened ecosystems of South Africa

The map in Figure 11 gives a close-up of the region, showing which threatened ecosystems the study area is within. The entire study area is within a threatened

ecosystem. The coloured veldtypes in Figure 11 are threatened while those areas / veldtypes in white (not coloured) are not threatened.

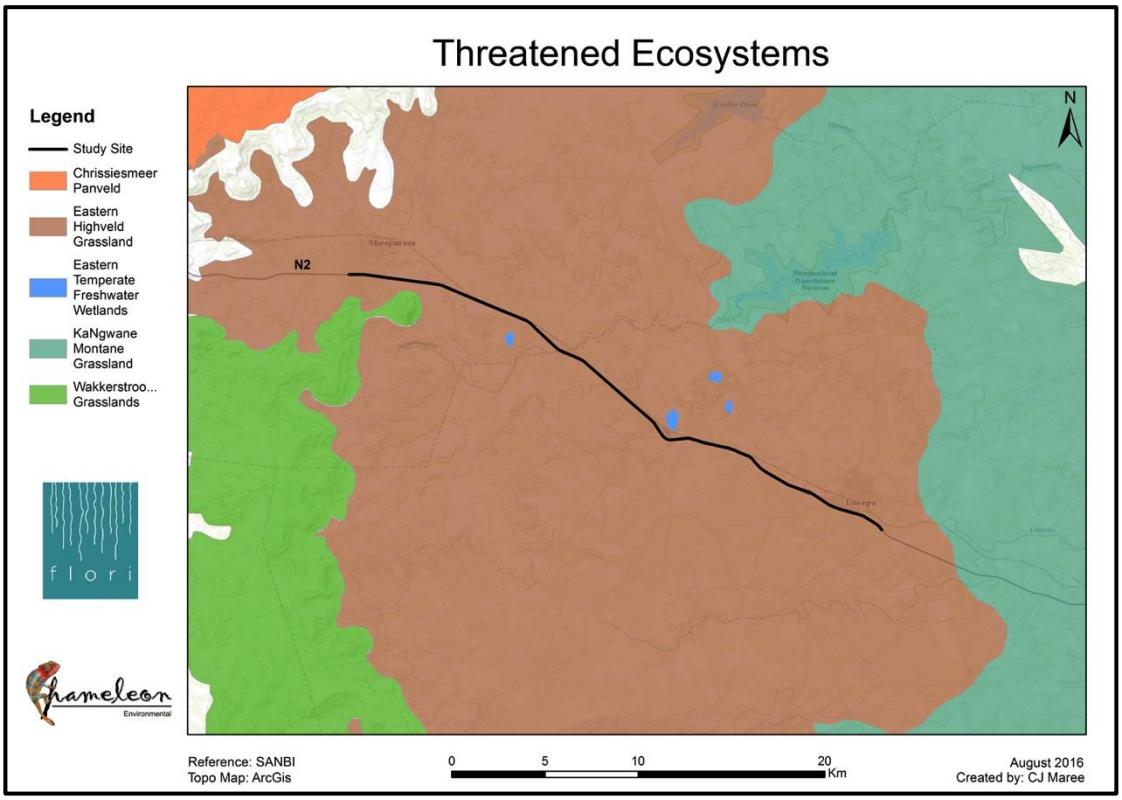

Figure 11: Threatened ecosystems of the region

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 *Boophone 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 6. The categories are as set out in the Conservation Act of Agricultural Resources Act, 1983 (CARA) (Act 43 of 1983).

Table 6: Alien plants identified in the study area

Botanical Name	Common Name	Category
Acacia mearnsii	Blackwattle	2
Argemone ochroleuca	White-flowered Mexican poppy	1
Bidens pilosa	Blackjacks	-
Caesalpinia decapetala	Mauritius thorn	1
Chromolaena odorata	Triffid weed	1
Conyza canadensis	Horseweed fleabane	-
Datura ferox	Large thorn-apple	1
Eucalyptus spp & cultivars	Gum trees; Eucalyptus	2
Guilleminea densa	Mat weed	-
Melia azedarach	Syringa	3
Malva verticillata	Mallow	-
Onopordum acanthium	Scotch thistle	-
Oxalis corniculata	Sorrel	-
Pinus pinaster	Pine	2
Solanum elaeagnifolium	Silverleaf bitter apple	1
Tagetes minuta	Khakibos, kahki weed	-
Tarazacum officinale	Common dandelion	-
Verbena bonariensis	Vervain	-
Xanthium strumarium	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. None are expected to occur.

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 large extent of 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 buffer zones 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 field mice, hares and mongoose.

4.5.2 Avifuana

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 12 & Figure 13). 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.

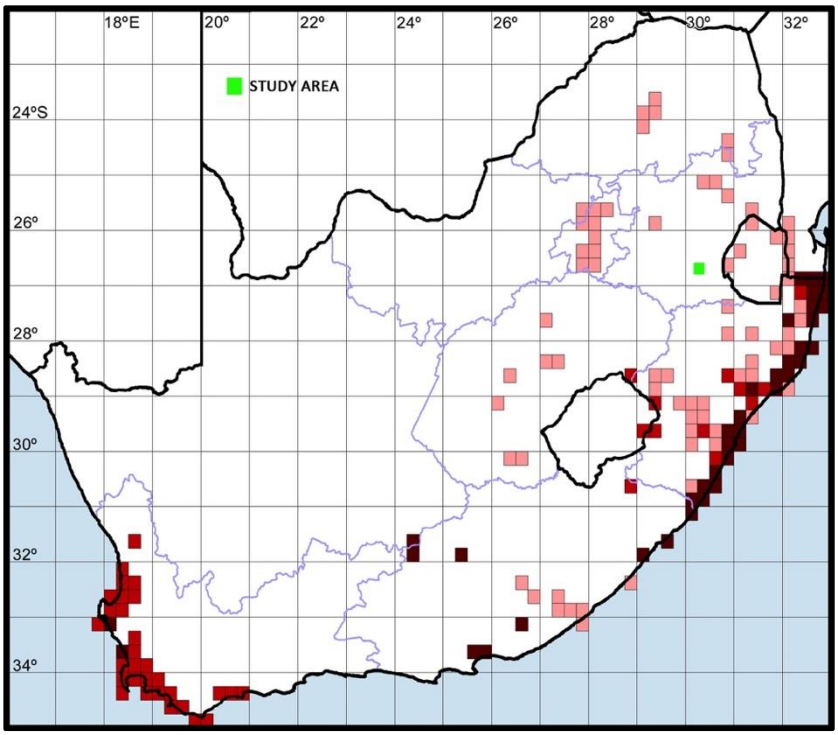

Figure 12: Snake hotspots

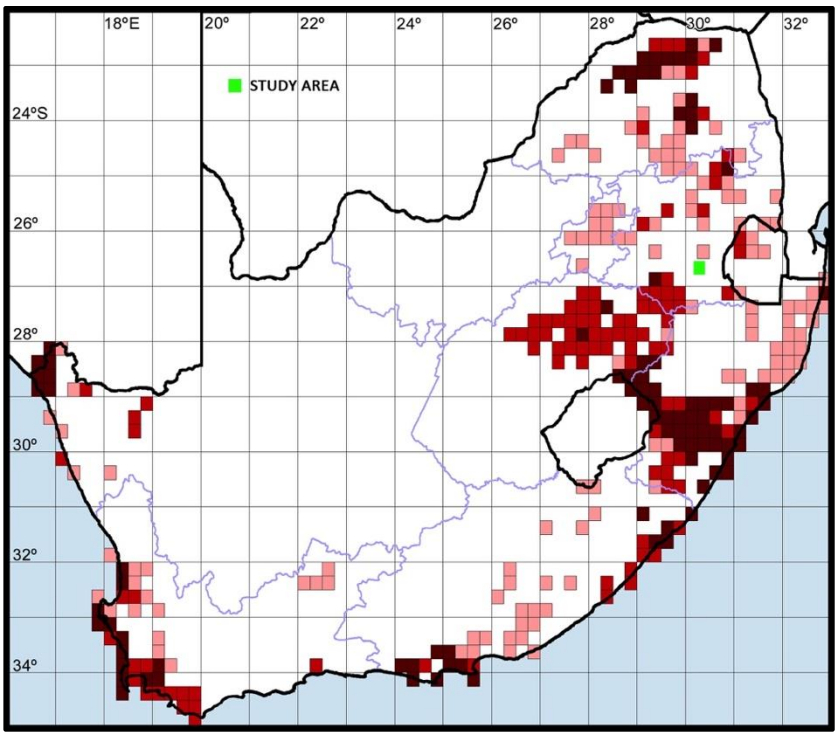

Figure 13: Lizard hotspots

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 14). 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.

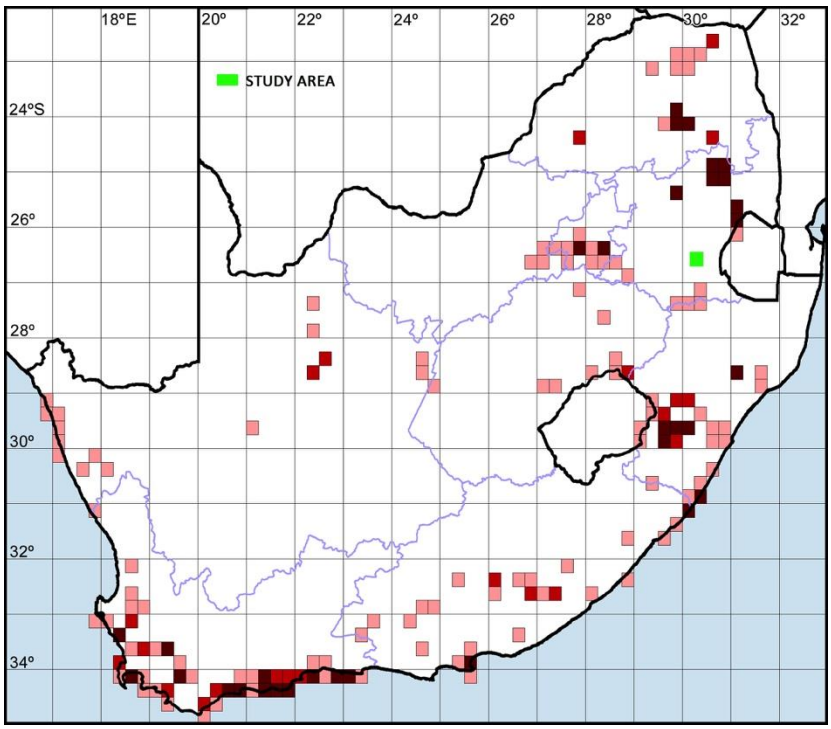

Figure 14: Butterfly hotspots

4.5.5 Faunal species of conservation concern

The general habitats present in the study area, with the exception of the wetlands (including pans) and some open moist grassland, are not ideal for most potentially occurring Red Data faunal species. The large pine and eucalypt plantations in and along side the study area tend to create an almost sterile environment for indigenous faunal species. However, care should still be taken to avoid impacting on, or interacting with, 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 7).

Table 7: Red Data Faunal Species likely to occur in the area

Scientific Name	Common Name	Conservation Status	Preferred Habitat	Habitat Restrictions
Birds				
Anthropoides paradiseus	Blue crane	VU	Grasslands, cultivated lands	Grasslands, moist areas
Asio capensis	Marsh owl	LC	Grasslands, wetlands, vleis	Grassy Wetlands
Balearica regulorum	Grey crowned crane	EN	Grasslands, cultivated lands	Grasslands, moist areas
Bugeranus carunculatus	Wattled crane	EN	Grasslands, cultivated lands	Grasslands, moist areas
Ciconia nigra	Black stork	NT	Broad, open waterbodies	Cliff ledges for breeding
Phoenicopterus minor	Lesser flamingo	NT	Broad, pans	Pans or shallow water areas, food
Phoenicopterus roseus	Greater flamingo	LC	Broad, pans	Pans or shallow water areas, food
Tyto capensis	Grass owl	LC	Grasslands, wetlands.	Wetland areas
Butterflies				
Metisella meninx	Marsh sylph	VU	Wetlands, moist grassy areas	Wetlands, Montane
Frogs				
Pyxicephalus adspersus	Giant bulfrog	LC	Grassland, Savanna	Temporary floodplains, pans
Mammals				
Atelerix frontalis	SA hedgehog	NT	Most, broad	None
Snakes				
Python natalensis	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 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 15).

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[1]	
			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.	*/ ***	*/ ***

[1] 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.

 Wetland

Figure 15: 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 "c*ommonly 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 only one main river or stream, namely the Ngwempisi River, and another small, unnamed stream (Figure 16). Besides the two streams there are only a few minor and small drainage lines and stormwater culverts along the study area route of the road (Study area). The GPS coordinates of these watercourses are shown in the table below (Table 8) and their location along the study area (red line) are shown in Figure 17. The pin numbers correspond with the ID numbers in Table 8.

Table 8: List of watercourses in the study area

Pin ID	Watercourse	Coordinates	Comments
661	Small, seasonal drainage line	26°49'13.66"S 30°28'48.30"E	Highly impacted on by plantations. No riparian zone. Can only be partially delineated on the west side and less so on the east side of the N2 due to planting of pine trees right in the watercourse areas.
662	Small, seasonal drainage line	26°48'58.99"S 30°28'16.37"E	Small, seasonal drainage line and stormwater culverts. Highly impacted on and modified.
663	Small, seasonal	26°48'59.17"S	Small, seasonal drainage line

	drainage line	30°28'16.62"E	and stormwater culverts. Highly impacted on and modified. (Is basically part of the same system as 662)
664	Small wetland and moist grassland area	26°47'44.94"S 30°25'27.24"E	A small wetland and moist grassland area west of the N2 road. Areas both sides of road are regularly burnt mowed and even planted (afforestation). Therefore, cannot be properly delineated.
665	Small, seasonal drainage line	26°46'19.69"S 30°23'46.63"E	Drainage line & associated seep areas. Highly transformed and impacted on by plantations in and around watercourse.
666	Ngwempisi River	26°46'8.34"S 30°23'20.35"E	At time of field investigations flowing strongly. No trees and no distinctive riparian zone. Grass, with some sedges & bulrushes
667	Small wetland / moist grassland area	26°44'10.47"S 30°19'39.56"E	Drainage line with associated seep areas and moist grassland
668	Unnamed, semi-perennial stream	26°43'59.04"S 30°18'12.91"E	Small stream with low, stagnant water levels at time of field investigations in winter. Some associated wetland areas to the north but outside of study area
669	Wetland area	26°43'55.71"S 30°17'47.93"E	

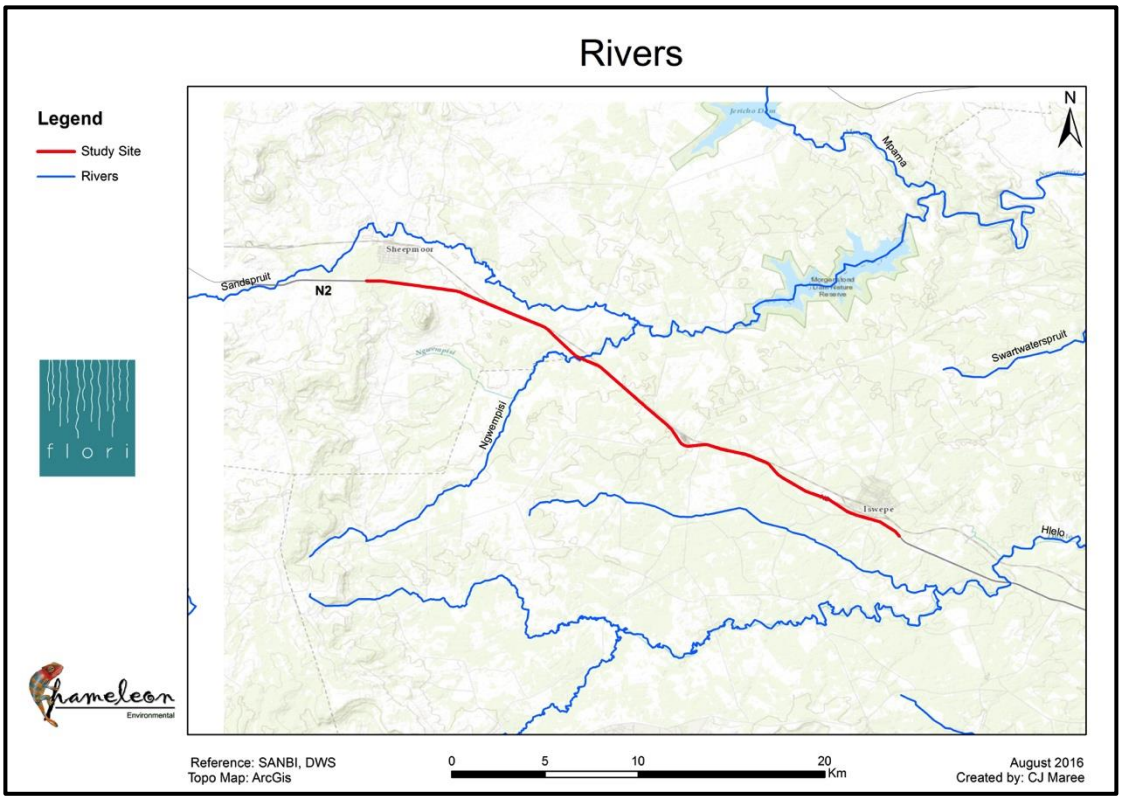

Figure 16: Main Rivers in the region

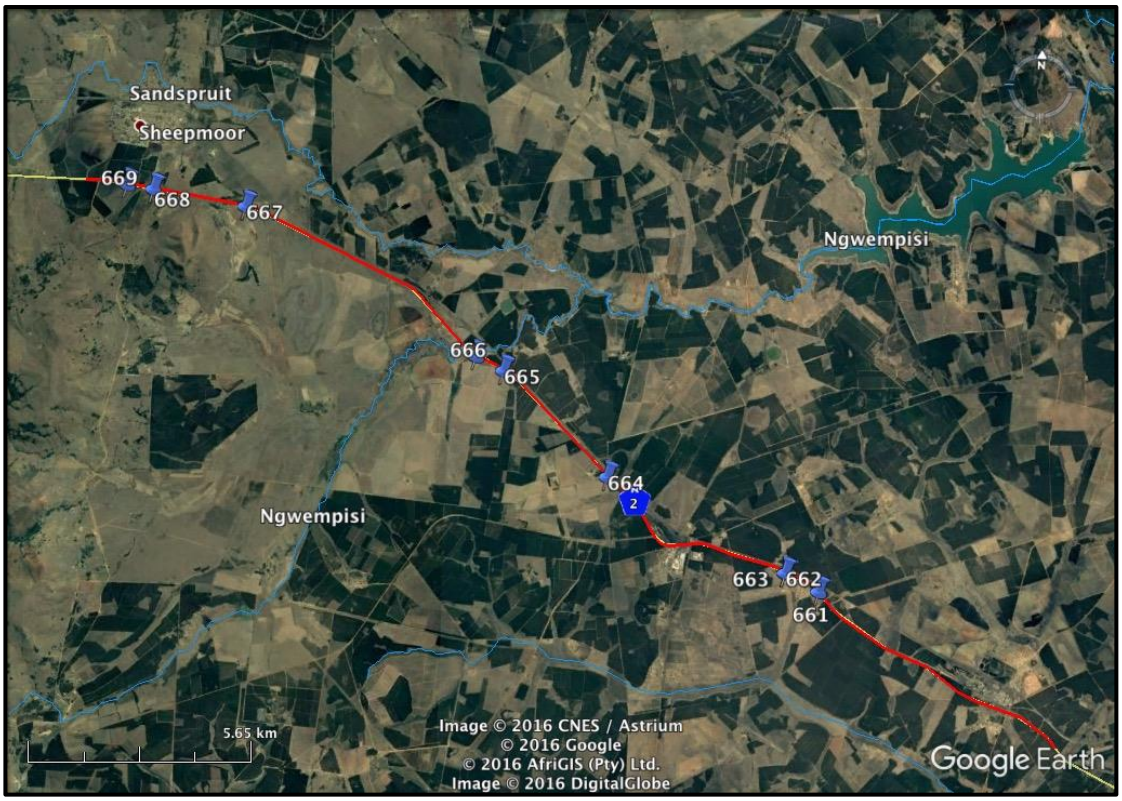

Figure 17: Location of watercourses

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 9 & Table 10). This in addition to the classification system used above for wetlands (Figure 15).

Table 9: 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	• Valley floor • Slope • Plain • Bench	River	• Mountain headwater stream • Mountain stream • Transitional stream • Upper foothill • Lower foothill • Lowland • Rejuvenated foothill • Upland floodplain
			Channeled valley bottom wetland	
			Unchannelled valley bottom wetland	
			Floodplain Wetland	
			Depression	• Exorheic • Endorheic • Dammed
			Seep	• With channel outflow (connected) • Without channel

				outflow (disconnected)
			Wetland flat	

Table 10: 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
Ngwempisi	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowlands)
Unnamed Streams / Drainage lines	Inland	Mesic Highveld Grassland Group 4	Plain	River (Lowlands)
Wetland areas	Inland	Mesic Highveld Grassland Group 4	Plain	Seeps and/or Unchannelled valley bottom wetland

5.6 Delineated Watercourses

The maps below show the extent of the delineated watercourses (Figure 18 to Figure 25). Some watercourses, especially in terms of associated seepage wetland areas are impossible to delineate accurately due to the years of cultivation and ploughing straight through these wetland areas; plantations of alien trees (afforestation) within and through these watercourse areas, etc. There are also moist grassland areas that are not proper wetland areas and have not been delineated as such, eventhough these areas sometimes become waterlogged during periods of high rainfall. However, most of these areas are outside of the study area.

The numbered pins in the maps below correspond to the pins in Table 8 & Figure 17.

Figure 18: 661 – Drainage line and associated wetland (seep) area

Figure 19: 662 & 663 - Drainage lines and stormwater culverts

Figure 20: 664 - small wetland & moist grassland area west of N2, but activities will have no measurable impacts on this area

Figure 21: 665 - drainage line & associated seep areas. Highly transformed and impacted on by plantations

Figure 22: 666 - Ngwempisi River. The largest watercourse and only true river in the study area.

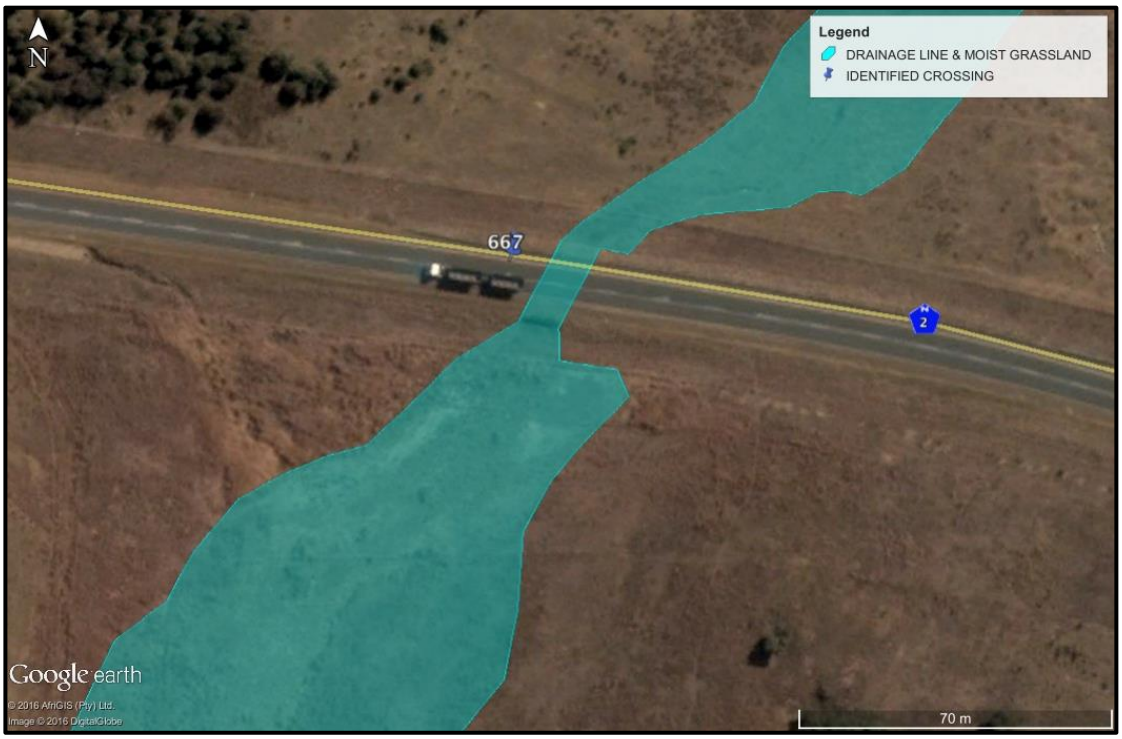

Figure 23: 667 - Drainage line with moist grassland area. Area to the south has been historically ploughed and cultivated

Figure 24: Small stream with no riparian zone, which is typical of the streams and drainage lines of the region

Figure 25: Drainage line and associated wetland areas. The channel and wetlands / moist grasslands have be largely modified and transformed by the surrounding plantations

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).

The study area is situated within the Primary Drainage Area (PDA) of W and the Quaternary Drainage Areas (QDA) of W52B and W53A (Figure 29). The study area is within the Usuthu to Mhlatuze Water Management Area (WMA 6) and under the jurisdiction of the Inkomati / Usuthu / Pongola Catchment Management Agency (CMA 3) (Figure 28). In terms of the water environment the study area is situated within a single Wetland Vegetation Ecoregion, namely the Mesic Highveld Grassland Group 4 (Figure 30).

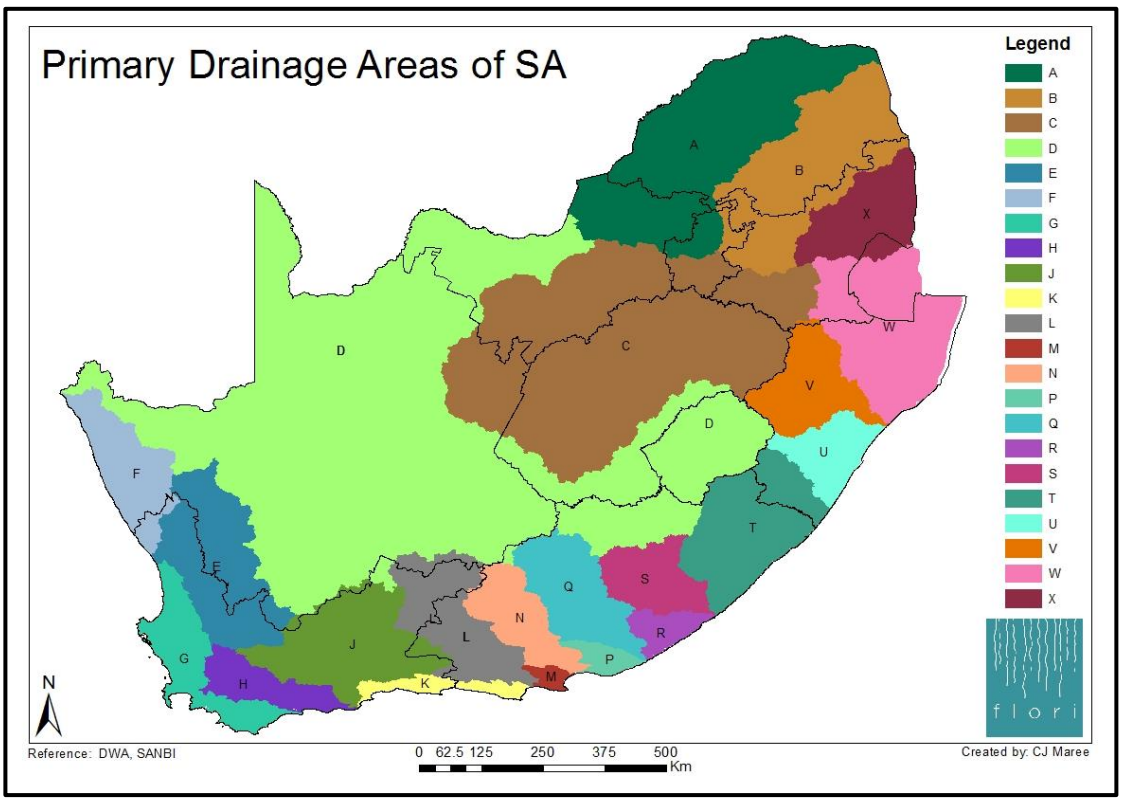

Figure 26: Primary drainage areas of South Africa

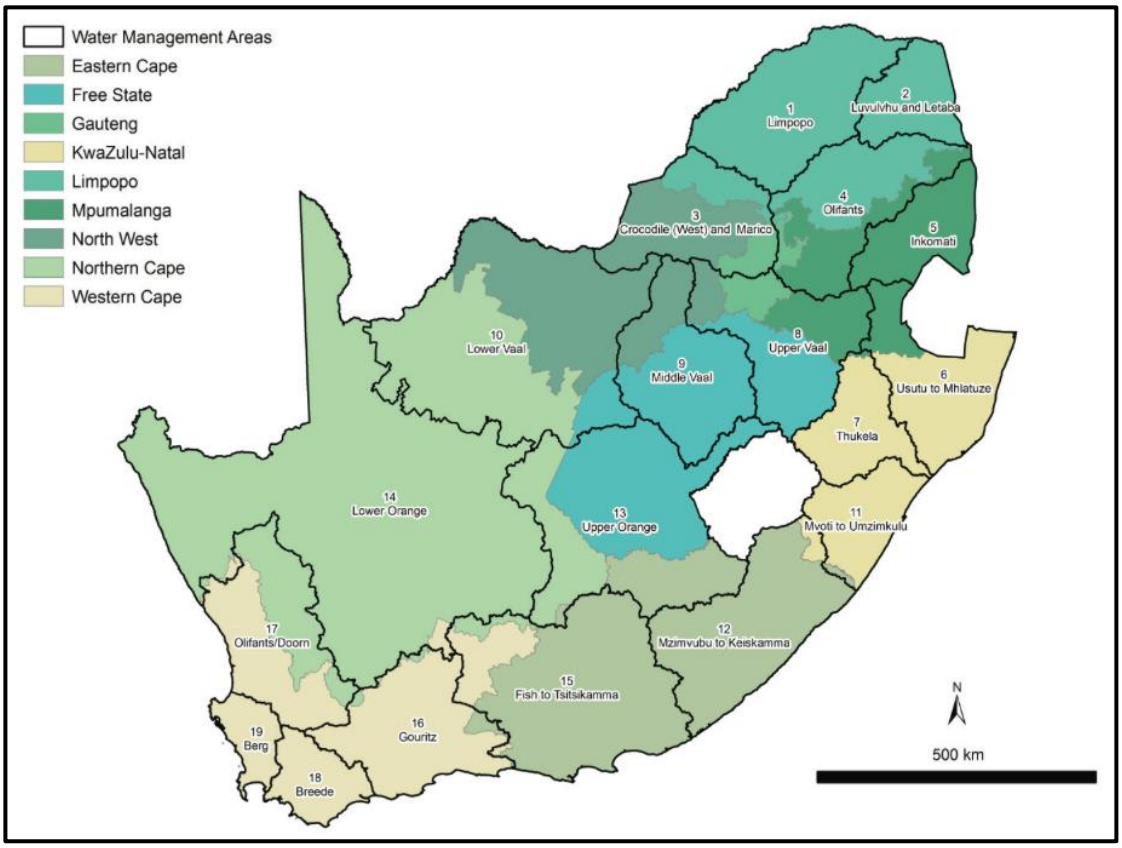

Figure 27: Water management areas of South Africa

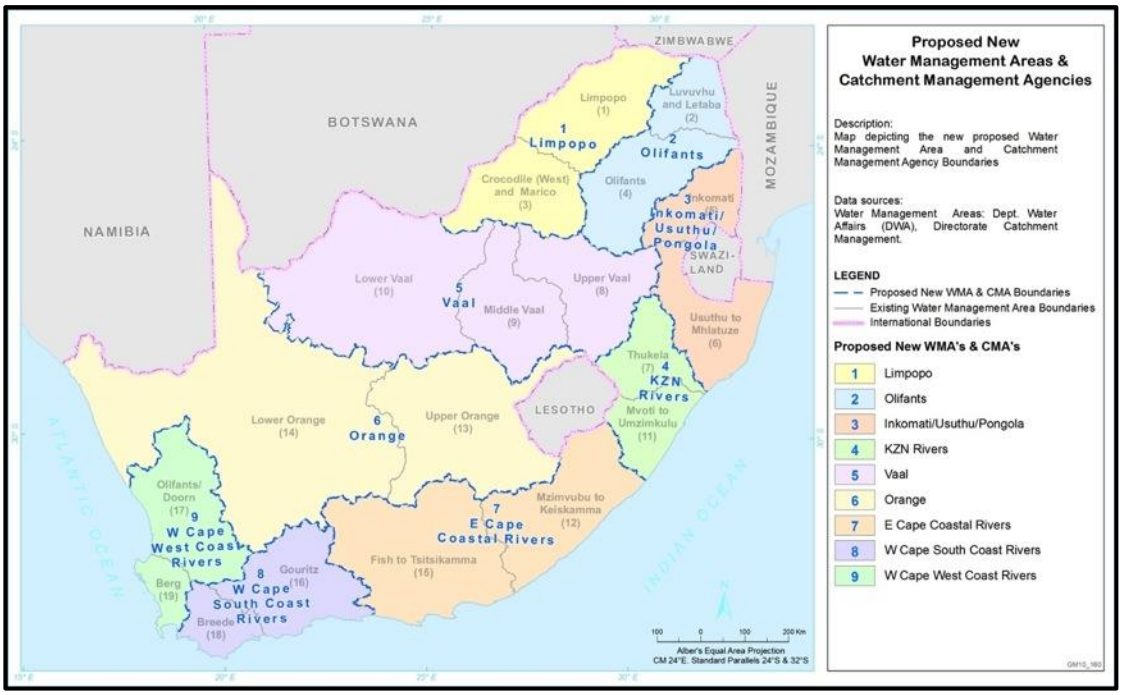

Figure 28: WMAs & CMAs of South Africa

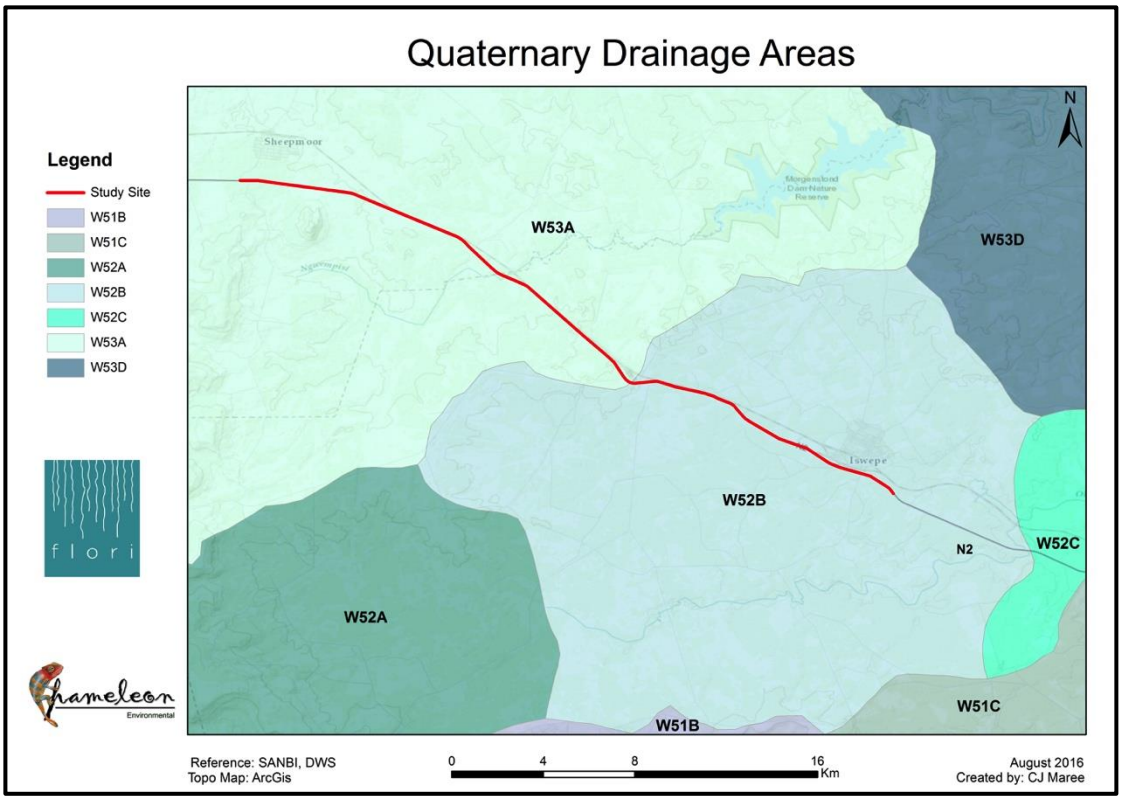

Figure 29: Quaternary drainage areas (QDAs)

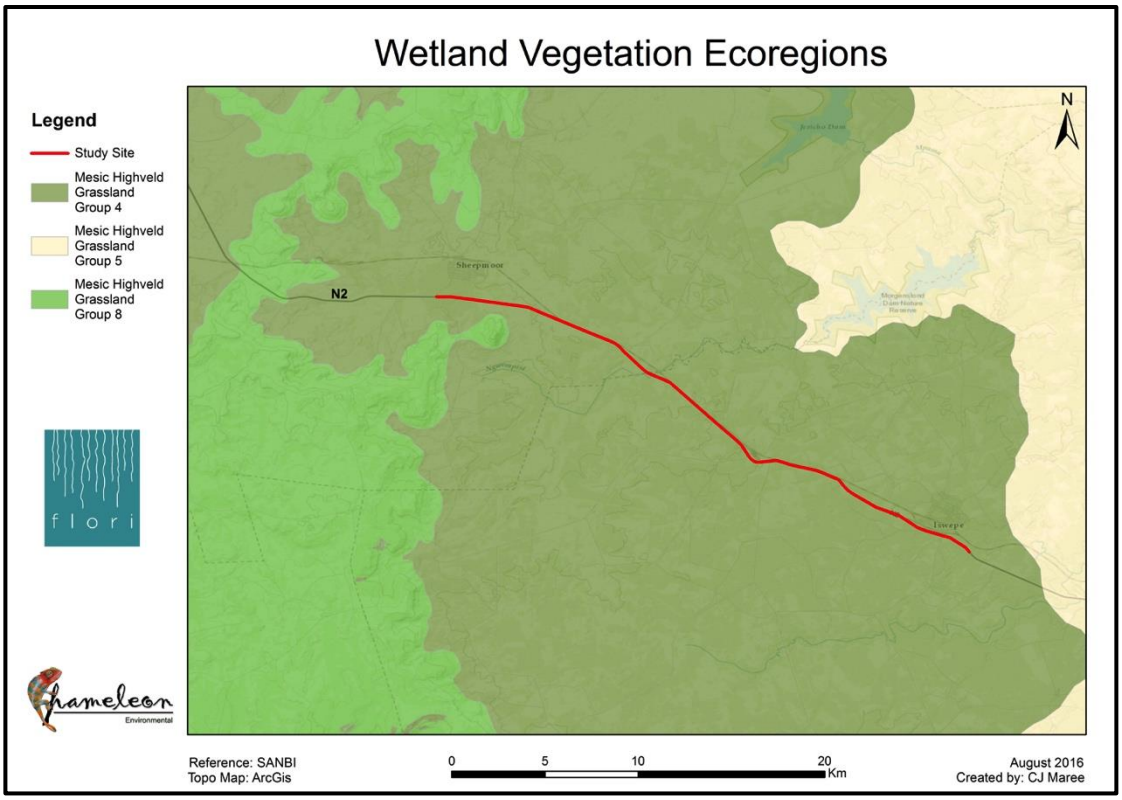

Figure 30: Wetland Vegetation Ecoregions

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).

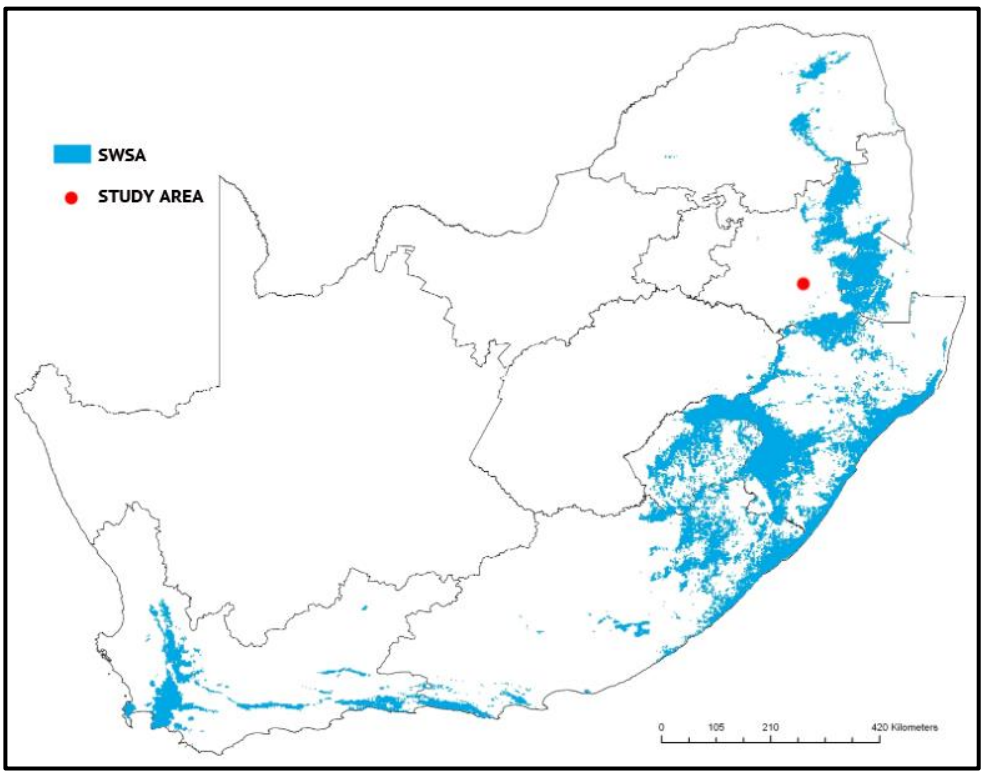

Figure 31: SWSA of South Africa

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 11 shows the criteria used for assessing the habitat integrity (PES) of wetlands and other watercourses, along with Table 12 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 11: 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 12: 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 13 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 13: 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.

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 Present Ecological State (PES) of watercourses

All of the watercourses identified during field investigations in the study area were assessed (Table 14). 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 14: PES of watercourses in the study area

Criteria	Identified Watercourses			
	Ngwempisis River	Unnamed stream	Drainage lines	Wetlands
HYDROLOGY				
Flow modification	2	2	2	2
Permanent inundation	2	1	1	1
WATER QUALITY				
Water Quality Modification	2	2	2	2
Sediment Load Modification	2	2	2	2
GEOMORPHOLOGY				
Canalisation	2	2	2	2
Topographic Alteration	2	2	2	2
BIOTA				
Terrestrial Encroachment	2	2	2	2
Indigenous Vegetation Removal	2	2	2	2
Invasive Plant Encroachment	3	3	3	3
Alien Fauna	3	3	3	3
Over utilisation of Biota	1	1	1	1
Total:	22	22	22	22
Average:	2,0	2,0	2,0	2,0
Category:	**D**	**D**	**D**	**D**
Integrity (PES):	**Low**	**Low**	**Low**	**Low**
PES Description	**Largely Modified**	**Largely Modified**	**Largely Modified**	**Largely Modified**
Recommended EMC	**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 15).

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 16).

Table 15: 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 moderating the quantity and quality of water of major rivers.	Very high 3 - 4	A
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 Ecological Importance & Sensitivity of watercourses

The ecological importance and sensitivity (EIS) ratings of the watercourses were determined using the above methodology. The calculations and categories for the various watercourse crossings are shown below (Table 16).

Table 16: EIS and EMC values of watercourses

Determinant	Ngwempisi River	Unnamed stream	Drainage lines	Wetlands	Confi-dence
PRIMARY DETERMINANTS					
1. Rare & Endangered Species	3	1	1	1	4
2. Populations of Unique Species	2	1	1	1	4
3. Species/taxon Richness	2	1	1	1	4
4. Diversity of Habitat Types or Features	2	1	1	1	4
5 Migration route/breeding and feeding site for wetland species	3	1	1	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	1	1	1	3
7. Sensitivity to Water Quality Changes	3	1	1	1	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	1	1	1	3
MODIFYING DETERMINANTS					
9. Protected Status	1	1	1	1	4
10. Ecological	3	1	1	1	4

Integrity					
TOTAL	25	10	10	10	-
AVERAGE	2,5	1,0	1,0	1,0	-
Overall EIS	**B**	**D**	**D**	**D**	**-**
Description	**High**	**Low**	**Low**	**Low**	**-**

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:

- Plantation (Afforestation);
- Impoundment by means of in-channel farm dams; and
- Over-utilisation of natural resources.

Although roads do have an impact on watercourses, especially in terms of impeding waterflow, their impact in the study area is not a major driver of ecological change.

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 17 & Table 18).

6.1 Floristic Sensitivity Analysis

Table 17: Floristic sensitivity analysis

Criteria	Distinctive habitats in the study area			
	Grassland	Plantations	Cultivated lands	Watercourses
Red Data Species	2	1	1	5
Habitat Sensitivity	2	1	1	7
Floristic Status	3	1	1	7
Floristic Diversity	3	1	1	6
Ecological Fragmentation	5	1	1	8
Sensitivity Index	30%	10%	10%	66%
Sensitivity Level	Medium / Low	Low	Low	Medium / High
Development Go Ahead	Go-Slow	Go	Go	Go-But

6.2 Faunal Sensitivity Analysis

Table 18: Faunal sensitivity analysis

Criteria	Distinctive habitats in the study area			
	Grassland	Plantations	Cultivated lands	Watercourses
Red Data Species	2	5	4	5
Habitat Sensitivity	2	1	1	7
Faunal Status	3	1	1	7
Faunal Diversity	3	1	1	6
Ecological Fragmentation	5	1	1	8
Sensitivity Index	30%	18%	16%	66%
Sensitivity Level	Medium / Low	Low	Low	Medium / High
Development Go Ahead	Go-Slow	Go	Go	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 19).

Table 19: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Grassland	Medium/Low	Medium/Low	Medium/Low	Go-Slow
Plantations	Low	Low	Low	Go
Cultivated lands	Low	Low	Low	Go
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 Priority areas

The study area does not fall within any priority areas, except those of NFEPA wetlands and streams. 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).

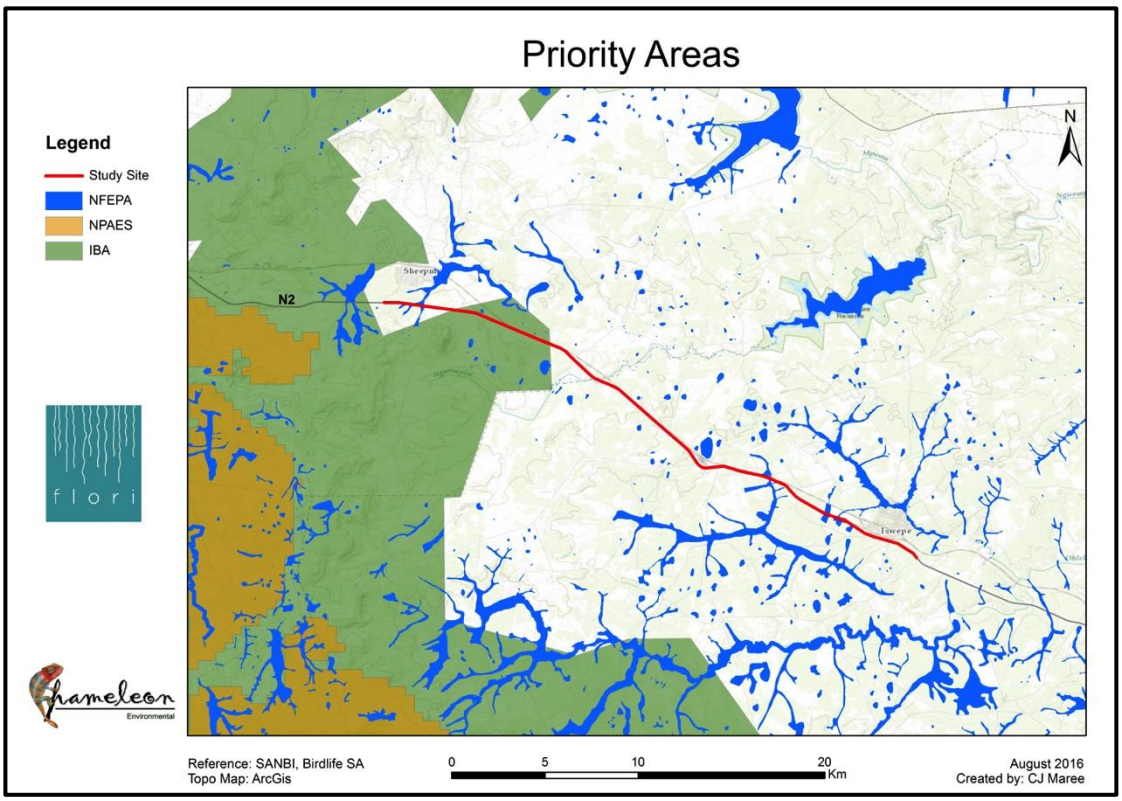

Figure 32: Priority areas

6.5 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) was developed by updating and revising the earlier Mpumalanga Biodiversity Conservation Plan (MBCP, 2006). Although the MBCP was widely accepted and well used, it became necessary to conduct a major revision. The state of the physical landscape has changed in some areas of the Province with respect to habitat modification, protection of certain ecosystems and landuse. The revised plan incorporates significant technical improvements, including more recent landcover data and better biodiversity data. It is important to note that the MBSP (2014) replaces the earlier MBCP (2006) and should be used as the official reference for biodiversity priority areas to be taken into account in land-use planning and decision-making in the Province (MBSP, 2014).

Figure 33 highlights the extent of the Critical Biodiversity Areas (CBA) that the study area potentially impacts on, or is situated within. Table 20, 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. The study area is situated within CBA: Irreplaceable and CBA: Optimal areas. These areas and their greater grassland vegetation types in the region are under threat mainly as a result of extensive afforestation of pine and eucalypt trees.

Table 20: 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 MBCP) 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.

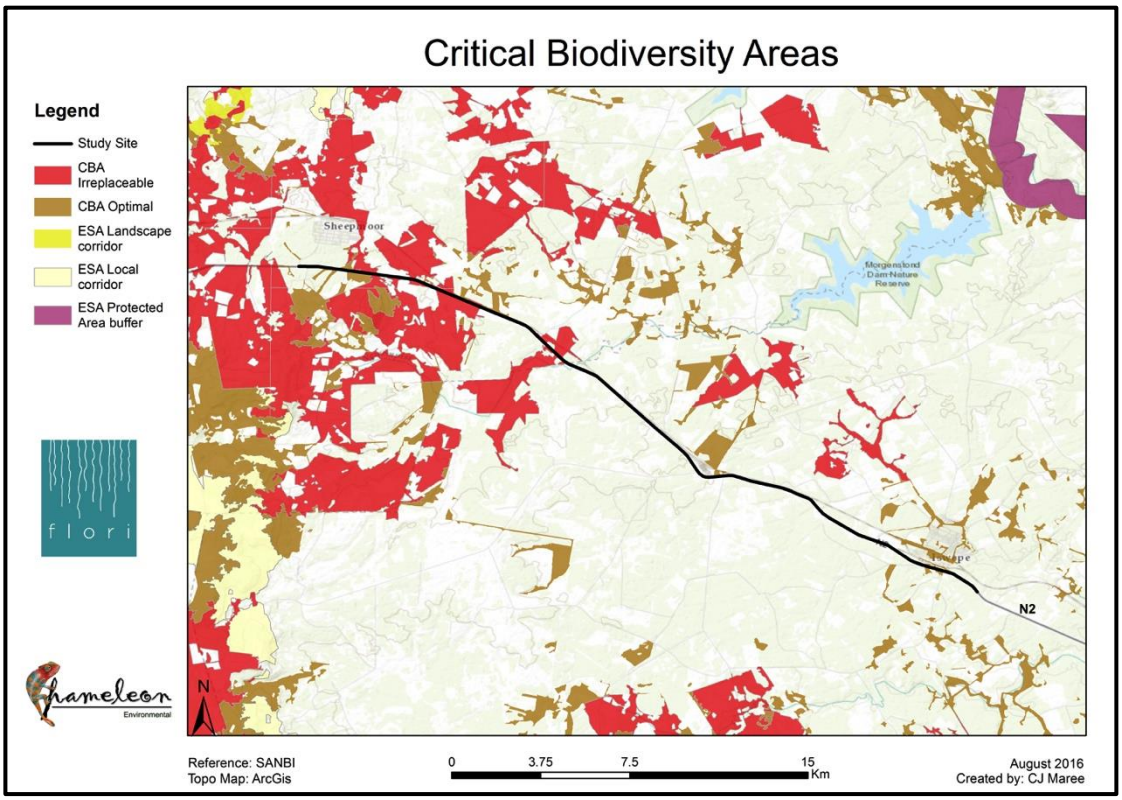

Figure 33: CBAs

6.6 National Screening Tool Desktop Assessment

The Department of Forestry, Fisheries and Environment (DFFE) (Previously DEA) has development 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 is a guideline tool 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. may be required by the competent authorities. According to the screening tool (accessed October 2022) the various sensitivities for the study site and immediate surroundings are as follows:

- Terrestrial biodiversity combined theme sensitivity: Very High.
- Aquatic biodiversity combined theme sensitivity: Very High.
- Plant species theme sensitivity: Low (Most of the area); Medium (Patches between Kriel and Sheepmoor).
- Animal species theme sensitivity: Mostly Medium with some patches of High, especially between Kriel and Sheepmoor.

It is important to note that the screening tool is a desktop guideline and needs to be verified / ground-truthed. During site inspections the actual study area (N2 Road and road reserve) was found to be as follows:

- Terrestrial biodiversity combined theme sensitivity: Low, with some patches of Medium.
- Aquatic biodiversity combined theme sensitivity: Low, with High at watercourses only.
- Plant species theme sensitivity: Low (Most of the area); Medium (Patches along watercourses and some open grassland in the vicinity of the study area, but not in the study area itself).
- Animal species theme sensitivity: Mix of Low and Medium.

The actual study area is an existing national road that is totally transformed with a road reserve that is mostly altered and transformed, as can be expected along any major road.

6.7 Sensitive areas identified during field investigations

The majority of the route of the study area is within highly modified or totally transformed environments. There are no pristine grassland areas within the study

area, except those directly connected to, or alongside watercourses, and even then very little in extent.

There are a few sensitive areas within the study area, which are all watercourses. Fortunately the nature of the project is such that basically all of the construction work is within existing asphalt-surfaced roads and within highly modified and transformed existing road reserves. So the activities of the project will result in little to no additional negative impacts on existing sensitive areas or natural grassland areas.

The sensitivity of the entire study area is 'Low' with the exception of the watercourse crossings, which have a sensitivity of 'High'. The 'High Sensitivity' areas are shown below in Figure 34, and the GPS positions of these crossings / areas are listed below in Table 21. The Pin ID's in Table 21 correspond with the pins in Figure 34.

Standard 32m wide buffers around all watercourses have been recommended. No other buffers are required and there are no other 'high sensitive' areas.

Table 21: Locations of High Sensitivity Areas

Pin ID	Watercourse	Coordinates
661	Small, seasonal drainage line	26°49'13.66"S; 30°28'48.30"E
662	Small, seasonal drainage line	26°48'58.99"S; 30°28'16.37"E
663	Small, seasonal drainage line	26°48'59.17"S; 30°28'16.62"E
664	Small wetland and moist grassland area	26°47'44.94"S; 30°25'27.24"E
665	Small, seasonal drainage line	26°46'19.69"S; 30°23'46.63"E
666	Ngwempisi River	26°46'8.34"S; 30°23'20.35"E
667	Small wetland / moist grassland area	26°44'10.47"S; 30°19'39.56"E
668	Unnamed, semi-perennial stream	26°43'59.04"S; 30°18'12.91"E
669	Wetland area	26°43'55.71"S; 30°17'47.93"E

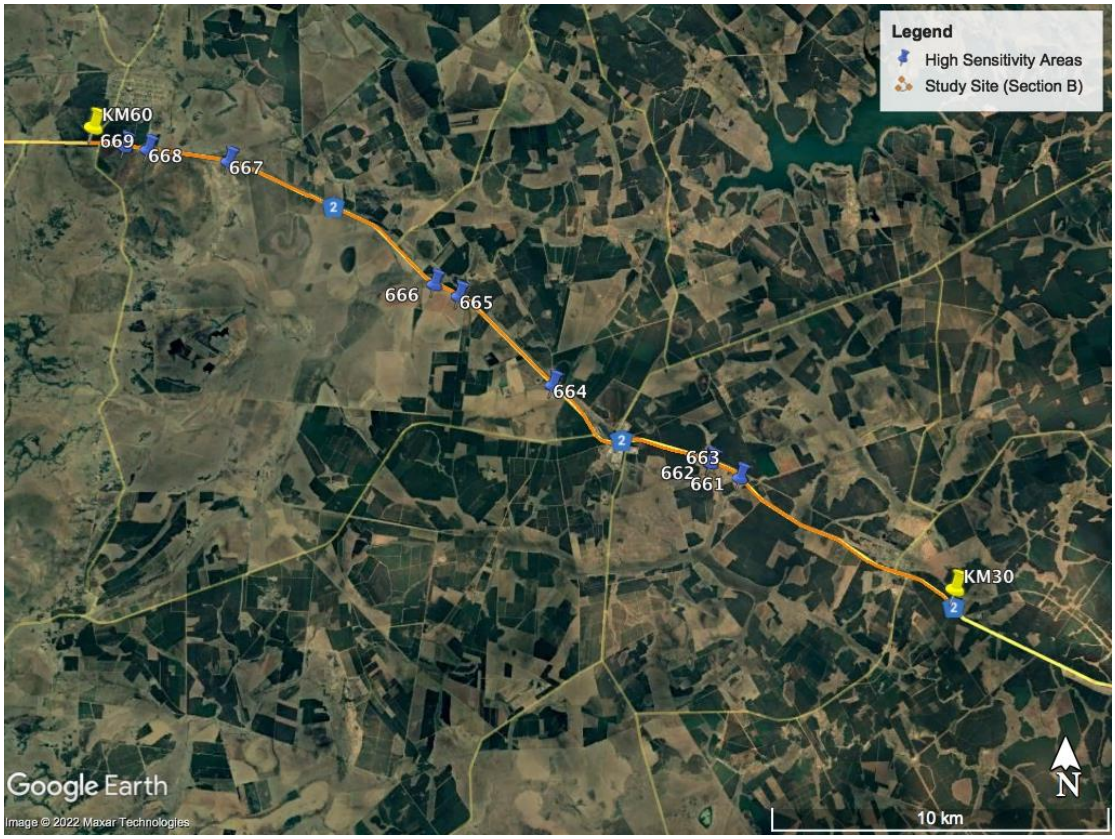

Figure 34: Sensitivity Map

6.8 Buffer Zones

Standard 32m wide buffer zones are required along the edges of all watercourses. These buffer zones are to be approached as 'no-go' zones with regards to the movement of vehicles, machinery, workers, and materials in and through them.

No temporary laydown areas, site offices, parking of vehicles, and storage of goods may be setup within a 100m of the edge of any and all watercourses, including rivers, seasonal streams, seasonal drainage lines and wetlands. It is impractical to delineate and map every single watercourse in the area of the project footprint within a report. Therefore, it is essential that SANRAL / Contractors are aware of the required buffer widths and implement them on the ground during each and all activities. For example, when setting up a temporary laydown area, or setting up a site office, or parking of vehicles and heavy machinery at the work site.

There are no required buffer zones for grasslands, farmlands, roads, etc.

Part of the scope of the project is the upgrade / widening / repair / rehabilitation of existing road surface and watercourse crossings (bridges, culverts, etc.). At this work points there is no buffer zone. However, the footprint of activities must be kept as

small as possible and the buffer still applies at these work points for laydown areas, site offices, parking of heavy machinery that is not in use, general movement of vehicles and workers.

The summary of buffers is as follows:

- 32m wide along the outer edge of all watercourses including wetlands. For rivers and streams this is from the edge of the stream bank.
- 100m wide with regards to all temporary laydown areas and site offices.
- 50m wide for portable toilets along the study area.
- No other buffers required.

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 B)		
SECTION B (N2-34: KM 60,0 to KM 87,4)		
GRASSLAND		
Impact Rating	**Mitigating Measures**	**Sensitivity**
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	**Construction Phase** All temporary facilities (i.e. storage, accommodation, portable toilets, etc.) to be setup in existing built-up areas or disturbed areas only. No temporary facilities to be setup within 100m of any watercourses, including wetlands. Ensure small footprint during construction phase. Use existing roads and road reserve for haul vehicles, contract vehicles, etc. If possible no new access roads to be constructed. No buffer zones are required within the terrestrial and grassland areas of the project. Dust suppression along gravel roads to be	LOW

Probability: (Highly probable) 3	implemented. Erosion to be continually monitored and rectified during construction phase, not only after construction. All excess materials brought onto site for construction to be removed after construction. No open trenches or mounds of soils to be left. Rehabilitation plan for disturbed areas to be compiled and implemented. Re-seeding of bare areas with local indigenous grasses to be part of the rehabilitation plan. No exotic species to be used for rehabilitation. No open fires allowed at all during the construction phase by contractors. The study area is within and surrounded by plantations, which are extremely susceptible to large, run-away fires. **Operation Phase & Maintenance Phase** Erosion plan to be compiled and implemented. Stormwater management plan to be compiled and implemented.	
WATERCOURSES		
Impact Rating	**Mitigating Measures**	**Sensitivity**
Before Mitigation: Medium Extent: Local: 2 Duration: Long-term: 3 Intensity: Moderate: 2 Probability: Highly probable: 2 Total: 9 After Mitigation: Low Extent: Site: 1 Duration: Long-term: 1 Intensity: Moderate: 2 Probability: Possible: 2 Total: 6	**Construction Phase** All temporary facilities (i.e. storage, accommodation, portable toilets, etc.) to be setup in existing built-up areas or disturbed areas only. No temporary facilities to be setup within 100m of any watercourses, including wetlands. No portable toilets to be stationed within 50m of the edge of any watercourses, including wetlands. Ensure small footprint during construction phase. Erosion around bridges and stormwater culverts to be monitored continually during the construction phase and rectified continually (if occurring directly as a result of the construction activities). Erosion control not to be left until after construction only. Avoid and minimise the unnecessary removal of any indigenous vegetation. Standard 32m buffer zones are required along all watercourses (rivers, streams, drainage lines) and wetlands. These buffer zones are 'no-go' zones for the movement of vehicles, workers, and equipment during the construction phase. **Note:** Buffers do not apply to watercourse crossings that are earmarked for upgrade / refurbishment / rehabilitation, or for work along the actual road surfaces or reserves as per the scope of the project. However, the footprint of such construction / rehabilitation activities must be confined to the footprint of the road, road reserve, bridge within that area. Full rehabilitation plans for water crossings, including stream banks, to be compiled and implemented. **Operation Phase & Maintenance Phase**	MEDIUM

	Erosion plan to be compiled and implemented. Stormwater management plan to be compiled and implemented.	
CULTIVATED LANDS AND PLANTATIONS		
Impact Rating	**Mitigating Measures**	**Sensitivity**
Before Mitigation: Low Extent: Regional: 2 Duration: Medium-term: 2 Intensity: Moderate: 2 Probability: Highly probable: 3 Total: 9 After Mitigation: Medium Extent: Site: 1 Duration: Long-term: 3 Intensity: Moderate: 2 Probability: Possible: 2 Total: 8	**Construction Phase** Access roads to and through farmlands / plantations to be limited and controlled. No movement of heavy vehicles through farmlands / plantations directly after rains to limit damage to lands and farm roads. All farm roads and plantation roads used by contractors during construction to be rehabilitated. Erosion along farm roads and plantation roads to be continually monitored and repaired. Especially after rain downpours. Ensure small footprint during construction phase. No buffer zones are required. Dust suppression along gravel roads to be implemented. Erosion plan to be implemented and monitored. Any farm roads / private roads / plantation roads used during construction to be rehabilitated after construction. Any fences, gates, etc. damaged during construction to be repaired. **Operation Phase & Maintenance Phase** N/a	LOW

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 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 remain neutral. Small negative impacts will be corrected (rehabilitated) and off set with the numerous 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 any related 'fatal flaws'.

8.2 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 and contractors. There are no additional or special conditions required.

8.3 Monitoring requirements

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

No special or specific monitoring requirements are required or recommended.

9 MITIGATION OF IMPACTS

The following mitigating measures, along with those set out in the Impact Assessment, 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 freshwater pans.
- No temporary facilities (including portable toilets) to be positioned within 100m 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 conclusions and recommendations were reached after desktop studies, field investigations and expert opinions of field investigators:

- There are no 'No-Go' zones in the study area.
- There are no 'fatal flaws'.
- No priority faunal species were encountered, although some will visit the area or be present in the area. However, the nature of the project is that any disturbances will be temporary (only last during the construction phase).
- No protected trees and no red data plant species were observed during field investigations.
- All watercourses should be viewed as sensitive.
- There are no actual areas of High Sensitivity in the study area (eventhough watercourses are approached as sensitive).
- 32m wide buffers to be implemented along the outer edge of all watercourses. For rivers, streams and drainage lines this is from the top edge of the stream bank. Note that buffers do not apply at the work site at watercourse crossings.
- Additional negative impacts arising from the activities of the project will be either temporary (during the construction phase) and/or insignificant (not measurable). This includes the potential impacts on watercourse crossings.
- Some positive impacts from the project include the replacement and cleaning of culverts, pipe, etc. that will positively impact on the flow of small streams and seasonal drainage lines.
- Recommended mitigating measures must be implemented.
- Taking all findings into account, along with mitigating measures and proposed project activities there should be no need for a Water Use Licence Application process as there will be no significant or measurable negative impacts on the watercourses in terms of Section 21 (c) & (i) water uses. Some of the upgrades to the culverts, bridges and stormwater pipes will have a positive impact on watercourses as these activities will reduce current impoundments and deviations of water flow from debris; broken and deteriorating infrastructure; siltation, etc.
- A rating matrix was compiled which determined the total impacts to of a Risk Rating Class of Low, which qualifies the project for a General Authorisation (GA) Process, at the very most.

11 APPENDICES

11.1 Risk matrix assessment

[Attached separately]

11.2 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 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 Listed (RDL) Species

None.

Priority Species (Species of conservation concern)

Boophone disticha, Hypoxis rigidula.

11.3 Grass Seed Mixes for Rehabilitation

The information below is a guideline and may need to be adjusted slightly depending on the availability of seed species and volumes. No alien plant species should be used for rehabilitation purposes, including grasses. Tef (*Eragrostis tef*) is often used for roadside rehabilitation, but it is not indigenous to the Mpumalanga Province or South Africa for that matter. All the grass species below are indigenous to the study area and establish and grow well in disturbed areas.

Table 24: Summer grass mix and application rate

Grass Species	Common Name	Application Rate
Eragrostis curvula	Weeping love grass	8 kg / ha
Setaria sphacelata var. *torta*	Creeping bristle grass	8 kg / ha
Cynodon dactylon	Couch grass	4 kg / ha
Aristida congesta	Spreading three-awn grass	7 kg / ha
Total	**-**	**27 kg / ha**

Table 25: Winter grass mix and application rate

Grass Species	Common Name	Application Rate
Eragrostis curvula	Weeping love grass	10 kg / ha
Aristida congesta	Spreading three-awn grass	10 kg / ha
Cynodon dactylon	Couch grass	10 kg / ha
Total	**-**	**30 kg / ha**

The contractor may determine the type of fertiliser or soil-improvement material to be added. The fertiliser is normally applied in liquid form and should ideally have a higher percentage of Nitrogen (N) and Phosphorus (P) than that of Potassium (K).

11.4 Photographs

Photo 1: Start of study area (approx. km 30) looking north along study area. Notice the eucalypt plantations on both sides

Photo 2: Typical 'wetland' area alongside study area (N2 road), which is more characteristic of 'moist grassland'. Plantations have had a massive negative impact on these 'wetland' areas

Photo 3: Small stream / drainage line crossed over. Notice the lack of riparian zone, which is typical of the watercourses in the study area and region

Photo 4: Stormwater drainage / culvert crossed over, which is small and typical of all of those found in the study area

Photo 5: Ngwempisi River. Looking west from N2. This is the only significant / large stream or river in the study area. Notice the absence of riparian zone

Photo 6: Ngwempisi River (stream), where it flows under the N2 (study area). West side looking south

Photo 7: Study area at approx. km 53 looking north. The areas, which are not plantations, are typically flat, open grasslands, grazing lands or cultivated lands. Notice that the road reserves are regularly burnt to create firebreaks, which also impacts on biodiversity

Photo 8: Small stream / seasonal drainage line in study area. Once again lacking any distinctive riparian zone

Photo 9: Small, seasonal drainage line crossing in study area. All the drainage lines and streams are small with no riparian zone, like this one.

11.5 Short CV of Specialist

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.
- 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 EXPERIENCE
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, with specific emphasis on high-yield agriculture.
- 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.

- Did “turn-key” projects in most agriculture related fields. This included – Tunnel and greenhouse production; Hydroponics; vegetables, cut flowers; field crops.

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