R504 SECTION 4

BIODIVERSITY ASSESSMENT

Terrestrial Ecological Assessment and Aquatic Assessment for the Proposed Upgrade of the R504 Section 4, between Leeudoringstad and the Vaal River in the Maquassi Hills Local Municipality, Dr. Kenneth Kaunda District Municipality, North West Province

Compiled by

FLORI SCIENTIFIC SERVICES

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PROJECT INFORMATION

PROJECT TITLE: Upgrade of the R504 Section 4

STUDY NAME: Biodiversity Assessment

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EXECUTIVE SUMMARY

Project Overview

The South African National Roads Agency (SOC) Limited (SANRAL) is currently busy with the planning for the proposed upgrade of the R504 Section 4, from just east of Leeudoringstad to just across the bridge over the Vaal River, in the Maquassi Hills Local Municipality, Dr. Kenneth Kaunda District Municipality, North West Province. The Vaal River is the provincial border between North West Province and Free State Province. The project involves the upgrade of the surface and the slight extension and securing of the road shoulder. The upgrade does not involve any significant rerouting or widening of the carriageway and all construction and upgrade activities are within the existing road and road reserve of the R504. The approximate length of the project along the R504 Section 4 is 24,5 km.

Chameleon Environmental was appointed on behalf of the South African National Roads Agency (SOC) Limited to undertake and Environmental Impact Assessment (EIA) for the proposed project. Flori Scientific Services cc was appointed as the independent consultancy to conduct an ecological assessment, which includes a terrestrial ecological assessment and an aquatic ecological assessment of the proposed project.

Field investigations were conducted on 26 October 2020.

Location of the study area

The study site consists of the existing road and road reserve of the R504 Section 4, between Leeudoringstad and the Vaal River bridge crossing (North West / Free State Provincial Border). The study site is within the Maquassi Hills Local Municipality, Dr. Kenneth Kaunda District Municipality, North West Province. The road (study site) starts at the R502/R504 intersection just outside of Leeudoringstad (km 0.0) and ends on the east side of the bridge crossing the Vaal River (km 24.1).

Vegetation

The entire study site is within the original extent of Vaal-Vet Sand Grassland, which is a threatened ecosystem (veldtype) with a status of 'Endangered'. However, much of the vegetation in the region and area of the study site has been transformed over many years by cultivated farmlands that are regularly ploughed. The vegetation and species-mix of the study site itself is also highly transformed and degraded due to the nature of the study site. That is, consisting of a hard-surface national road and a road reserve, that although consisting mainly of grass, is regularly cut or burnt. There is no pristine or characteristically identifiable Vaal-Vet Sandy Grassland present in the study area.

Watercourses

The study site crosses over two semi-perennial streams and one perennial river, namely the Leeudoringspruit (stream), Klipspruit and Vaal River.

There are a number of freshwater pans scattered throughout the region and although the road is within close proximity to some of them, it does not cross through any of these pans. The project and related activities will also not impact on any wetlands, including pans.

Drainage Regions

Below is a summary of the drainage regions in which the study site is situated.

Level	Category
Primary Drainage Area (PDA)	C
Quaternary Drainage Area (QDA)	C25A, C24J
Water Management Area (WMA) – Previous / Old	Middle Vaal
Water Management Area (WMA) – New (as of Sept. 2016)	Vaal (WMA 5)
Sub-Water Management Area	Vaal Tributaries
Catchment Management Agency (CMA)	Vaal (CMA 5)
Wetland Vegetation Ecoregion	Dry Highveld Grassland Group 3
Strategic Water Source Area (SWSA)	No
Priority Quaternary Catchment	No
Fish FEPA	No (except Vaal River)
Fish FSA	No (except Vaal River)
Fish Corridor	No (except Vaal River)
Fish Migratory Corridor	No (except Vaal River)
Priority Quaternary Catchment	No

Ecological Sensitivity

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. According to the analyses of the floristic, fanual and overall ecological sensitivities there are no high sensitivity areas or habitats. In other words, there are no 'No-Go' areas within the study area itself.

However, watercourses are, by default, considered sensitive and must be approached as such.

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity
Grasslands	Low	Low	Low
Watercourses	Medium	Medium	Medium

Fatal Flaws

There are no fatal flaws and the project may proceed.

Conclusions

The conclusions of the study are as follows:

- The study site consists of the existing road and road reserve of the R504 Section 4.
- The study site is within the original extent of Vaal-Vet Sandy Grassland (which is a threatened ecosystem with a status of 'endangered').
- The vegetation of the study site itself is highly degraded and transformed due to the dominant presence of the existing hard-surface road (R504) and road reserve, which is routinely mowed and/or burnt.
- There are no areas of pristine veldtype, vegetation or ecosystems in the study site.
- The site is not within any priority areas.
- The site is not within a strategic water source area (SWSA) of South Africa.
- The study site (road) crosses over two semi-perennial / seasonal streams (Leeudoringspruit & Klipspruit) and one large perennial river (Vaal River).
- There are no wetlands within the study site itself, but there are a number of pans (a type of wetland) scattered throughout the region, some of which are close to the road.
- The project will have little to no additional measurable medium- or long-term negative impacts on the environment.
- There are no obvious environmental fatal flaws and the project may proceed.

Recommendations

The recommendations of the study are as follows:

- All mitigating measures must be implemented, including recommended buffer zones and/or regulated areas.
- A 50 m buffer zone / regulated zone is recommended for the stream / river systems delineated, even though a 32 m would be adequate due to the nature of the watercourses with no real riparian zone and the medium to low rainfall regime. Farming activities are within these zones and there are also houses within these zones.
- No additional site investigations or specialist studies are required due to the highly transformed nature of the study site in which the activities are to take place.
- It is the opinion of the specialist that the project should be authorised and allowed to proceed to the next phase.

Below are the sensitivities of the study area along with some descriptions of the surrounding land uses.

REVIEW AND APPROVAL

Name	Title	Signature	Date
Johannes Maree	Ecologist & Author (Flori Scientific Services)		**18/11/2020**
Paul Bothma	Lead EAP (Chameleon Environmental)		**20/11/2020**

Acknowledgements

The authors would like to acknowledge and thank Chameleon Environmental Consultants, South African Roads Agency SOC Limited (SANRAL) and other role players for their assistance with information and queries related to the project.

EXPERTISE & DECLARATION OF THE SPECIALIST

EXPERTISE

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 in training, assessing & service provision (AgriSeta).

Registered with South African Council for Natural Scientific Professions (SACNASP). Registration number: 400077/91

21 years experience in technical and managerial positions, project management and consultancy.

19 years experience in writing of articles, books, training material, training & presentations.

13 years direct experience in EIAs.

Has conducted hundreds of field investigations and compiled hundreds of speciaist reports for EIAs, including ecological assessments (fauna & flora), wetland assessments and avifauna impact assessments. Projects include power lines, roads, quarries, 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 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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ACRONYMS

BA	Basic Assessment
CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DEA	Department of Environmental Affairs (Old name of DEFF)
DEFF	Department of Environment, Forestry & Fisheries
DWA	Department of Water Affairs (Old name for DWS)
DWS	Department Water and Sanitation
EAP	Environmental Authorised Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
EMF	Environmental Management Framework
HGM	Hydrogeomorphic
IBA	Important Bird Area(s)
IUCN	International Union for Conservation of Nature
MAP	Mean Annual Precipitation
a.s.l.	Above sea level
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
PES	Present Ecological State
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
REC	Recommended Ecological Category (or Class)
REMC	Recommended Ecological Management Category (or Class)
RVI	Riparian Vegetation Index
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency (SOC) Limited
SWSA	Strategic Water areas of South Africa
WMA	Water Management Areas
WUL	Water Use Licence
WULA	Water Use Licence Application

1 BACKGROUND

1.1 Project overview

The South African National Roads Agency (SOC) Limited (SANRAL) is currently busy with the planning for the proposed upgrade of the R504 Section 4, from just east of Leeudoringstad to just across the bridge over the Vaal River, in the Maquassi Hills Local Municipality, Dr. Kenneth Kaunda District Municipality, North West Province. The Vaal River is the provincial border between North West Province and Free State Province. The project involves the upgrade of the surface and the slight extension and securing of the road shoulder. The upgrade does not involve any significant rerouting or widening of the carriageway and all construction and upgrade activities are within the existing road and road reserve of the R504. The approximate length of the project along the R504 Section 4 is 24,5 km.

The proposed project is the upgrading of the R504, section 4, national road between Leeudoringstad and the North West province/Free State Province Border (Vaal River). The start of the project is the R502/R504 intersection just outside of Leeudoringstad (km 0.0) and the project ends on the eastern side (Free State Province side) of the Vaal River bridge (km 24.1).

Proposed project upgrades include:

- Strengthening of the existing pavement structure

In situ construction of a new crushed stone base and new surfacing seal.

- Upgrading the capacity of major culvert C0646 at Km 14.59.

Replacement of railings with SANRAL specified railings and the reparation of eroded embankments.

- Rejuvenation of the rail bridge across the Vaal River

The Balustrades of the existing bridge will be altered according to the latest SANRAL specifications and primary columns will be strengthened and erosion damage of embankments repaired

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Field investigations were conducted on 26 October 2020.

1.2 Purpose of the study

The project requires Environmental Authorisation. Therefore a Basic Assessment (BA) process is required, which includes the need for specialist studies such as ecological and aquatic assessments. Therefore, a biodiversity assessment (which includes terrestrial ecology and aquatic ecology) is

needed. The purpose of the study is to assess the natural environment of the site and to determine if any ecological sensitive habitats (including watercourses) are present; if any red data listed (RDL) fauna and flora are present; etc. If so, to highlight and assess the potential impacts the project might have on these environments and species and to recommend mitigating measures where and if necessary to reduce the impacts arising from the proposed project.

1.3 Quality and age of base data

The latest data sets were used for the report in terms of background information for veldtypes, ecosystems, threatened ecosystems, red data listed (RDL) fauna and flora species and priority areas.
The data used is of high quality and was sourced from the same data sets that are generally used and approved by most consultants and governmental organisations.
The source, data and age of data included the following:

- Screening Tool: Dept. Environmental Affairs (DEA) – (www.screening.environment.gov.za).
- Threatened ecosystems: South African National Biodiversity Institute - (www.bgis.sanbi.org).
- Protected areas: Protected Areas Register (PAR): DEFF – (https://portal.environment.gov.za).
- RDL species: Red List of South Africa Plants (latest update) – (www.redlist.sanbi.org).
- Veldtypes and ecosystems: Mucina & Rutherford, 2006, 2010. Updated 2012.
- Endangered Wildlife Trust (EWT) – latest data sets – (www.ewt.org.za).
- SANBI data sets – latest updated website data (www. bgis.sanbi.org).
- North West Biodiversity Sector plan (2015).

1.4 Assumptions and Limitations

The assumptions and limitations for the assessment are as follows:

- All information regarding the proposed project and related activities as provided by the Client are taken to be accurate.
- Field investigations were conducted on 26 October 2020, which forms part of a spring season investigation.
- The spring investigations are deemed sufficient for the study. A number of other specialist studies have recently been conducted on the area and these were also used as references. Therefore, adequate information has been collated.
- Although field investigations were conducted just outside of the 1 November summer investigations period, sufficient summer rainfall had already taken place to facilitate summer vegetative growth. The project footprint is also very small in that it is very narrow (width of the road and road reserve) and is concentrated within an already transformed area of the existing road itself. Therefore due to the previously mentioned reasons and the nature of the project the

site investigations and timing thereof is sufficient for the project and study and provides sufficient information to make meaningful and calculated conclusions and recommendations.

- The site investigations and study is deemed adequate for the project and no further specialist, environmental studies are required or recommended.
- Precise buffer zones, regulated zones, etc. or exact GPS positions cannot be made using generalised corridors or kml files on Google Earth. However, buffer zones and delineations drawn are accurate to within a few metres;
- The latest data sets were used as background information and desktop review for the project. The data sets were verified and refined during field investigations (ground-truthing). These include inaccurate Wetland Map 5 delineations for the area.
- Equipment used: Standard soil augers; hand-held Garmin GPS instrument; EC & pH hand-held meters; IPhone 7 for photographs, MacBook Pro and Epson PC Laptops; Google earth maps, 1:50 000 South African topographical maps.
- Computer packages used: MS Word; MS Excel; Adobe Photoshop, ARC GIS; Google Earth; Garmin Base Maps.

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 and datasets used were from Mucina & Rutherford (eds) (2006, 2010, updated 2012); the South African National Biodiversity Institute (SANBI: www.bgis.sanbi.org); and Endangered Wildlife Trust (www.ewt.org.za). Background data regarding soils, geology, climate and general ecology were also obtained from existing datasets and relevant organisations. A number of specialist studies have been conducted in the area and these were also consulted to obtain additional background information.

2.2 Site investigations

Site investigations of the study site and surrounding areas were conducted on 26 October 2020.

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

- Biophysical environment, including regional and site-specific vegetation.
- Habitats ideal for potential red data listed fauna and flora species;
- Watercourses.

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

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 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.

2.5 Present Ecological State

The Present Ecological State (PES) is the current (present) ecological condition (state) in which the watercourses are found, prior to any further developments or impacts from the proposed project. The PES of watercourses found in the study area is 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). The criteria used for assessing the PES of watercourses are found in Table 1. The scores for the various attributes are found in Table 2. 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 watercourse.

Table 3 provides guidelines for determining the category of the Present Ecological Status (PES) based on the total score determined during assessments. This approach is based on the assumption that extensive degradation of any of the attributes may determine the PES of the watercourse (DWA, 2005).

Table 1: 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 2: 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 3: 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.

2.6 Ecological Importance and Sensitivity

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 4).

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 / watercourse / wetland in terms of EIS, PES and function, and the desire to 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 watercourses identified in the study area are shown below (Table 4).

Table 4: 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

2.7 Ecological Impact Assessment

2.7.1 Criteria for the classification of an impact

Scale (Extent)

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 the country
- International: Impact is across countries

Duration

Indicates what the lifetime of the impact will be.

- Immediate: The impact will either disappear with mitigation or will be mitigated through natural process in a time span shorter than the construction phase.
- Short-term: The impact will either disappear with mitigation or will be mitigated through natural process within 0 – 5 years.

- Medium-term: The impact will either disappear with mitigation or will be mitigated through natural process within 5 – 15 years.
- 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. Impact ceases after the operational life of the activity.
- 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.

Magnitude (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 / Unknown: 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.
- Low probability / possible: The impact may occur.
- Medium probability: It is more than likely that the impact will occur.
- Highly probable: High likelihood that the impact will occur.
- Definite / Unknown: The impact will definitely (most certainly) occur, or is unknown and therefore needs to be afforded a high probability score.

Significance

Significance (environmental significance) constitutes the overall risk and 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.

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

2.7.2 Scoring Method

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 scoring method (rating 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 below in Table 5.

Table 5: Scoring method for impact assessment

Magnitude (Intensity)	**Duration**
10 - Very high/unknown	5 - Permanent
8 - High	4 - Long-term*
6 - Moderate	3 - Medium-term (5-15 years)
4 - Low	2 - Short-term (0-5 years)
2 - Minor	1 - Immediate
0 - None	0 - None
Scale (Extent)	**Probability**
5 – International	5 – Definite / Unknown
4 – National	4 – Highly probable
3 – Regional	3 – Medium probability
2 – Local	2 – Low probability
1 - Site only	1 – Improbable
0 – None	0 – None

* Impact ceases after operational life of the activity

Once the above factors had been ranked for each impact, the overall risk (environmental significance) of each impact will be assessed using the following formula:

Significance (SP) = [Magnitude (M) + Duration (D) + Scale(S)] x Probability (P)

The maximum value is 100 significance points (SP). Environmental impacts will be rated as either that of High, Moderate or Low significance on the following basis:

- SP ≥60: Indicates **high** environmental significance;
- SP 31 ≥ 59: Indicates **moderate** environmental significance;
- SP ≤ 30: Indicates **low** environmental significance.

3 RECEIVING ENVIRONMENT

3.1 Study Site Location

The study site consists of the existing road and road reserve of the R504 Section 4, between Leeudoringstad and the Vaal River bridge crossing (North West / Free State Provincial Border). The study site is within the Maquassi Hills Local Municipality, Dr Kenneth Kaunda District Municipality, North West Province. The road (study site) starts at the R502/R504 intersection just outside of Leeudoringstad (km 0.0) and ends on the east side of the bridge crossing the Vaal River (km 24.1) (Figure 1, Figure 2).

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

- Leeudoringstad: 27°13'58.66"S; 26°14'31.21"E.
- Vaal River Bridge: 27°19'52.39"S; 26°27'24.35"E.
- Start of Section 4 (R502/R504 Intersection) (KM 0.0): 27°14'5.39"S; 26°15'17.49"E.
- End of Section 4 (KM 24.1): 27°19'55.04"S; 26°27'36.27"E.
- Quarter Degree Square (QDS): 2726AB; 2726AD.
- Quaternary Drainage Area (QDA): C25A; C24J.

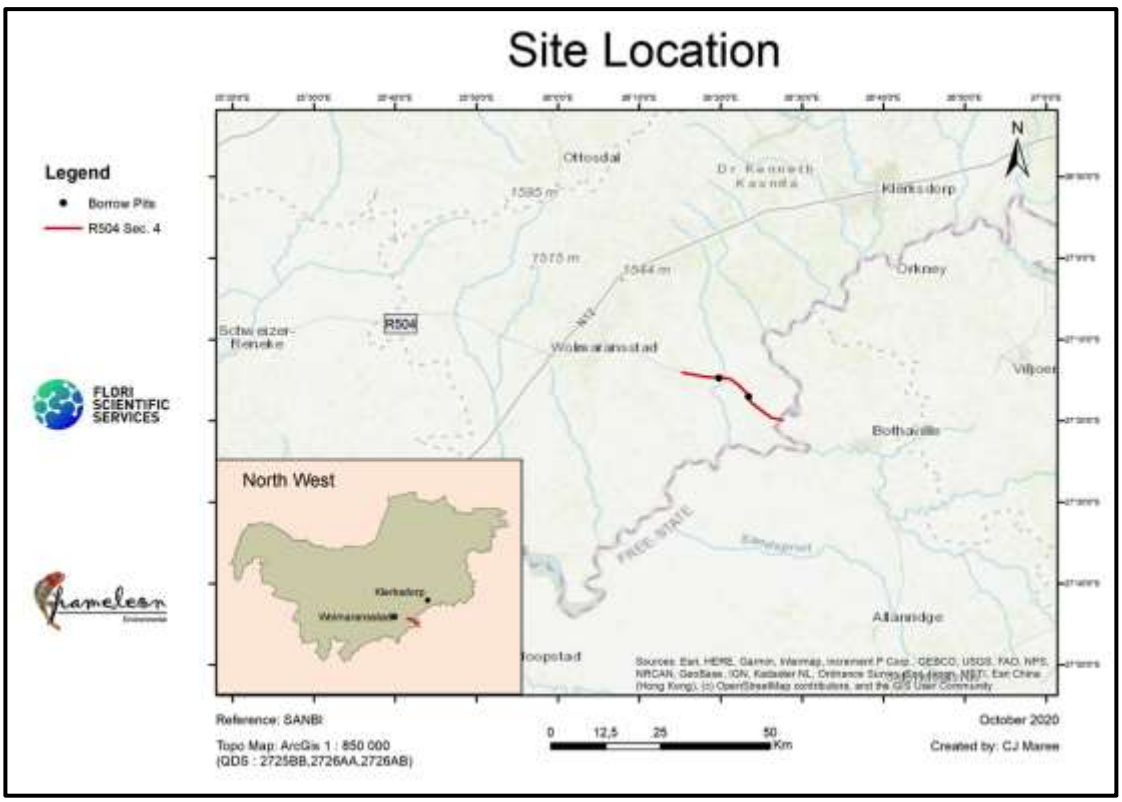


Figure 1: Study site location

Figure 2: Site location (Google Earth)

3.2 Topography

The topography of the area is predominantly that of flat to gently undulating plains, and no mountains, hills or ridges. The average height (metres above sea level –masl) across the length of the study site is approximately 1 296 masl. The lowest point in the study area is on the Vaal River at about 1 252 masl, and the highest point is in the area of the R502/R504 intersection at the start of Section 4, which is about 1 317 masl. The average slope or gradient across the length of the study site is 0,6% - 0,8%.

3.3 Geology and Soils

The basic geology and soils of areas within Vaal-Vet Sandy Grassland Veldtype / Ecosystem is that of aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms in the study site and region of Vaal-Vet Sandy Grassland are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba (Mucina & Rutherford, 2006). The soils are typically structureless (fine) and red and/or yellowish in colour.

Short descriptions of the prominent landtypes of the study area are shown below (Table 6).

Table 6: Description of land types found in the region

Land Type	Description
Ae	RED-YELLOW APEDAL, FREELY DRAINED SOILS (Red, high base status soils, > 300 mm deep, without dunes). Moderately deep (average 500-1200 mm) red, freely drained, apedal (= structureless) soils. Soils occur in areas associated with low to moderate rainfall (300-700 mm per annum) in the interior of South Africa and have a high fertility status. A wide range of texture occurs (usually sandy loam to sandy clay loam).
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.

3.4 Climate

The climate of the study site is that of a warm-temperate summer rainfall climate with an average mean annual precipitation (MAP) of around 530 mm. The summer days can be warm to hot, with winters that are very dry with cool to cold nights and frequent frost, especially in the lower lying areas, such as in the vicinity of the Vaal River.

The average annual temperature for Wolmaransstad is 17.6°C. The warmest month, on average, is January with an average temperature of 23.5°C. The coolest month on average is June, with an average temperature of 9.9°C (weatherbase.com). The average rainfall for the year in Wolmaransstad is 533.4 mm. The month with the most precipitation, on average, is January with 96.5 mm. The month with the least precipitation, on average, is July with an average of 5.1 mm (weatherbase.com). Climatic data for Leeudoringstad tends to suggest that the area is drier than Wolmaransstad, and that the average annual rainfall is closer to about 353 mm.

The study site is within the medium rainfall region of South Africa (401 mm – 600 mm) and in the Cold Interior Climatic Zone of the country (Figure 3, Figure 4).

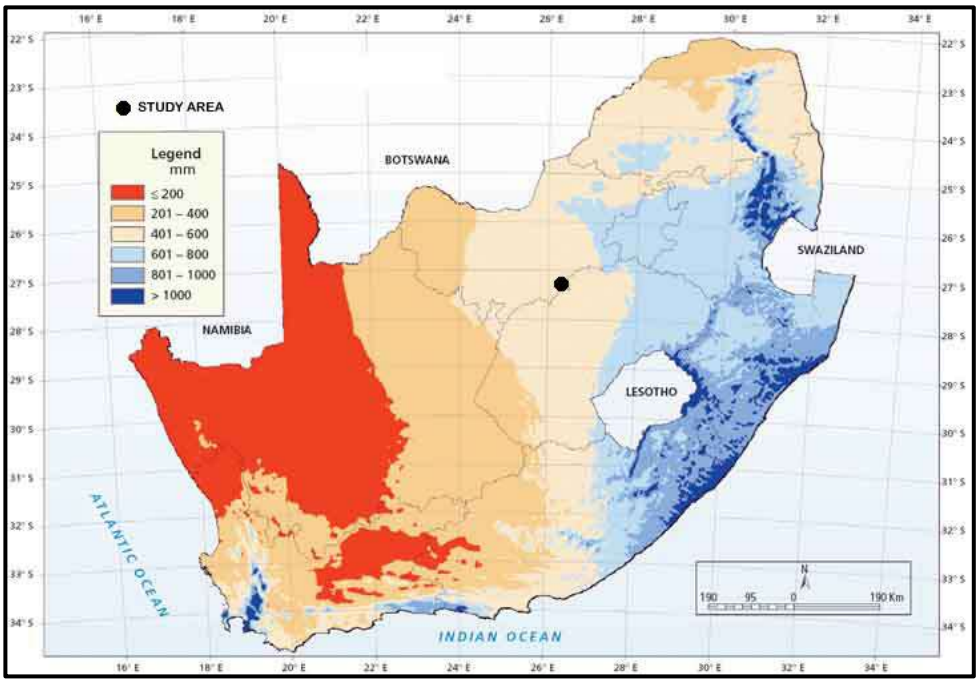


Figure 3: Rainfall zones of South Africa

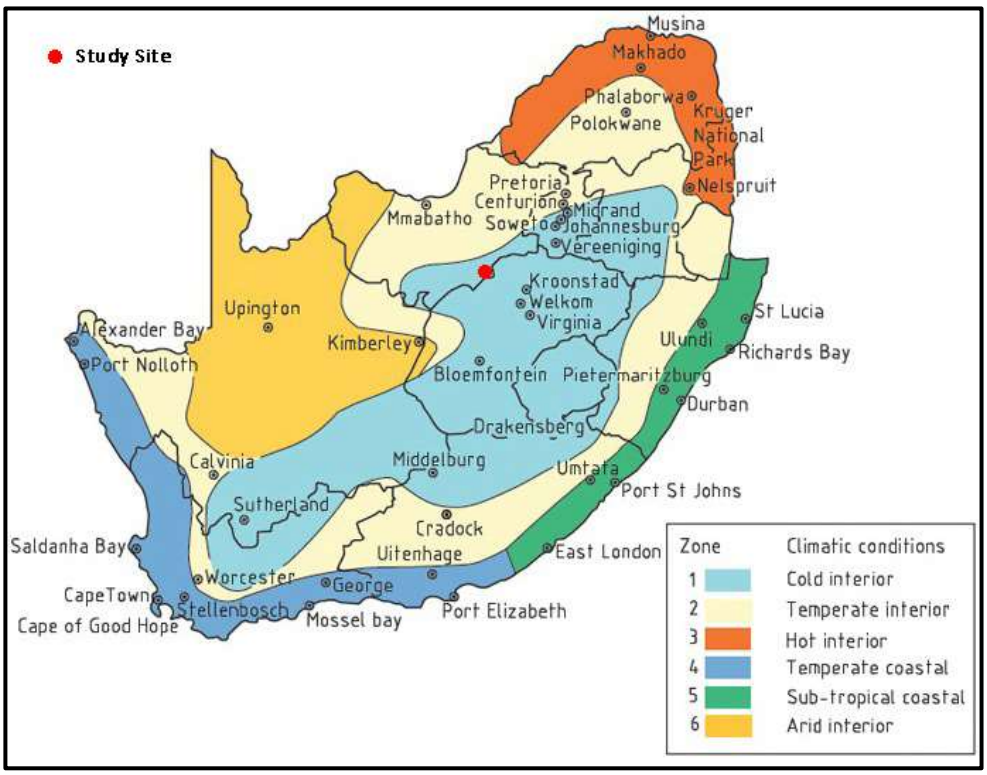


Figure 4: Climatic zones of South Africa

3.5 Land cover

The land cover or land use of the study site is almost entirely that of an existing national hard-surfaced carriageway (road), which is the R504 between Leeudoringstad and the Vaal River. Besides the hard asphalt surface, the road reserve is fenced and routinely cleared of any trees; the grass cut and kept short; and oftentimes burnt by contractors or landowners to create firebreaks. In other words, the study site is predominantly that of a transformed ecosystem with a land use of road infrastructure.

The overwhelmingly dominant land use in the region of the study site is that of highly commercialized cultivated farmlands, with low levels of urban density, except in the small towns and settlements such as Leeudoringstad, Witpoort, etc. Farmlands used for the grazing of livestock are also a significant land use in the region.

4 TERRESTRIAL ECOLOGY

4.1 Vegetation

The study site is situated in the Grassland Biome of South Africa (Figure 5). The site is within the original extent of the veldtype (or ecosystem) known as Vaal-Vet Sandy Grassland (Figure 6), which is within the Dry Highveld Grassland Bioregion of the Grassland Biome.

The riparian vegetation along the Vaal River is sometimes described or delineated as a separate veldtype, namely Highveld Alluvial Vegetation. However, the species are mostly common to the veldtype in which it is embedded, but often richer and denser. The vegetation is basically riparian vegetation within richer, alluvial soils along the length of the riverbanks.

The hierarchy of the vegetation units (veldtypes) in which the study site is situated is shown below in Table 7.

Table 7: Hierarchy of vegetation of the study site

Category Description	Classification
Biome	Grassland
Bioregion	Dry Highveld Grassland
Vegetation Types	Vaal-Vet Sandy Grassland
Conservation Status	Vaal-Vet Sandy Grassland: Endangered (Threatened ecosystem)

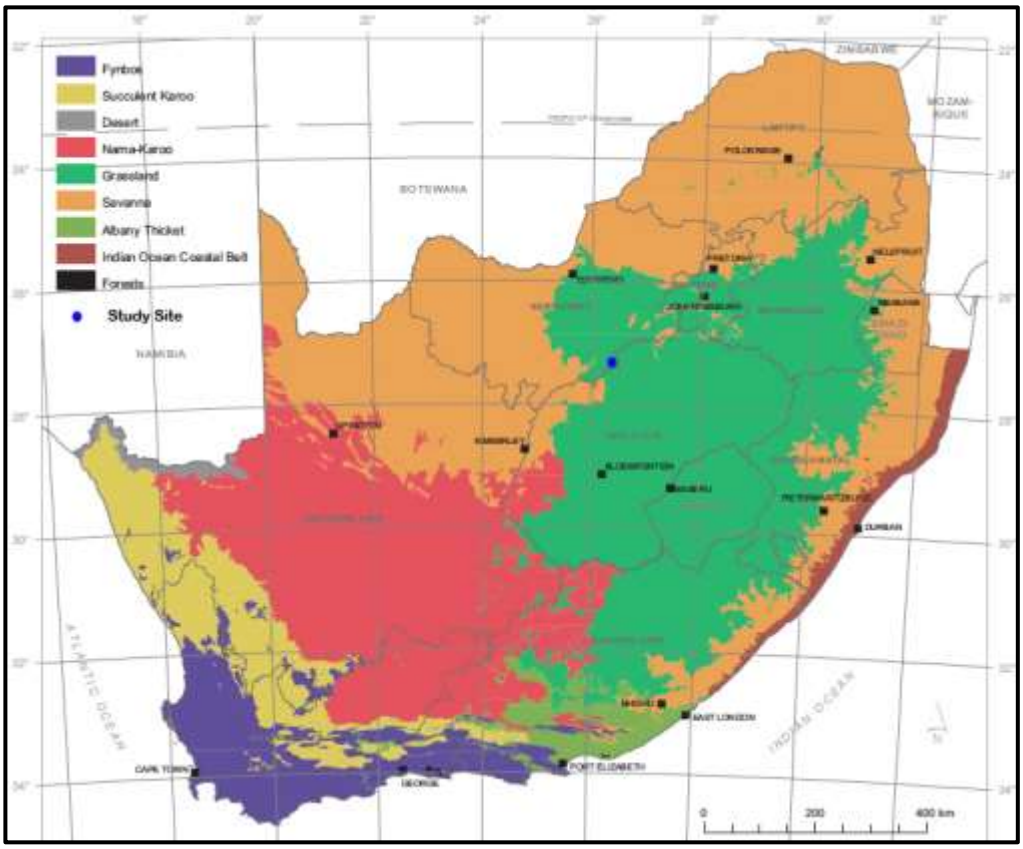


Figure 5: Biomes of South Africa

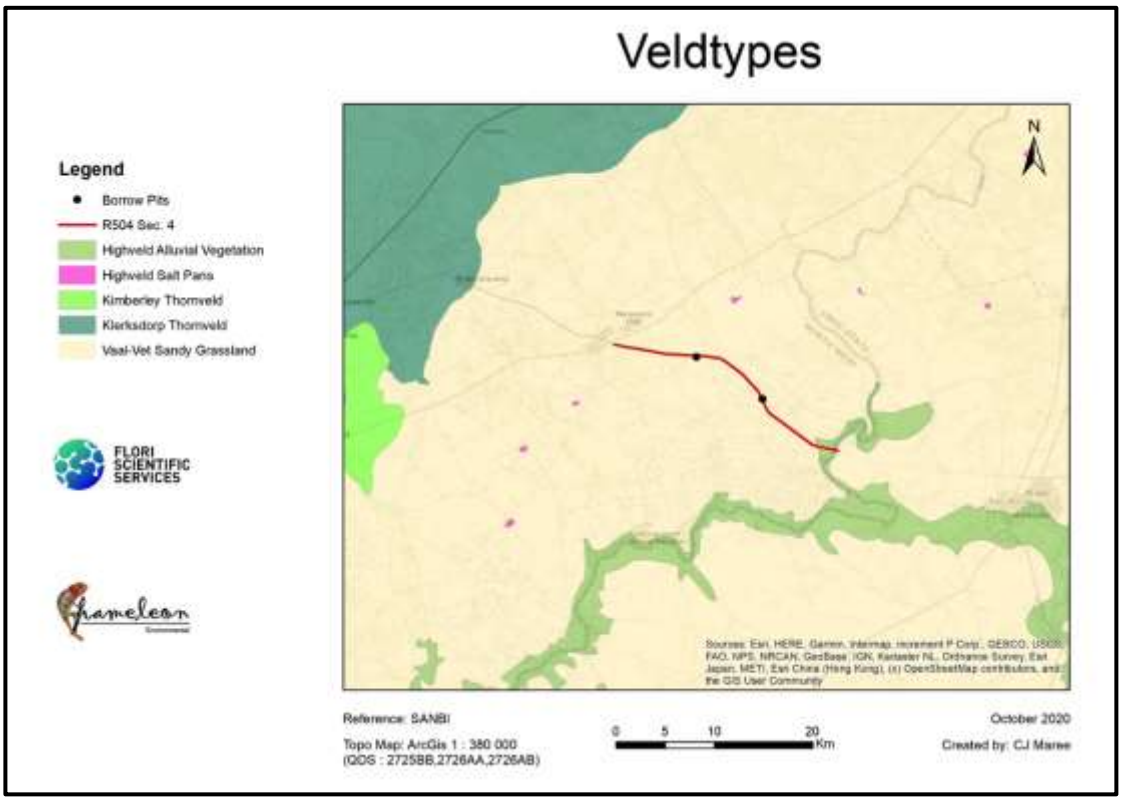


Figure 6: Veldtypes

Vaal-Vet Sand Grassland is characterised by a landscape that is dominated by open flat plains, with some scattered, slightly irregular undulating plains and hills. The vegetation is mainly low-tussock grassland with an abundant karroid element (Karoo related plants that grow in the drier semi-desert areas of the country). Dominance of *Themeda triandra* (Red grass) is an important feature of this vegetation unit (veldtype). Locally low cover of *Themeda triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

4.1.1 Vegetation of the study site

The entire study site is within the original extent of Vaal-Vet Sand Grassland. However, much of the vegetation in the region and area of the study site has been transformed over many years by cultivated farmlands that are regularly ploughed. The vegetation and species-mix of the study site itself is also highly transformed and degraded due to the nature of the study site. That is, consisting of a hard-surface national road and a road reserve, that although consisting mainly of grass is regularly cut or burnt. Young trees are thereby usually also destroyed. This is necessary as part of the road maintenance to keep the road clear of obstacles and maintain safety for motorists. Farmers also routinely burn grassland along farm boundaries and in the road reserve as important firebreaks. The result is that there is no pristine or characteristically identifiable Vaal-Vet Sandy Grassland present in the study area. The activities also results in a drastic reduction in the amount of species present, with typically only a few becoming dominant and well established.

No Red Data Listed (RDL) plants were observed during field investigations and it is highly unlikely that any occur. Two ODL (or priority pants) were observed in the general area of the study site, namely, *Hypoxis hemerocallidea* and *Boophone disticha*. Hypoxis are found in wetter grassy areas, while Boophone are found more in rocky soils and areas. A few species of Hypoxis could likely be present in the study area, in the road reserve, but it is unlikely that any will be damaged or destroyed by proposed project activities. However, during the construction phase it is still advisable to be aware that they are in the region and avoid any if encountered.

4.1.2 Protected trees

No protected trees are present within the study area.

According to the National Forests Act (Act No. 84 of 1998): *"No person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister."*

Any removal or pruning of these species will require a license to be issued from the administrators of the National Forests Act. These act as an extension of the Department of Agriculture, Forestry and Fisheries (DAFF).

4.2 Conservation status

Vaal-Vet Sandy Grassland is a threatened ecosystem with a status of 'Endangered' (GN 1002 of 9 December 2012). A short summary of the veldtype is given in the table below (Table 8).

Table 8: Veldtype status

Veldtype	Status	Information
Vaal-Vet Sandy Grassland	Endangered (EN)	Only about 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3% of the area) to low (11% of the area) (Mucina & Rutherford, 2006, 2010).

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). The criteria for determining the status of an ecosystem (or veldtype) are shown below in Table 9, with the levels or structure shown in Figure 7 (Mammal Red List, 2016).

Table 9: Ecosystem Status: Simplified explanation of categories used

STATUS	% Transformed	Effect on Ecosystem
Least Threatened (LT) / Least Concerned (LC)	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.

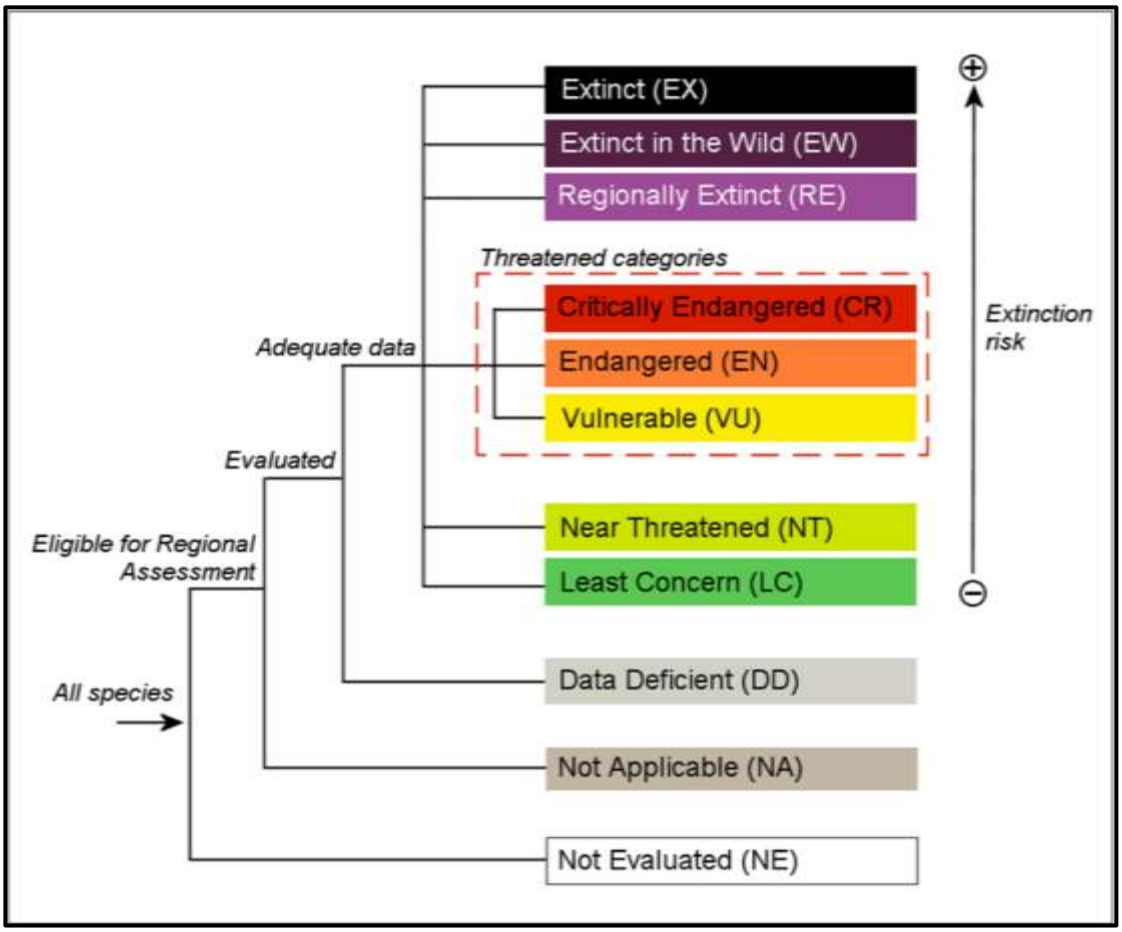


Figure 7: Structure of categories used at the regional level

4.2.1 Alien plants identified in the Study Area

A few alien plant species were identified in the study area. The main species present in the area are: *Cylindropuntia imbricata, Opuntia humifusa, Opuntia ficus-indica, Agave americana, Melia azedarach, Tagetes minuta and Solanum elaeagnifolium.*

Note: Alien species observed in the small towns around homes or within gardens were not included in the list of weed species found in the more open farmlands and grasslands of the study site.

The categories are as set out in the Conservation Act of Agricultural Resources Act, 1983 (CARA) (Act 43 of 1983) and more recently NEM:BA, 2004 (Act No. 10 of 2004): Alien Invasive Species List 2016).

Table 10: Alien plants identified in the study area

Botanical Name	Common Name	Category
Agave americana	Century plant	2
Bidens pilosa	Blackjacks	-
Conyza canadensis	Horseweed fleabane	-
Eucalyptus spp.	Gum tree	1
Melia azedarach	Syringa	3
Opuntia ficus-indica	Prickly pear	1
Opuntia humifusa	Large-flowered prickly pear	1
Parkinsonia aculeata	Jerusalem thorn	1b
Solanum elaeagnifolium	Silverleaf bitter apple	1
Tagetes minuta	Khakibos, kahki weed	-

4.3 Fauna

4.3.1 Mammals

Potentially the diversity of mammals in the study area and surrounding regions of the dry highveld grasslands is medium to high. From previous studies and documents of original distribution approximately 54 terrestrial mammals and 9 bats can potentially be found in the greater region.

There are also a few game farms, west of the study site, in the vicinity between Wolmaransstad and Leeudoringstad, but closer to Wolmaransstad. Therefore, a number of large mammal species will be kept on these farms. The fencing is good and it is unlikely that many of these species will be found permanently within the actual study site. However, many wild animals are highly mobile and often dig under fencing or get passed it by some other means. There are no ideal habitats within the study site itself. However, due to the nature of a road running through open veld, watercourses, farmlands and game farms it is more than likely that mammals will be encountered on occasion within the study site or crossing the road, which especially at night creates a danger both for animals and motorists alike. The most ideal habitats for the presence of wild mammals, and other species in close proximity to the study site (R504 Section 4) are the watercourses, which include small, seasonal streams and small freshwater pans. The Vaal River is a very important and sensitive habitat on the outer edge of the study site.

Species previously recorded in the region of Wolmaransstad include South African Ground Squirrel, African Mole Rat, Steenbok, Cape Porcupine, Aardvark and Scrub Hare (Savanna Environmental, 2015).

Priority mammals, which may occur in the greater area, include the White-tailed Mouse *Mystromys albicaudatus* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed Cat *Felis nigripes* (Vulnerable), Honey badger *Mellivora capensis* (IUCN LC, SA RDB EN), South African hedgehog *Atelerix frontalis* (SA RDB NT) and Ground Pangolin *Smutsia temminckii* (VU) (Savanna

Environmental, 2015). Aardvark (Antbear) *Orycerοpus afer*, although not a threatened species, is protected and possibly is also found in the greater area. No mammals, or other fauna, may be killed or interacted with by contractors (Savanna Environmental, 2015). Cape clawless otter *Aonyx capensis* (NT) and Spotted-necked otter *Lutra maculicollis* (VU) could both potentially occur in the area of the Vaal River.

No RDL or priority mammal species were encountered during the site investigations for this study.

4.3.2 Avifauna

The study site is not within, or close to, any Important Bird Areas (IBAs). Previous counts and recordings taken from SABAP1 and SABAP2 databases show that around 190 birds have previously been recorded in the greater area and region of the study site. From these lists, 8 IUCN-listed species are potentially found in the area from time to time, keeping in mind that most birds are highly mobile and can cover vast distances in search of food or during times of migration.

Priority species, which have been observed in the region, include the Greater flamingo (*Phoenicopterus roseus*); Lesser flamingo (*Phoenicopterus minor*); Lesser kestrel (*Falco naumanni*); and Black-shouldered kite (*Elanus caeruleus*). Flamingoes feed long hours in shallow pans and this becomes an essential habitat for them. There are a few small pans scattered throughout the area. Lesser kestrels are summer visitors (migrants) that are found over most of South Africa during the summer months. Black-shouldered kite (*Elanus caeruleus*) is another 'common' priority raptor species that is found fairly regularly throughout the larger region of the study site. They are often seen hovering (kiting) over farmlands or sitting on telephone poles and wires.

Like many other faunal species, roads are a high danger risk potential for birds. This is even more prevalent and dangerous for nocturnal species such as owls and nightjars. However, as already noted, the study site is not within an important bird area. It is therefore unnecessary to erect caution signs for owls as occurs on some roads in South Africa.

4.3.3 Reptiles

There are potentially quite a few reptiles present in the greater region. According to previous studies as many as 45 species are present in the region. However, to date, no RDL or priority species have been identified in the study area. Habitat diversity is the study site is very low and no real ideal habitats are present, or large enough to continually sustain any significant populations of reptiles. One of the main reasons being the extensively transformed grasslands and natural habitats by cultivated farmlands. Reptiles usually favour rocky areas, such as the Maquassi Hills (to the west of the study site) or marshy, wet areas. As a result, most species encountered in the study are likely to be common species associated with open ground or areas with low levels of tree cover.

4.3.4 Amphibians

A total of 14 amphibians are known to have originally occurred in the greater area, with the majority of species being common species. There are no endemic species in the study area or surrounds. Giant Bullfrog *Pyxicephalus adspersus*, which is listed as Near Threatened or Least Concern, is a priority species that does occur in the region in wetlands or freshwater pans. It is more than likely that some animals are present in the larger stream crossings and pans in the area, but less likely within the study area itself.

4.3.5 Faunal Hotspots

The maps below show the areas in South Africa that are hotspots for faunal species of conservation concern (priority species) for snakes, lizards and butterflies (Figure 8, Figure 9, Figure 10). The study site is not situated within any quadrants that are hotspots for snakes, lizards or butterflies.

The topography and climate of the study area are not ideal for many species of butterflies and lizards. Butterflies tend to be very specific as to the host trees or shrubs they lay their eggs on and the study site is all but void of trees and shrubs. Lizards ideally prefer rocky outcrops, ridges with good cover and enough vegetation, which lures in potential prey / food for them. The best habitat in the region for lizards and snakes are the Maquassi Hills, between Wolmaransstad and Witpoort, which is a few kilometres west and outside of the study site and therefore not an issue. Another ideal habitat is along the Vaal River and associated riparian zone.

Figure 11, below, shows a complete set of expert map features gathered and overlaid for the North West Province (NWP Biodiversity Conservation Assessment Technical Report, 2009). The map shows that there are potentially no significant presences of listed priority species or habitats, with the exception of the Maquassi Hills, east of Wolmaransstad and west of the study site.

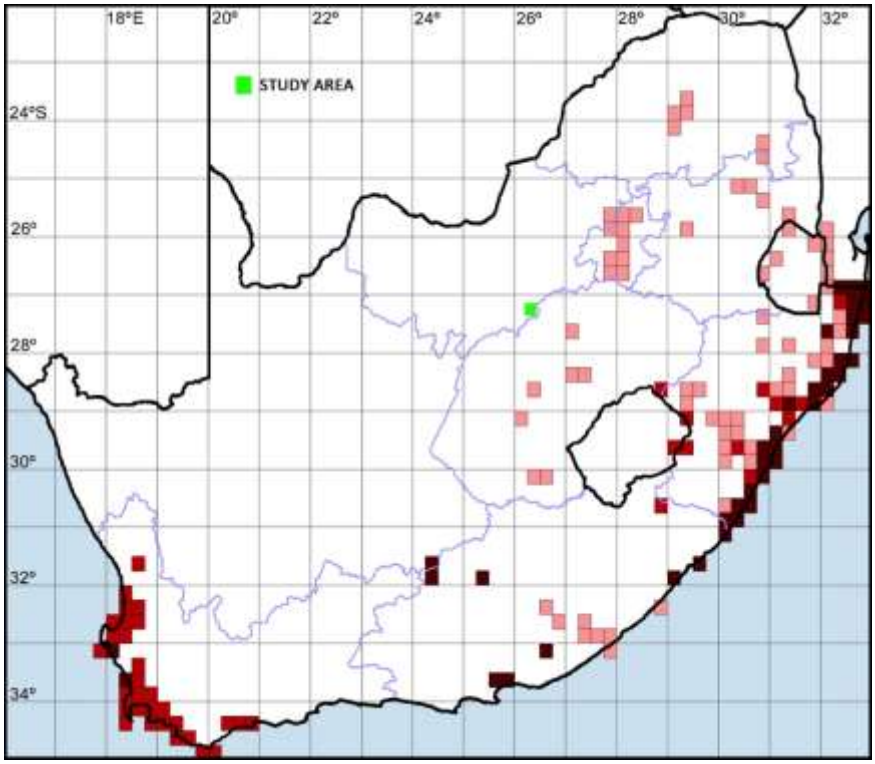


Figure 8: Snake hotspots

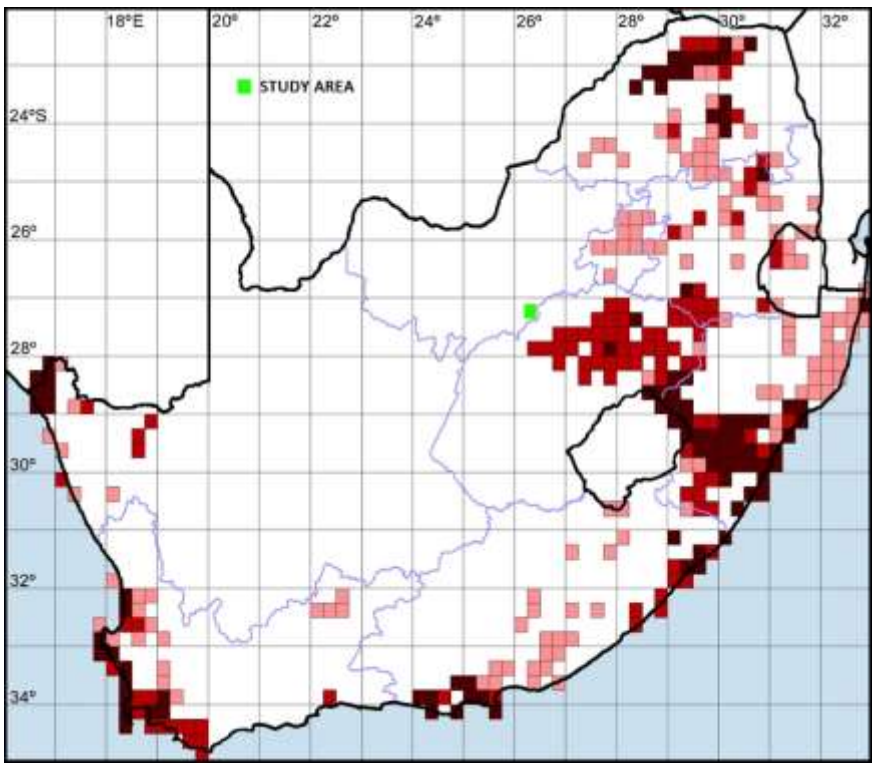


Figure 9: Lizard hotspots

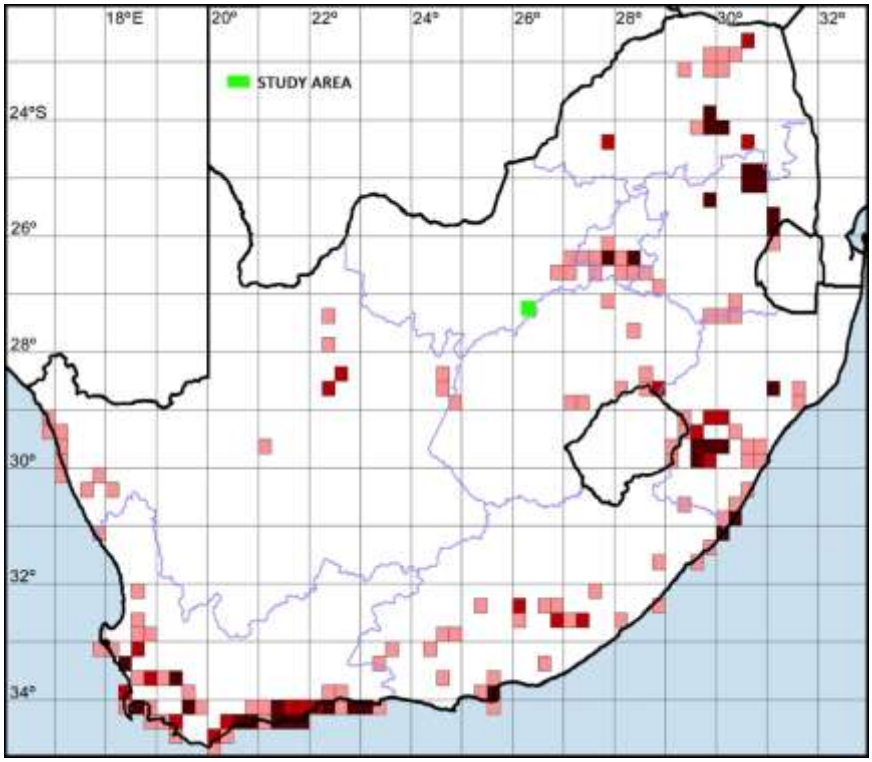


Figure 10: Butterfly hotspots

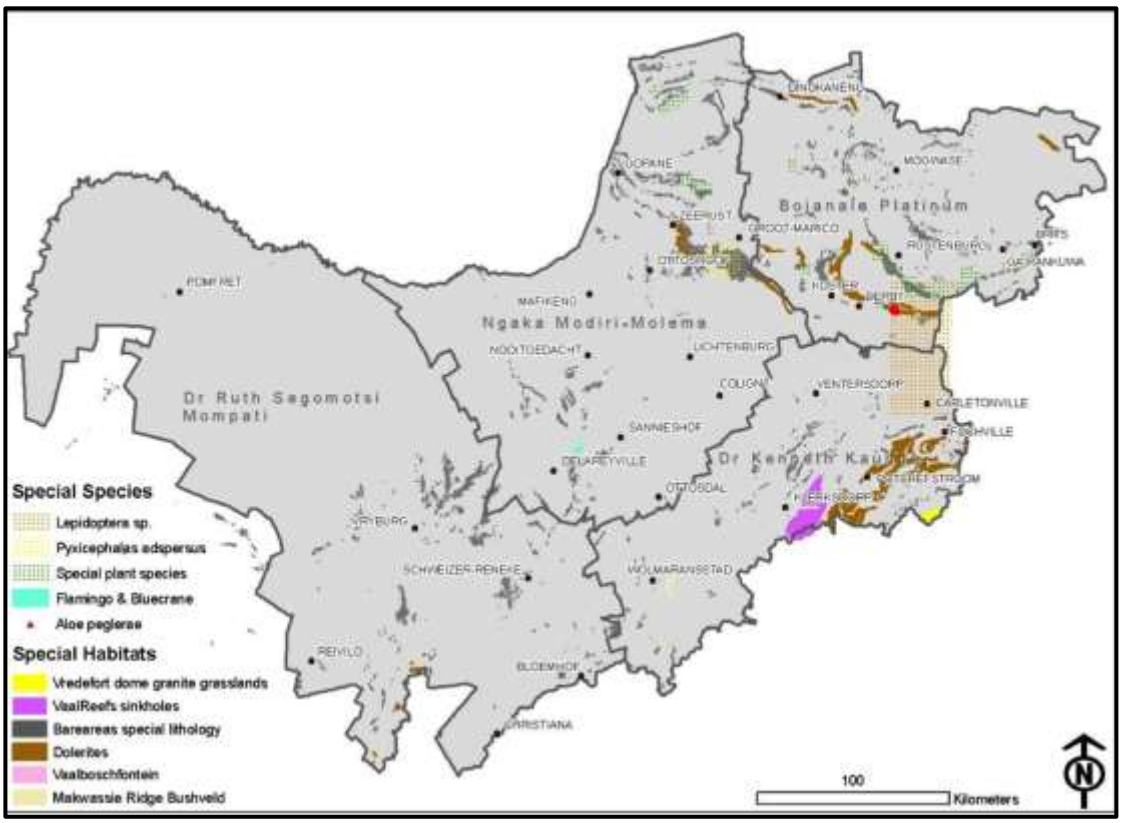


Figure 11: Special habitats and priority Faunal species mapped for NW Province

5 AQUATIC ECOLOGY

The aquatic ecology focuses on the natural surface water (watercourses) within the study site. These watercourses include wetlands, rivers, streams, pans, lakes and natural drainage lines. Manmade structures such as dams or canals are also considered, although these are not necessary as sensitive as natural systems. A pan (freshwater and saltwater) is 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. All watercourses in South Africa, regardless of their actual condition or ecological state are, by default, viewed as sensitive.

5.1 Watercourses in the study area

The study site crosses over three main rivers or streams, namely the Leeudoringspruit (stream), Klipspruit and Vaal River. The Study Site, R504 Section 4, crosses over two Quaternary Drainage Areas (QDAs) or Catchments, namely, C25A and C24J, when moving from West to East, respectively. The R504 Section 4, starts just outside and east of the small town of Leeudoringstad, crosses over the Leeudoringspruit, then the Klipspruit and finally ends just across the Vaal River. The rivers / streams and boundaries of the QDAs are illustrated below in Figure 12.

There are a number of freshwater pans scattered throughout the region and although the road is within close proximity to some of them, it does not cross through any pans. The project and related activities will also not impact on any wetlands, including pans.

Figure 12: Main rivers in the area

The Leeudoringspruit is a tributary of the Klipspruit. The Klipspruit is a tributary of the Vaal River. Leeudoringspruit and the Klipspruit flow in a Southerly direction. These are semi-perennial rivers or streams and the main river is the large, perennial Vaal River, which is part of the Middle-Vaal of the Vaal River Water Management Area and is managed by the Bloemfontein, Free State Province Department of Water and Sanitation Office. The Vaal River flows in a Westerly direction in this area. No significant wetlands, including pans were identified within the road reserve or which the road crossed over. However, the area immediately west of the Vaal River near the end of the study site shows a few seasonal drainage lines that are demarcated as unchannelled valley bottom wetlands.

Figure 13, below, is taken from the latest dataset of watercourses and identifications, namely the National Wetland Map 5 (2018).

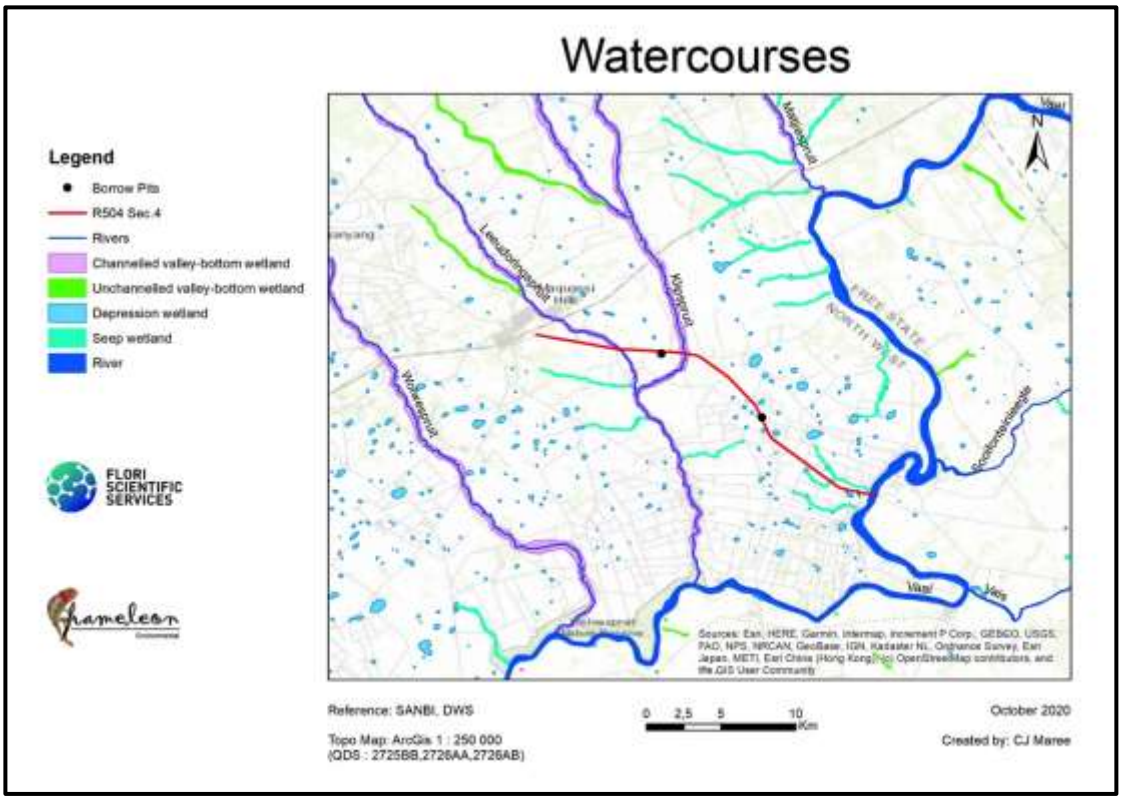


Figure 13: Watercourses (National Wetland Map 5, 2018)

5.2 Classification of watercourses in the study area

There are no perennial rivers, streams or wetlands in the study area itself, namely the existing road and road reserve. However, there are three significant watercourses (watercourse crossings) along R504 Section 4. Two of which are over non-perennial streams (Leeudoringspruit and Klipspruit) and the third over a large, perennial river (Vaal River). These streams and river do pass under the road through existing culverts, pipes, bridges, etc. which will most likely not be altered or upgraded in any way that will have additional impacts on the watercourses, or require activities / work within the watercourses themselves outside of the road reserve. The study area is extremely flat and there are a number of small culverts / pipes that allows for stormwater to flow under the road, so that the road does not impede the natural surface flow and direction of stormwater / rainfall.

The watercourses were identified and delineated during field investigations, 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) (Table 11, Table 12).

Table 11: Classification levels 1 - 4

LEVEL 1 System	LEVEL 2 Regional setting	LEVEL 3 Landscape Unit	LEVEL 4 HGM Unit	
			HGM Type	Landform

	(Ecoregion)			
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 12: Classification of Watercourses

Delineated systems	Level 1 System	Level 2 Regional Setting (Ecoregion)	Level 3 Landscape Unit	Level 4 HGM Unit
Leeudoringspruit	Inland	Dry Highveld Grassland Group 3	Plain	River (Lowland)
Klipspruit	Inland	Dry Highveld Grassland Group 3	Plain	River (Lowland)
Vaal River	Inland	Dry Highveld Grassland Group 3	Plain	River (Lowland)

5.3 Drainage areas

The study area is situated in the Primary Drainage Area (PDA) of **C** and across three Quaternary Drainage Areas (QDAs) of **C25A** and **C24J** (**Error! Reference source not found.**). The study site is ithin the Vaal Water Management Area (WMA 5) and under the jurisdiction of the Vaal Catchment Management Agency (CMA 5) (**Error! Reference source not found.**). The site is not situated within a

riority quaternary drainage catchment, in terms of guidelines and legislation from the Department of Water & Sanitation (DWS). The table below gives a summary of the catchment areas and management areas for the study site (Table 13).

South Africa is geographically divided up into a number of naturally occurring Primary Drainage Areas (PDAs) and Quaternary Drainage Areas (QDAs) (Figure 14). The different areas are demarcated into Water Management Areas (WMAs) and Catchment Management Agencies (CMAs). Previously there were 19 WMAs and 9 CMAs (Figure 15). As of September 2016, these were revised and there are now officially only 9 WMAs, which correspond directly in demarcation to the 9 CMAs (Figure 16) (Government Gazette, 16 September 2016. No.1056, pg. 169-172).
The study site is situated within the QDAs of C25A and C24J (Figure 17) and in the Wetland Vegetation Ecoregion of Dry Highveld Grassland (Figure 18).

Table 13: Summary of Catchment Areas for the study site

Level	Category
Primary Drainage Area (PDA)	C
Quaternary Drainage Area (QDA)	C25A, C24J
Water Management Area (WMA) – Previous / Old	Middle Vaal
Water Management Area (WMA) – New (as of Sept. 2016)	Vaal (WMA 5)
Sub-Water Management Area	Vaal Tributaries
Catchment Management Agency (CMA)	Vaal (CMA 5)
Wetland Vegetation Ecoregion	Dry Highveld Grassland Group 3
Strategic Water Source Area (SWSA)	No
Priority Quaternary Catchment	No
Fish FEPA	No (except Vaal River)
Fish FSA	No (except Vaal River)
Fish Corridor	No (except Vaal River)
Fish Migratory Corridor	No (except Vaal River)
Priority Quaternary Catchment	No

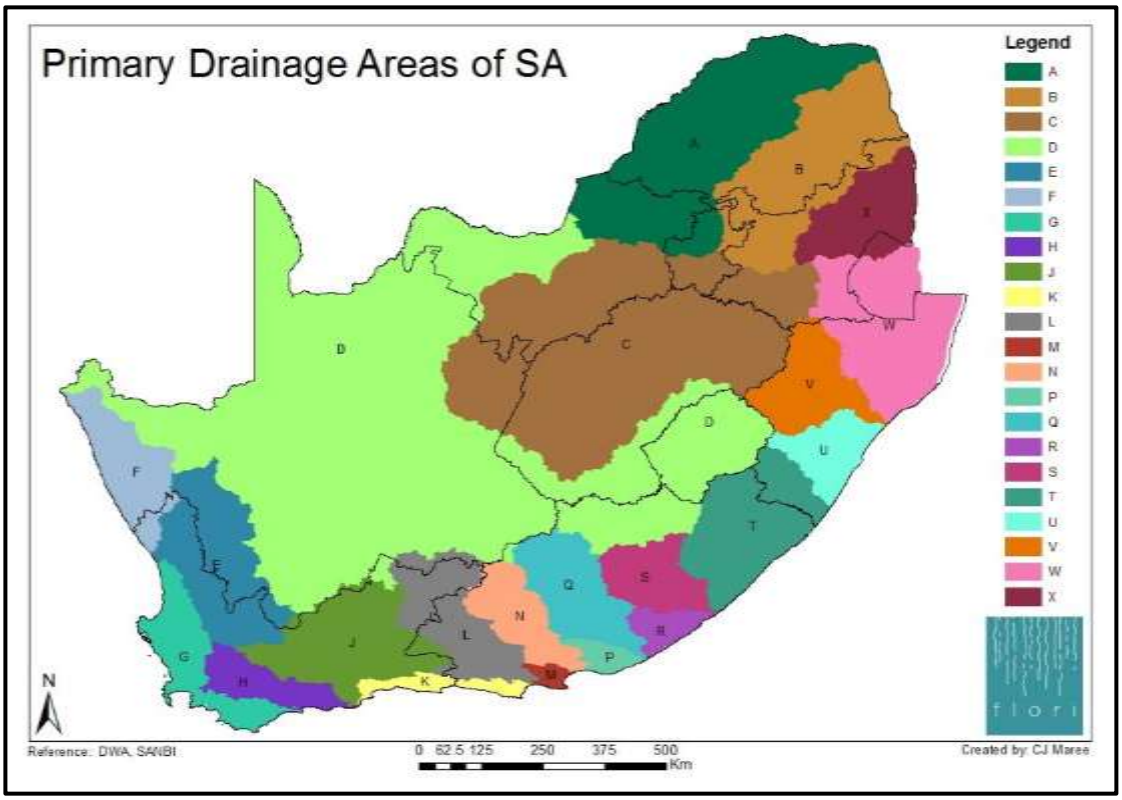


Figure 14: Primary drainage areas of South Africa

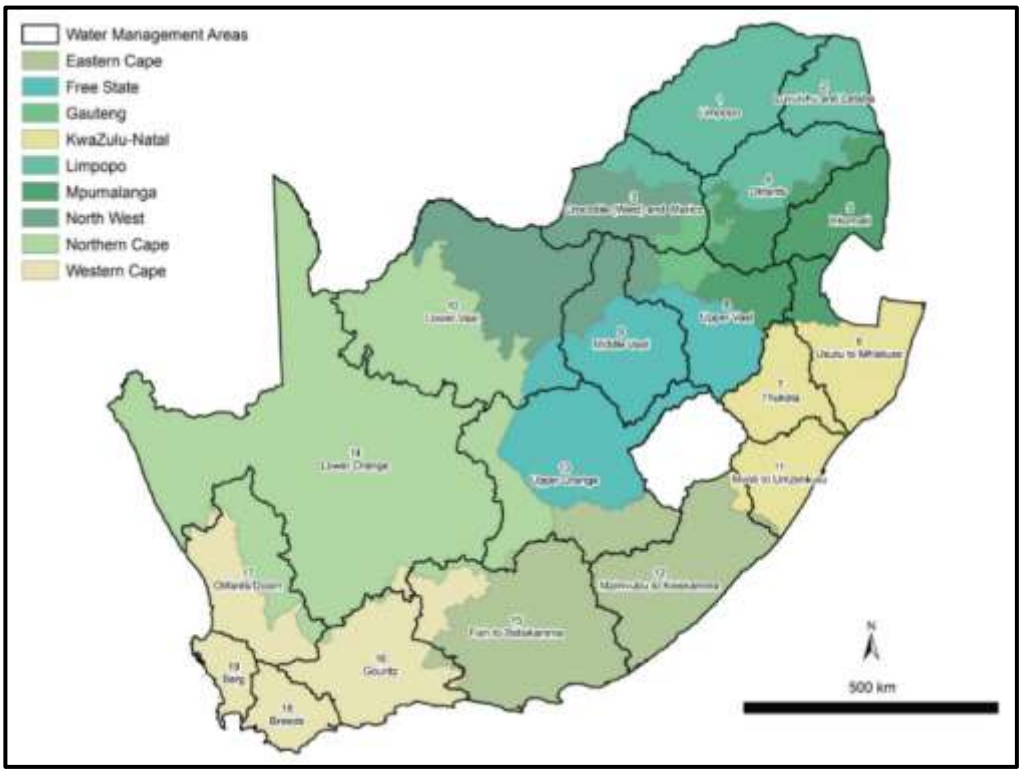


Figure 15: Old WMAs of South Africa

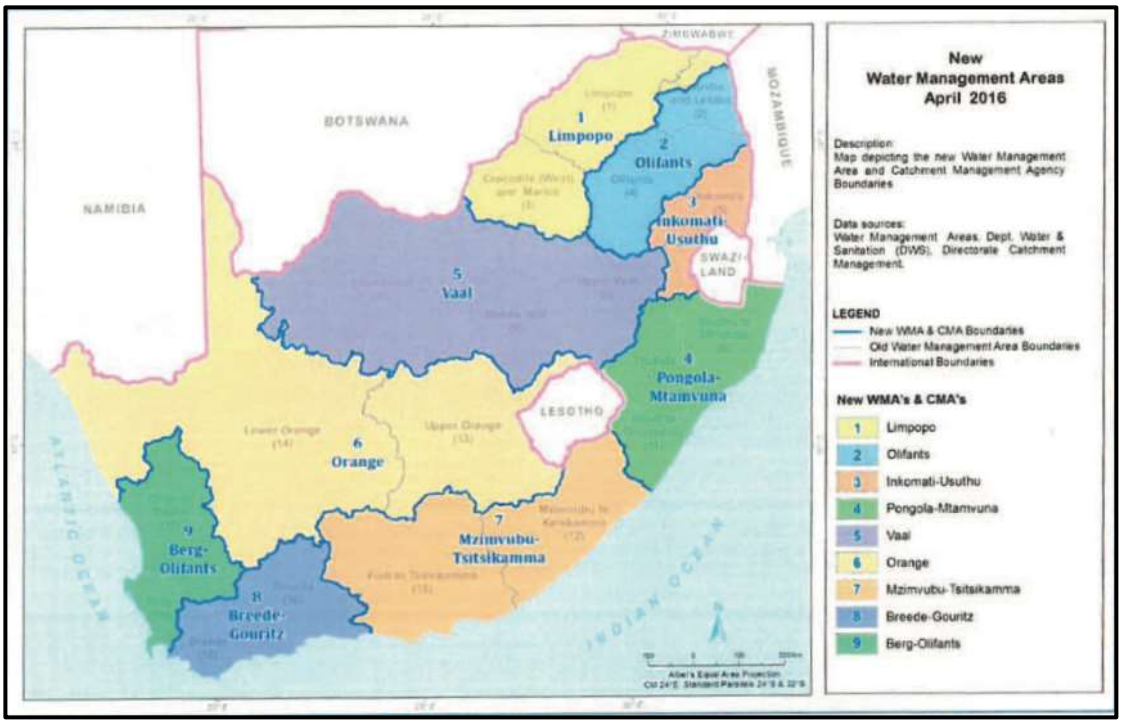


Figure 16: New WMAs & CMAs of South Africa

Figure 17, below, illustrates the project site across the Quaternary Drainage Areas (QDAs), and **Error! eference source not found.** illustrates the Wetland Vegetation Ecoregions.

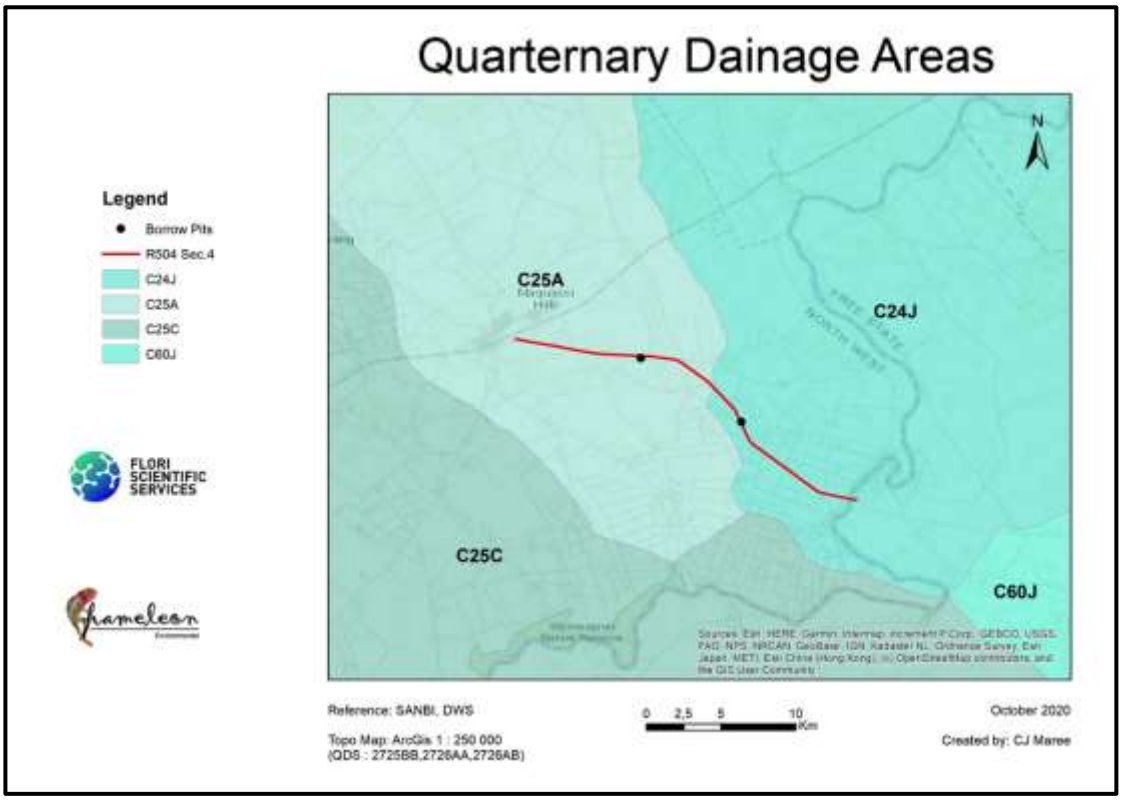


Figure 17: Quaternary drainage areas (QDAs)

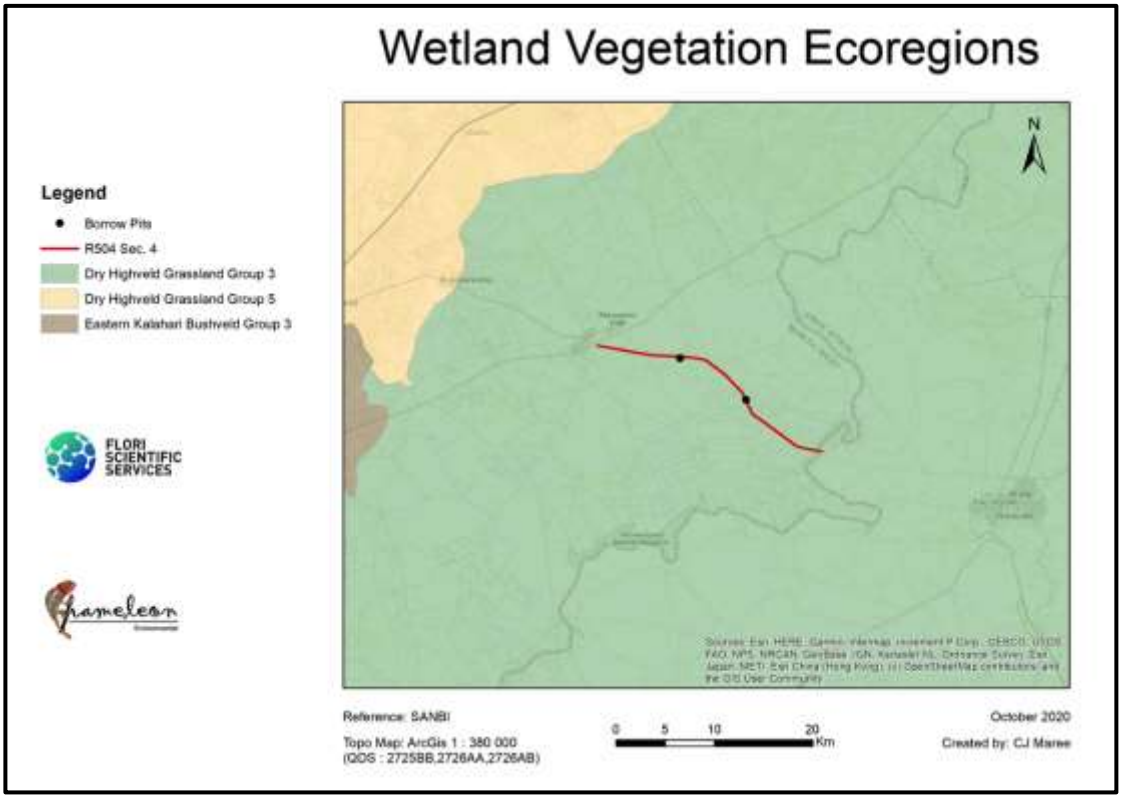


Figure 18: Wetland Vegetation Ecoregions

5.4 Strategic water source areas (SWSA) of South Africa

The study area is not situated within a national Strategic Water Source Area (SWSA) of South Africa (Figure 19). However, it must be clear that this area, in which the study site is located, is a dry part of the country and does not have significant surface water run-off or major rivers.

A national Strategic Water Source Areas of South Africa (SWSA) are those areas that supply a disproportionate amount of mean annual runoff in relation to the size of the geographical region. These areas are important because they have the potential to contribute significantly to overall water quality and supply, 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 (SANBI).

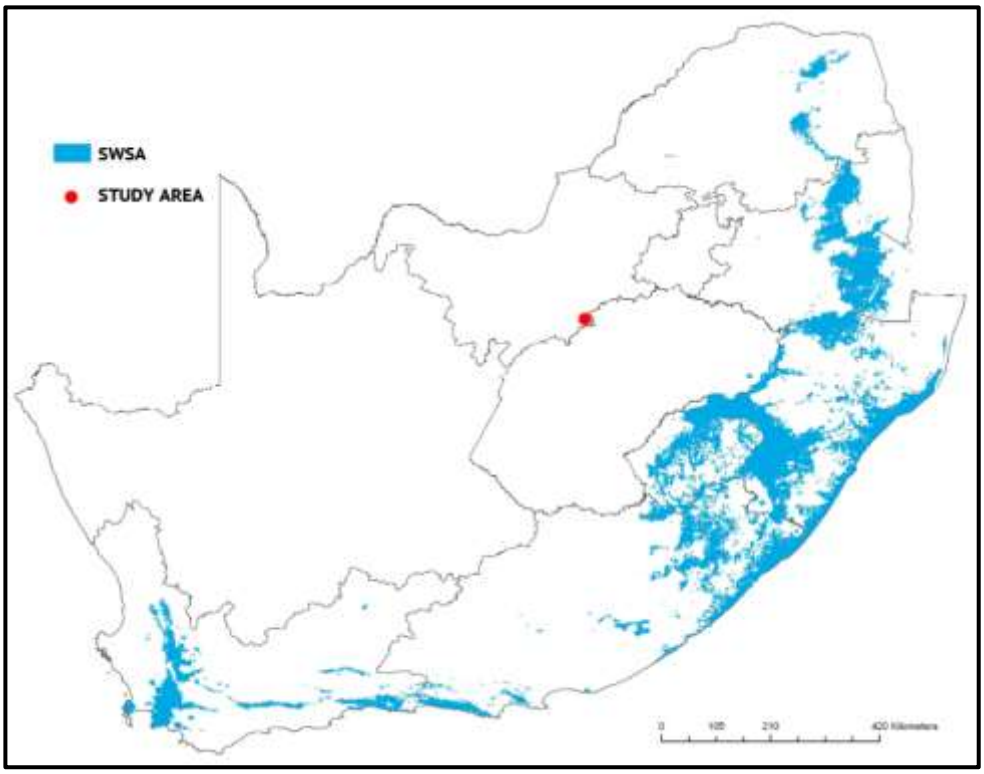


Figure 19: National SWSA of South Africa

A Water Source Area (WSA) is a water catchment or aquifer system that either supplies a relatively large volume of water for its size or is the primary source of water for a town, city or industrial activity. Strategic Water Source Areas (SWSAs) are defined as areas of land that either: (a) supply a disproportionate (i.e. relatively large) volume of mean annual surface water runoff (i.e. water in streams, rivers and wetlands) in relation to their size and so are considered nationally important; or (b) have relatively high groundwater recharge and groundwater forms a nationally important resource (has high levels of use or settlements depend on it); or (c) areas that meet both criteria (a) and (b). A SWSA is one where the water that is supplied is considered to be of national importance for water security, but there are others, which are considered to be of sub-national importance (WRC, 2019).

5.5 PES of watercourses in the study area

The assessment criteria and structure to determine the PES of watercourses 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. The present ecological state (PES) of the rivers/streams at the three crossings at the Leeudoringspruit, Klipspruit, and Vaal River were assessed and are shown in Table 14, below.

It is important to note the following:

- Leeudoringspruit is obviously being impacted on as can be seen by sludge/waste material in the bed of a narrow channel. Settlement of Kgakala, is 4.6 km upstream of the crossing and has a small sewage works that is seemingly discharging into the system (details need to be confirmed), but there is definitely an organic water quality impact on the watercourse. The Leeudoringspruit has a narrow active channel with a wider floodplain area, which has an influence on the terrestrial flora. That is, the terrestrial flora (eg. trees) is typically denser in these areas, but the species-mix does not change. In other words, the riparian vegetation is not distinct from the terrestrial vegetation.
- Klipspruit is less negatively impacted on. In the higher reaches of the river is dry-land farming in the form of cultivation taking place. The Klipspruit also has a narrow channel, but has a bigger flood plain because of a larger catchment area.
- The Vaal River is also included in the PES below, but the river has been highly impacted on but upstream developments (Gauteng) and water transfer schemes. The Vaal River acts largely as a conduit.

Table 14: PES of watercourses in the study area

Criteria	Identified Watercourses		
	Leeudoringspruit	Klipspruit	Vaal River
HYDROLOGY			
Flow modification	1	4	0
Permanent inundation	1	4	0
WATER QUALITY			
Water Quality Modification	2	3	0
Sediment Load Modification	4	3	1
GEOMORPHOLOGY			
Canalisation	3	4	3
Topographic Alteration	3	4	1
BIOTA			
Terrestrial Encroachment	3	4	1
Indigenous Vegetation Removal	3	4	1
Invasive Plant Encroachment	3	3	1
Alien Fauna	4	3	1
Over utilisation of Biota	3	4	3
Total:	40	40	11
Average:	2.7	3.6	1.0
Category:	**C**	**B**	**E**
Integrity (PES):	**Medium**	**High**	**Low**
PES Description	**Moderately Modified**	**Mostly Natural**	**Seriously Modified**
Recommended EMC	**C**	**B**	**E**

5.6 EIS of Watercourses in the study area

The EIS values of the watercourses were determined using the above methodology. The calculations and categories are shown for the rivers at the three crossings at Leeudoringspruit, Klipspruit and the Vaal River (Table 15).

Table 15: EIS and EMC values of watercourses

Determinant	Leeudoringspruit	Klipspruit	Vaal River	Confidence
PRIMARY DETERMINANTS				
1. Rare & Endangered Species	2	2	1	3
2. Populations of Unique Species	2	2	1	3
3. Species/taxon Richness	3	3	2	3
4. Diversity of Habitat Types or Features	3	3	2	3
5 Migration route/breeding and feeding site for wetland species	2	2	2	3
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	3
7. Sensitivity to Water Quality Changes	3	3	1	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	1	3
MODIFYING DETERMINANTS				
9. Protected Status	2	3	2	3
10. Ecological Integrity	2	3	2	3
TOTAL	24	26	16	-
AVERAGE	2.4	2.6	1.6	-
Overall EIS	**B**	**B**	**C**	**-**
Description	**High**	**High**	**Medium**	**-**

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, by default, even if they are badly degraded or if their actual ecological sensitivity rating is less sensitive. However, keep in mind that this does not necessary mean that watercourses are therefore, by default, 'no-go' areas. Areas or habitats have a higher conservation value (or sensitivity) based on their threatened ecosystem status, presence or ideal habitats for priority species (including Red Data Listed species), species-richness, distinctive habitats, etc. The final 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.

There are only three distinctive habitats within the general area, namely grasslands, watercourses and farmlands. However, there are only two habitats within the study site itself, namely, grasslands and watercourses. Farmlands are have an ecological sensitivity of 'Low'.

Note: The sensitivity analyses below are only looking at the distinctive ecosystems within the study site.

6.1 Floristic Sensitivity Analysis

Table 16: Floristic sensitivity analysis

Criteria	Distinctive habitats in the study area	
	Grasslands	Watercourses
Red Data Species	2	5
Habitat Sensitivity	2	7
Floristic Status	2	5
Floristic Diversity	2	5
Ecological Fragmentation	2	6
Sensitivity Index	20%	56%
Sensitivity Level	**Low**	**Medium**

6.2 Faunal Sensitivity Analysis

Table 17: Faunal sensitivity analysis

Criteria	Distinctive habitats in the study area	
	Grasslands	Watercourses
Red Data Species	2	5
Habitat Sensitivity	2	5
Faunal Status	2	5
Faunal Diversity	2	5
Ecological Fragmentation	2	6
Sensitivity Index	20%	52%
Sensitivity Level	**Low**	**Medium**

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 18). According to the analyses of the floristic, fanual and overall ecological sensitivities there are no high sensitivity areas or habitats. In other words, there are no 'No-Go' areas within the study area.

However, watercourses are, by default, considered sensitive and must be approached as such. Vaal-Vet Sandy Grassland is a threatened ecosystem with a status of 'Endangered', which also automatically increases the final sensitivity, even though in the area of the study site most has been transformed into cultivated farmlands. The actual road and road reserve has an ecological sensitivity of 'Low' due to its transformed and highly degraded status.

Table 18: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity
Grasslands	Low	Low	Low
Watercourses	Medium	Medium	Medium

6.4 Priority areas

6.4.1 National Priority Areas

The study area, which is only the existing road and road reserve, is not within any national priority areas (Figure 20).

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.

There are NPAES areas north of the study site. These areas are Vaal Grassland NPAES focus areas, many of which are situated within existing farmlands, such as cultivated lands and grazing areas for livestock. The project will have no impact on these NPAES areas at all.

According to the Protected Areas Register, which is maintained by the Department of Environment, Forestry & Fisheries (DEFF Website - https://portal.environment.gov.za) there are no protected areas in or within 5 km of the study site. The closest protected areas are south of the study site along the Vaal River.

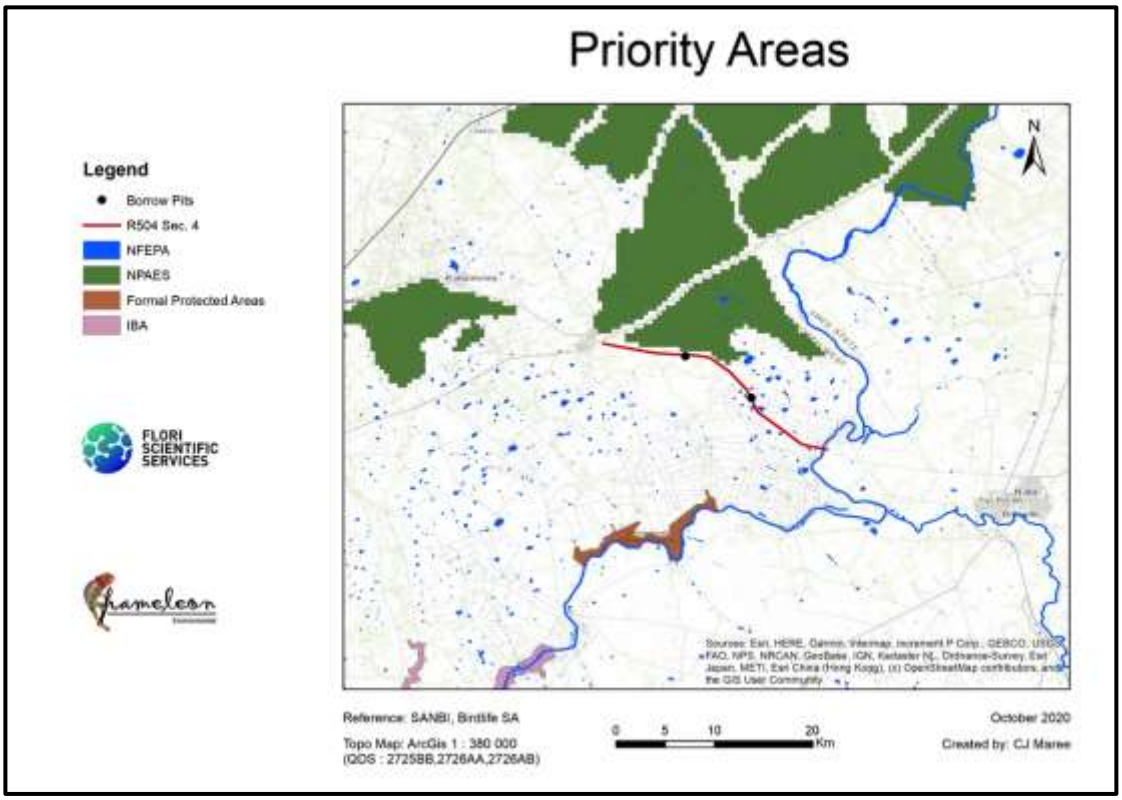


Figure 20: Priority areas

6.4.2 Critical Biodiveristy Areas and Ecological Support Areas

The study site itself is not within any sensitive habitats as it is within existing transformed areas that are predominantly hard-surface roads and transformed road reserves. According to the North West Province Biodiversity Sector Plan (2015), there are critical biodiversity (CBA) and ecological support areas (ESA) delineated areas across the area through which the study site runs (Figure 21). The various watercourses and freshwater pans are delineated as CBAs. Other areas are marked fairly confusingly and incorporate large areas of farmlands, which do not make complete sense. Some of the demarcated areas, such as those along the Vaal River that are delineated as CBAs incorporate wetland areas, which is understandable. It is also important to keep in mind that the general ecosystem of the area (Vaal-Vet Sandy Grassland) is highly threatened with a status of 'Endangered', which adds to the overall sensitivity and inclusion in CBA and ESA areas.

The project will have no negative impact on any CBAs or ESAs. No additional natural areas will be cleared or transformed either. Great care will be taken during construction work through these areas, even and across any watercourses.

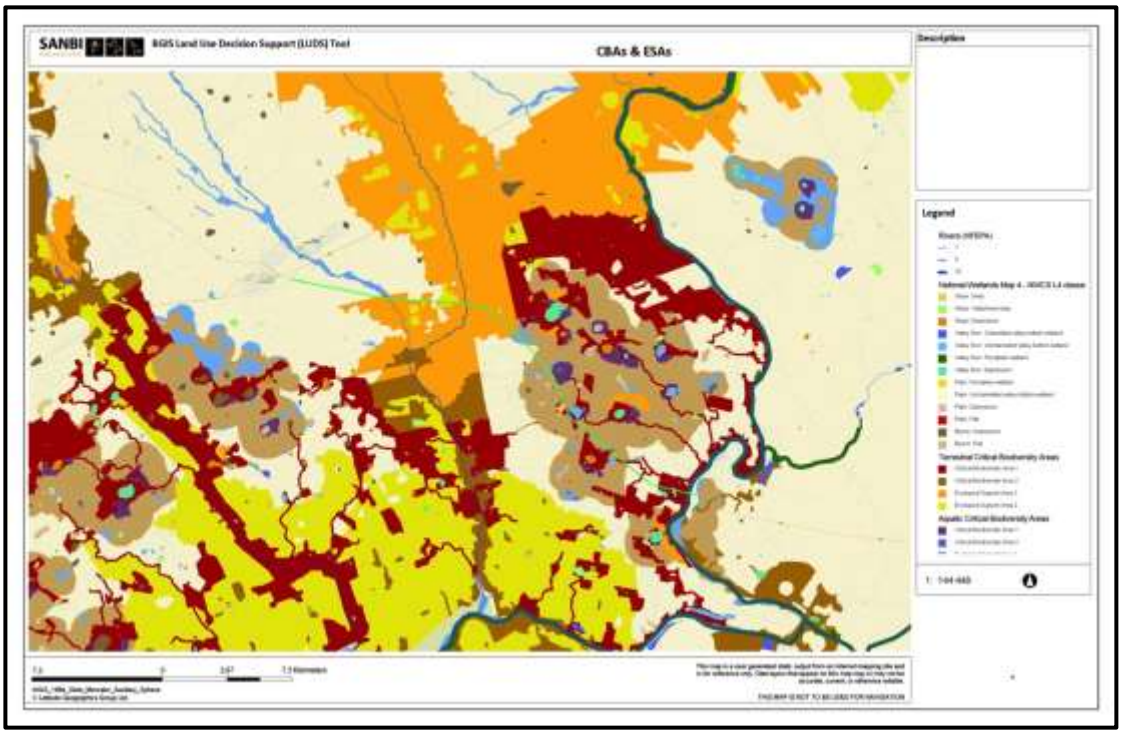


Figure 21: Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs)

6.5 DEA Screening Tool

The DEA Screening Tool (www.screening.environment.gov.za) is required for ecological assessments and environmental impact assessments (EIAs). The screening tool was accessed on 12 October 2020. The assessments of sensitivities according to the screening tool are as follows:

- Animal Species Theme: Mostly Low Sensitivity, with patches of Medium Sensitivity.
- Plant Species Theme: Medium Sensitivity.
- Aquatic Biodiversity Sensitivity: Low, with all watercourses as Very High.
- Terrestrial Biodiversity Sensitivity: Very High.

During site investigations the sensitivity ratings of Animals, Plants and Aquatic were found to be as per the screening tool assessment. The project will have little to no negative impact on these themes.

According to the screening tool the terrestrial biodiversity sensitivity for the entire area through which the study site runs is 'Very High'. However, this is not found to be the case during field investigations (ground-truthing). It unclear as to why the DEA screening tool assessment would show a high sensitivity for areas such as farmlands that are totally transformed by cultivation over many years.

The only possible reasons could be that Vaal-Vet Sandy Grassland is a threatened ecosystem (Endangered), but the rest of the area is not ecological sensitive in terms of actual field investigations and calculations.

6.6 Delineated Watercourses

The main watercourses in the study site were delineated (See Figure 22 - Figure 27, below). Three watercourses were delineated. The region is fairly arid with a low rainfall regime and therefore there are few perennial and even semi-perennial rivers or streams present. There are no perennial rivers or streams within the study area or which the road crosses over, with the exception of the bridge at the end of the route, which crosses over the Vaal River.

A 50 m buffer zone / regulated zone is recommended for the watercourse systems delineated, even though a 32 m would be adequate due to the nature of the watercourses with no real distinctive riparian zone and the medium to low rainfall regime. Farming activities are within these zones and there are also houses within these zones. There are a number of small pans along the route and these are often surrounded by cultivated farmlands. None of these pans will be impacted on.

A number of stormwater culverts are found along Section 4 of the R504. These have not been delineated as they are not actually within watercourses but are within the road design to simply facilitate and not impede normal surface flow of stormwater / rainfall in the area of very flat plains.

There were three watercourse crossings along the 24.1 km length of the Section 4 of the R504. The first crossing is across Leeudoringspruit, east of the small town of Leeudoringstad. The active channel of the stream is narrow with a wider floodplain. There is significant negative impact on the stream arising from the Kgakala settlement sewage works, which appears to be discharging into the river (most likely with no to little treatment). See a photo in Figure 23, and delineation of the Leeudoringspruit in Figure 24, below.

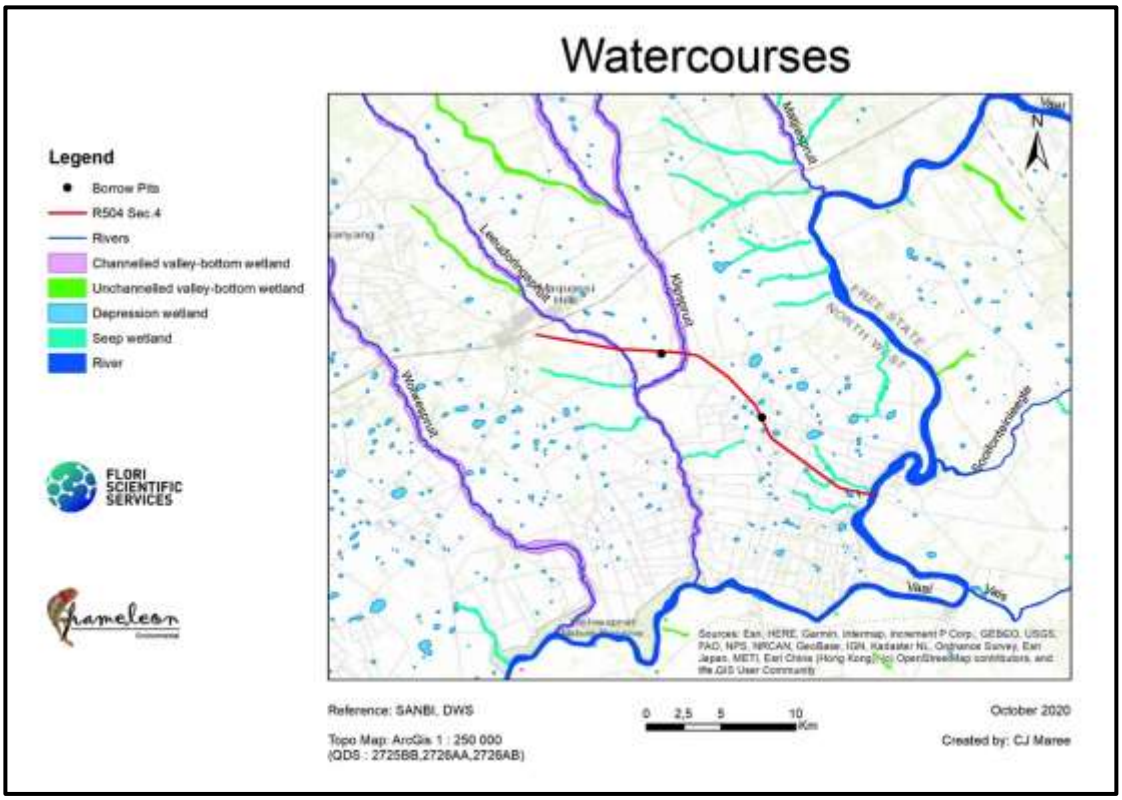


Figure 22: Main Rivers in the Study Area

Figure 23: Leeudoringspruit

Figure 24: Delineation of Leeudoringspruit

The second crossing is over the Klipspruit. See the photo of the Klipspruit in Figure 25, and the delineation as illustrated in Figure 26, below.

Figure 25: Klipspruit

Figure 26: Delineated Klipspruit

The third crossing is over the Vaal River. Maintenance done on the main columns of the bridge will not impact on the characteristics of the water crossing. Reparation of the eroded embankments will have a positive impact. The delineation of the Vaal River, which is a big river, is seen in Figure 27, below.

Figure 27: Delineated Vaal River

6.7 Sensitive areas identified

There are no 'high sensitivity' areas, 'no-go zones' or highly sensitive habitats delineated or identified within the study site itself. The sensitive areas on the fringes of the study site are the identified and delineated watercourse crossings as well as nearby pans. The nearby sensitive areas within a hundred metres of each side of the road have been highlighted in the sensitivity maps for the study site. There is an area at the Vaal River bridge that has been delineated with a sensitivity of 'High'. This area is not totally transformed by cultivation and is a demarcated CBA.

There is also an area on the western side of the R504 at KM 15.4 that is delineated with a sensitivity of 'High'. This is because it is degraded Vaal-Vet Sandy Grassland that is endangered and there is a wetland (pan) within it. Great care must be taken not to cross over with any activities (including transport) into this area.

Below is the sensitivity map for the study site (Figure 28, Figure 29). Areas adjacent to the two streams, where there is still some grassland (although degraded) have been delineated with a sensitivity of 'Medium'. Preferably these areas should also be avoided.

Figure 28: Sensitivity Map

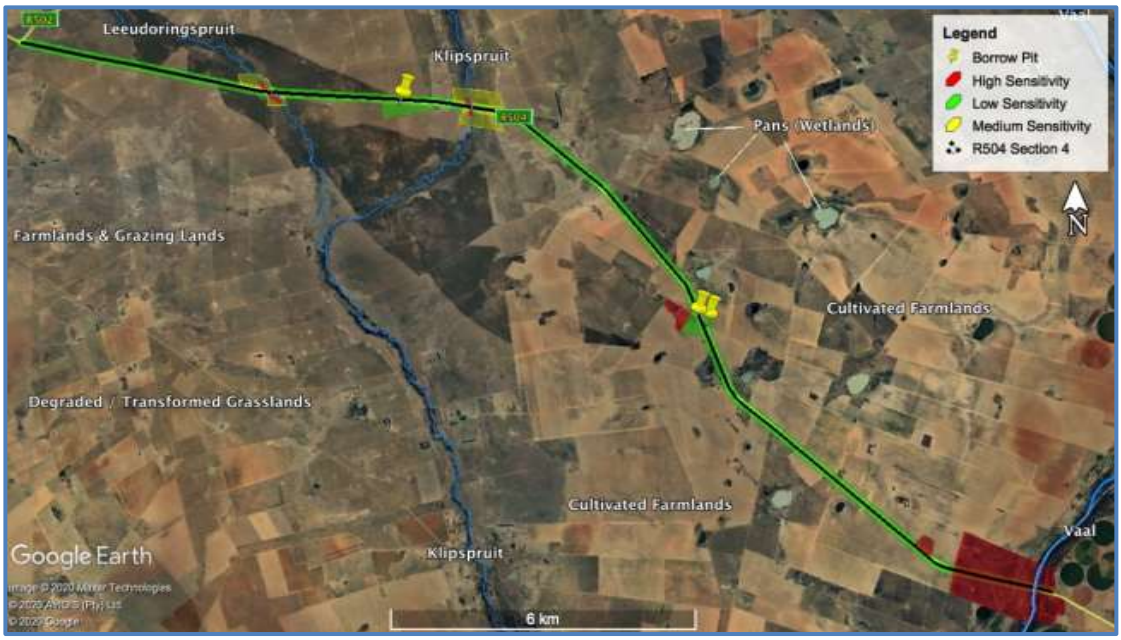


Figure 29: Sensitivity map with landcover overlays

7 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 the negative impacts (cumulative effect). The impact assessment focuses mainly on the construction phase of the project, but does consider the long-term impact the project may have on the natural environment. The operation phase is only considered in terms of ongoing, routine maintenance after clean up and rehabilitation at the end of the construction phase.

7.1 Existing Impacts

In terms of the natural ecology and the watercourses of the area, the primary existing negative impacts on the study area and surrounds are predominantly farmlands in the form of cultivated lands and grazing lands; small towns (urban areas); and related infrastructure such as roads, farm dams and power lines. The most significant impacts noted were:

- Dry land farming, irrigated farming (cultivated lands) and small-scale grazing,
- Small towns and settlements, and
- Related infrastructure such as roads.

The biggest impact on some of the watercourses is the existing road. These impacts did not appear to be significant, only increasing levels of channelization, which has caused an increase in flood plain

widening, damming and siltation. There were no trees or significant or important habitats that needed to be protected within the road reserve. The road through the smaller towns has houses close and possible within the road reserve with alien trees

7.2 Potential Impacts

The potential negative impacts of the proposed project are primarily where the road crosses watercourses, and where work will need to be done within the watercourses. However, the construction impacts will be over within a very short period of time and watercourses will quickly recover and reestablish back to the PES prior to construction activities. The existing impact of channelization and damming will not change with widening of culverts.

Care should be taken during planning of temporary sites where construction camps and temporary lay down areas for the stockpiling of gravel, sand, asphalt, etc. are located. Furthermore, no open fires and interaction with any wild animals is allowed.

There are no obvious positive ecological impacts arising from the proposed project., except possibly the cleaning out / rehabilitation of some storm water culverts which would then improve free-flow of surface storm water. However, there are numerous other significant positive impacts, including making the road safer for motorists.

7.3 Assessment of potential impacts

The assessment of potential impacts on the natural environment arising from the project and related activities is shown below in Table 19.

The scoring method used in the impact assessment is as follows:

Significance (SP) = [Extent (E) + Duration (D) + Magnitude (M)] x Probability (P).

The maximum value is 100 significance points (SP). Environmental impacts will be rated as either that of High, Moderate or Low significance on the following basis:

- SP ≥60: Indicates **high** environmental significance;
- SP 31 ≥ 59: Indicates **moderate** environmental significance;
- SP ≤ 30: Indicates **low** environmental significance.

Further explanation of the assessment methodology is found in the section on methodology

7.4 Cumulative Effect

The cumulative effect speaks to the total sum of negative impacts on the natural environment. The cumulative effect is the sum of the existing impacts and the new, additional actual negative impacts arising from the project and related activities. In general, the overall cumulative effect of the proposed project will be negligible to non-measurable, especially post construction / upgrade.

Table 19: Assessment of Potential Impacts

Potential Impacts arising from Project	Phase of Project	Impact Rating					
		Extent	Duration	Magnitude	Probability	Total	Significance
Total Impact of Proposed Project	**Construction Phase: Pre-mitigation**	**Local (2)**	**Shot-term (2)**	**Moderate (6)**	**Medium (3)**	**30**	**Moderate**
	Construction Phase: Post mitigation	**Site (1)**	**Shot-term (2)**	**Minor (2)**	**Low (2)**	**10**	**Low**
	Operational Phase	**Site (1)**	**Immediate (1)**	**Minor (2)**	**Improbable (1)**	**4**	**Low**
Mitigating Measures	i. Impacts on the existing natural environment related to the project are '**LOW**' No areas of natural vegetation of Grassland will be transformed or lost. No riparian vegetation or zone in the area of the Vaal River will be cleared, transformed or lost. No RDL faunal or floral species will be lost or impacted on. No additional danger risks will be created for wild animals crossing the road. ii. Any temporary storage, lay-down areas or accommodation facilities to be setup in existing built-up areas or disturbed areas where possible. iii. Ensure small footprint during the construction phase. iv. Only disturbed areas to be used as temporary office site and laydown areas. No temporary sites allowed within 100 m of any watercourse. v. Proposed buffer areas (no-go zones) along the watercourse must be implemented and strictly controlled (These are 50 m from the edge of the stream bank). vi. Regulated areas to be strictly controlled in terms of movement of people and vehicles in and through them. The only regulated zones are the 50 m zones along the edge of stream banks. vii. All hazardous materials must be stored appropriately to prevent these contaminants from entering the water environment; viii. All excess materials brought onto site for construction to be removed after construction. ix. No open trenches or mounds of soils to be left. x. Rehabilitation plans for disturbed areas to be compiled and implemented as part of the construction phase. xi. No construction vehicles may drive through any watercourses. Existing roads to be used. xiii. If possible, only existing access roads may be used to and from construction sites. Any farm roads and gravel roads used to be maintained.						
Cumulative Effect of Project on Terrestrial Ecology	After construction and during operational phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	**Low**
Cumulative Effect of Project on Aquatic ecology	After construction and during operational phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	**Low**

Individual Impacts							
		Extent	Duration	Magnitude	Probability	Total	Significance
1. Loss of natural vegetation	**Construction Phase: Pre-mitigation**	**Site (1)**	**Shot-term (2)**	**Low (4)**	**Medium (3)**	**21**	**Low**
	Construction Phase: Post mitigation	**Site (1)**	**Shot-term (2)**	**Minor (2)**	**Low (2)**	**10**	**Low**
	Operational Phase	**None (0)**	**Immediate (1)**	**Minor (2)**	**Improbable (1)**	**3**	**Low**
Mitigating Measures	i. No protected trees are within the study site. Therefore no protected trees will be lost or destroyed. ii. No pristine grassland or Vaal River riparian vegetation will be disturbed or lost. Minor levels of disturbed grassland along road edges will be lost. iii. Any priority species encountered must be identified and rescue prior to any excavation or construction activities. However, no RDL are expected to be present. A few ODL might be found as single specimens. These can easily be lifted are transplanted close by without the need for a permit and under the supervision of the ECO.						
2. Loss or impact on wildlife	**Construction Phase: Pre-mitigation**	**Site (1)**	**Shot-term (2)**	**Moderate (6)**	**Medium (3)**	**27**	**Low**
	Construction Phase: Post mitigation	**Site (1)**	**Shot-term (2)**	**Minor (2)**	**Low (2)**	**10**	**Low**
	Operational Phase	**Site (1)**	**Immediate (1)**	**Minor (2)**	**Improbable (1)**	**4**	**Low**
Mitigating Measures	i. Care must be taken not to interact directly with any wild life encountered. ii. Any bird nests encountered in the vegetation or in the watercourses must not be interfered with. If encountered must first be discussed with specialist. This includes active burrows of small animals such as field mice or scrub hares.						
3. Fringe impacts arising from construction phase	**Construction Phase: Pre-mitigation**	**Site (1)**	**Shot-term (2)**	**Moderate (6)**	**Medium (3)**	**27**	**Low**
	Construction Phase: Post mitigation	**Site (1)**	**Shot-term (2)**	**Minor (2)**	**Low (2)**	**10**	**Low**
	Operational Phase	**Site (1)**	**Immediate (1)**	**Minor (2)**	**Improbable (1)**	**4**	**Low**
Mitigating Measures	i. Due to the nature of the project the potential for any significant fringe impacts is low. ii. Care must be taken with heavy machinery used on the project. All access roads and farm roads used must be monitored and maintained. iii. Soils and stones excavated may be used in the immediate vicinity and farms as backfill, fixing of roads, filling of dongas, etc. iv. Excavated soils and rocks may not be simply dumped in any pristine bushveld, or within 100 m of the edge of watercourses or dams.						

8 FATAL FLAWS

8.1 Potential Fatal Flaws for the Project

There are no fatal flaws and the project may proceed. However, mitigating measures still need to be implemented to reduce potential negative impacts. Most importantly is to adhered to recommended buffer zones and regulated areas, although these are not extensive.

8.2 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, 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.

9 CONCLUSIONS & RECOMMENDATIONS

9.1 Conclusions

The conclusions of the study are as follows:

- The study site consists of the existing road and road reserve of the R504 Section 4.
- The study site is within the original extent of Vaal-Vet Sandy Grassland (which is a threatened ecosystem with a status of 'endangered').
- The vegetation of the study site itself is highly degraded and transformed due to the dominant presence of the existing hard-surface road (R504) and road reserve, which is routinely mowed and/or burnt.
- There are no areas of pristine veldtype, vegetation or ecosystems in the study site.
- The site is not within any priority areas.
- The site is not within a strategic water source area (SWSA) of South Africa.
- The study site (road) crosses over two semi-perennial / seasonal streams (Leeudoringspruit & Klipspruit) and one large perennial river (Vaal River).
- There are no wetlands within the study site itself, but there are a number of pans (a type of wetland) scattered throughout the region, some of which are close to the road.
- The project will have little to no additional measurable medium- or long-term negative impacts on the environment.
- There are no obvious environmental fatal flaws and the project may proceed.

9.2 Recommendations

The recommendations of the study are as follows:

- All mitigating measures must be implemented, including recommended buffer zones and/or regulated areas.
- A 50 m buffer zone / regulated zone is recommended for the stream / river systems delineated, even though a 32 m would be adequate due to the nature of the watercourses with no real riparian zone and the medium to low rainfall regime. Farming activities are within these zones and there are also houses within these zones.
- No additional site investigations or specialist studies are required due to the highly transformed nature of the study site in which the activities are to take place.
- It is the opinion of the specialist that the project should be authorised and allowed to proceed to the next phase.

10 APPENDICES

10.1 Photographs

Photo 1: Area at the Start of R504 Section 4 at Leeudoringstad

Photo 2: Area at the End of the R504 Section 4, just over the Vaal River in Free State

Photo 3: General View or Activity along the R504 Section 4

Photo 4: General View of the area along the R504 Section 4

Photo 5: Klipspruit

Photo 6: Klipspruit

Photo 7: R504 Section 4 at Klipspruit crossing

Photo 8: Klipspruit

Photo 9: Leeudoringspruit

Photo 10: Leeudoringspruit

Photo 11: Leeudoringspruit

10.2 Plant Species

10.2.1 Species on Site and nearby areas

Trees and Shrubs

Vachellia (=*Acacia*) *hebeclada, Vachellia* (=*Acacia*) *karoo, Vachellia* (=*Acacia*) *erioloba, Searsia lancea, Vachellia* (=*Acacia*) *caffra, Grewia flava.*

Forbs, Herbaceous plants

Felicia muricata, Anthospermum rigidum, Asparagus burchellii, Hermannia tomentosa, Pentzia globosa, Helichrysum dregeanum, Bulbine asphodeloides, Bulbine abyssinica, Hypoxis hemerocallidea and Boophone disticha, Pterodiscus speciosus.

Grasses

Eragrostis lehmanniana var. lehmanniana, Eragrostis superba, Anthephora pubescens, Aristida congesta subsp. barbicollis, Stipagrostis uniplumis var. neesii, Cynodon dactylon, Heteropogon contortus, Themeda triandra and Pogonarthria squarrosa;

Priority Plants

Hypoxis hemerocallidea and *Boophone disticha* are ODL plants found in the area. There are a few specimens within the road reserve and watercourses, but these do not need to be lifted or transplanted. Care should just be taken not to damage or destroy any during the construction phase.

Note: *Vachellia* (=*Acacia*) *erioloba* is a protected tree, but none are present on the study site.

Alien Plants

Cylindropuntia imbricata, Opuntia humifusa, Opuntia ficus-indica, Agave americana, Melia azedarach, Tagetes minuta and Solanum elaeagnifolium.

The list below is of the dominant plant species found in pristine and good condition **Vaal-Vet Sandy Grassland** (Mucina & Rutherford, 2006).

Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

(d) = Dominant.

10.3 Definitions

10.3.1 Rivers and streams

A river or stream is a linear inland aquatic ecosystem with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit (Ollis *et al.* 2013). According to the Water Act and DWS the extent of the river includes the 1:100 year floodline as well.

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.

10.3.2 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 30).

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*."

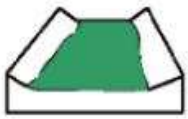
Furthermore, the guidelines stipulate that wetlands must have one or more of the following defining attributes:

- 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 50 cm of the soil.

10.3.3 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*."

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 30: Classification of wetlands

10.3.4 Regulated Area versus Buffer Zone

A buffer zone implies a zone or area in which "nothing" should be done, or no activities are allowed to take place. A regulated area, has certain legal implications, under which certain or regulated activities may or may not take place.

The following areas / zones and regulations are relevant:

- The 32 m in the NEMA listed activities. This is 32 m from the 1:1 year flood line or first flood bank of the active stream area. This is not 32 metres from the 1:100 year flood line or 32 metres from the 500 m zone of the delineated wetland as determined by DWS. Experts keep

on using definitions in the NEMA to support or define things or issues in the NWA or vice versa. This should not be done).

- The 1:100 flood line, or the riparian area (which ever is the furthest) as defined by the GN509 in terms of the NWA; or
- The wetland area and 500 m from the wetland area as defined by GN509 in terms of the NWA

These areas are the "Extent" or "regulated area" of a watercourse. In other words areas in which the applicable legislation applies. Before any activity can take place as defined by the legislation the activity must be authorised in terms of that legislation. The term is "Regulated Area". This means an activity may take place within a regulated area. Only if after the necessary environmental evaluation processes have been followed and it has been determined that the impacts are acceptable or the mitigating actions implemented will address any unacceptable impacts.

10.4 Biodiversity Summary of the Maquassi Hills Local Municipality

Below is the biodiversity summary for the Local Municipality, in which the study site is situated (Accessed from: SANBI. www.bgis.sanbi.org).

Protected Areas

Land-based protected areas (formal)

Name	NSBA Category	Size (ha)	Size (%)
Bloemhof Dam Nature Reserve	Nature Reserve	9035,2 ha	1,95%
Sandveld Nature Reserve	Nature Reserve	52 ha	0,01%
Wolwespruit Nature Reserve	Nature Reserve	1743,5 ha	0,38%
3 reserves covering 10830,6 ha (2,33 %)			

Ramsar sites

There are no Ramsar sites in the municipality.

Terrestrial Ecosystems

Biomes

Name	Size (ha)	Size (%)
Grassland Biome	431622,8 ha	92,96%
Savanna Biome	32681,8 ha	7,04%
2 biomes in the municipality covering 464304,6 ha (100 %)		

Vegetation Types

Name	Size (ha)	Size (%)
Highveld Alluvial Vegetation	19199 ha	4,13%
Highveld Salt Pans	643,3 ha	0,14%
Kimberley Thornveld	26428,6 ha	5,69%
Klerksdorp Thornveld	139812,3 ha	30,11%
Vaal-Vet Sandy Grassland	205493,1 ha	44,26%
Western Highveld Sandy Grassland	72728,3 ha	15,66%
6 vegetation types in the municipality covering 464304,6 ha (100 %)		

Threat Status of Veldtypes in the Local Municipality

Threatened EcoSystems (Critically Endangered)

Name	Size (ha)	Size (%)
Western Highveld Sandy Grassland	18183 ha	3,92%

1 Critically Endangered Threatened EcoSystems in the municipality covering 18183 ha (3,92 %)

Threatened EcoSystems (Endangered)

Name	Size (ha)	Size (%)
Vaal-Vet Sandy Grassland	103398,6 ha	22,27%

1 Endangered Threatened EcoSystems in the municipality covering 103398,6 ha (22,27 %)

Threatened EcoSystems (Vulnerable)

There are no Vulnerable Threatened EcoSystems in the municipality.

Freshwater Ecosystems

Rivers

Name
Bamboesspruit
Klipspruit
Makwassiespruit
Sandspruit
Vaal

5 rivers in the municipality

Estuaries

There are no estuaries in the municipality.

Wetlands

1 wetlands in the municipality covering 16415,7 ha (3,54 %)

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