Proposed Chicken Farms at Roodewal, North-West Province.

Wetland/Riparian Delineation and Functional Assessment
December 2016

Drafted by
Limosella Consulting Pty Ltd
Reg No: 2014/023293/07
Email: antoinette@limosella.co.za
Cell: +27 83 4545 454
www.limosella.co.za

Drafted for Labesh
Postnet Box 469
Private Bag x 504
Sinoville 0129
Email: admin@labesh.co.za

Declaration of Independence

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- 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 in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

Antoinette Bootsma (PrSciNat)
Ecologist/Botanist
SACNASP Reg. No. 400222-09

2016.12.09
Date

Indemnity
This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.
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Qualification of Specialists

Report writing assistance and review	Antoinette Bootsma Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09 Marinus Boon Wetland specialist / Ecologist SACNASP Reg. No. 200083/15
Field work and data analysis	Marinus Boon Wetland specialist / Ecologist SACNASP Reg. No. 200083/15

EXECUTIVE SUMMARY

Limosella Consulting was appointed by Labesh to undertake a wetland and/or riparian delineation and functional assessment to inform the Environmental Authorization process for the proposed chicken farms at Roodewal, North-West Province.

Fieldwork was conducted on the 2nd of December 2016.

The terms of reference for the study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory,
- Undertake a functional assessment of wetlands areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss mitigation and management procedures relevant to the conservation of wetland areas on the site and downstream hydrological features

A total of five natural watercourses and numerous artificial waterbodies including farm (earthen) dams and artificial canals were found on site. Of the five natural watercourses only two, the Selons River and the downstream sections of a smaller tributary of the Selons River, are classified as a perennial rivers in terms of information from the National Geospatial Information (NGI) and National Freshwater Ecosystems Priority Areas (NFEPA). Site verification and information from the farm proved that these two watercourses are instead non-perennial ephemeral rivers. The remaining three watercourses are classified as ephemeral drainage lines (no flow for 3 – 6 months). It should however be noted that due to the current droughts some of these ephemeral rivers might even be classified as “episodic” as the indication is that they only flow in response to extreme rainfall events. It should further be noted that each of these natural watercourses/aquatic ecosystems identified, delineated and assessed in this study include various small tributaries/headwater streams that drain into the main watercourses. The drainage lines in the south-east corner of the study area located on the hillside. These hillside watercourses are difficult to identify except during periods of rain although indicators such as their topographic positon (low points in the local landscape) and evidence of sediment deposition and debris can provide a sufficient indication. More watercourses not included in the assessment are located within the surrounding area. Another non-perennial ephemeral river not affected by the proposed poultry farm is located to the east and the north-east of the RCL properties. The rivers/watercourses that are likely to be impacted in some way by the proposed chicken runs are numbered as follows:

- Selons River (Non-Perennial River located in the north-west corner of the RCL properties);
- Non-Perennial 2 (tributary of the Selons River);
- Non-Perennial 3 (tributary of Non-Perennial 2);
- Non-Perennial 4 (tributary of Non-Perennial 3); and
- Non-Perennial 5 (tributary of a Non-Perennial River located to the North-East of the RCL properties).

All of the watercourses have been impacted to some degree. These impacts, together with their current integrity status, are summarised in the table below:

Nr	Affected Watercourse	Approximate central coordinates	Recorded Impacts	EC Score	QHI Score
1	**Selons River**	25°45'32.90"S and 27° 4'22.78"E	Channelisation, channel collapse, increased runoff, erosion, soil compaction and subsequent sedimentation.	**C/D**	**C/D**
2	**Non-Perennial 2**	25°46'43.75"S and 27° 5'2.33"E	Channelisation, channel collapse, increased runoff, erosion, soil compaction and subsequent sedimentation.	**C/D**	**C/D**
3	**Non-Perennial 3**	25°46'34.73"S and 27° 5'54.64"E	Channelisation, channel collapse, increased runoff and erosion.	**B/C**	**C**
4	**Non-Perennial 4**	25°47'8.43"S and 27° 6'44.44"E	Channelisation, channel collapse, increased runoff, erosion, soil compaction and subsequent sedimentation.	**C**	**C**
5	**Non-Perennial 5**	25°45'46.15"S and 27° 6'10.99"E	Channelisation, channel collapse, increased runoff, erosion, soil compaction and subsequent sedimentation.	**C**	**C**

The study area is located within Quaternary Catchments A22C and is in the third water management area, the Crocodile (West) and Marico. In this water management area, the.

The proposed chicken runs footprints do not traverse any major rivers but are located in close proximity to the natural water courses associated with the Selons River that drain into the Elands River.

The important factors relevant to the project are summarised in the table below:

	Quaternary Catchment and WMA areas	Important Rivers possibly affected	Buffers
	A22C, Crocodile (West) and Marico (WMA)	Rivers potentially affected include natural watercourses that are associated with the Selons River and/or tributaries that drain into the Selons River. Major rivers in this catchment include the Crocodile, Marico, Elands, Pienaars and Molopo River	**15 m calculated buffer for all the natural watercourses (rivers)**
NEMA Impact assessment	Most activities have a medium impact score before implementation of mitigation measures and a low score after mitigation		
DWS Impact assessment	Most of the activities associated with the poultry farm fall in the low category. Construction of access roads and stormwater management fall in the medium category. This is primarily due to the long term effect of potential impacts, such as altered surface water runoff and potential changes to water flowpaths that sustain the watercourses. It is possible that, during the detailed design phase, with the input of stormwater engineers and a geohydrologist or hydropedologist, it can be shown that mitigation for changes to the runoff properties of the infrastructure does not have a net effect on the regional hydrograph. The score may then be lowered to fall in the Low category. The DWS should be consulted regarding the necessity for application for a Water Use Lisence		
Does the specialist support the development?	Yes. However it should be done in a manner that does not further alter the natural watercourses (rivers) and their catchments, particularly regarding potential pollution from animal waste The proposed development traverse ecological support areas (ESA1) and critical biodiversity areas (CBA2) and care should be taken to limit impacts in these areas to a minimum.		
Major concerns	• Changing the quantity and fluctuation properties of the watercourse • Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount) • Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate) • Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons • Changing the physical structure within a water resource (habitat) • Erosion in the Selons River and downstream rivers		
Recommendations	The placement of the chicken runs should exclude the natural watercourses/aquatic ecosystems as far as possible. Where alternatives have been investigated and watercourses and associated tributaries/headwater streams are in close proximity it is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology.		
CBA and other Important areas	The proposed development traverses ecological support areas (ESA1) for the largest part of the site and critical biodiversity areas (CBA2) for the remainder. The Moot Plains Bushveld vegetation type which include most of the site is vulnerable.		

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1 INTRODUCTION

RCL Foods proposes an extension of a chicken farm on the portions of the farm Roodewal 322 and a portion of the farm Elandsfontein 366, North West Province. The project entails the establishment of seventeen (17) new chicken runs (Figure 1), south of their nine (9) existing chicken runs. It is envisaged that each chicken house will cover an area of 200m by 200m. The exact layout plans were not available to the specialist on the days which the site visit was conducted. Limosella Consulting was appointed by Labesh to assess wetlands potentially affected by the proposed development. Fieldwork was conducted on the 2nd of December 2016.

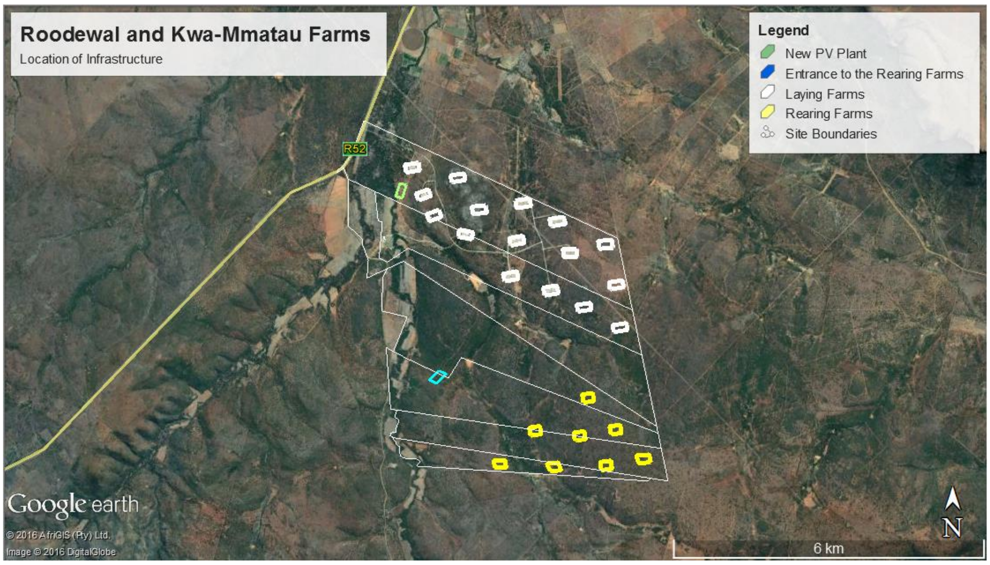

Figure 1: The approximate localities of the final facilities, including the 17 new facilities (i.e. 15 new rearing and laying farms + 2 facilities for other purposes) to be constructed on Roodewaal and Kwa-Mmatau Farms.

1.1 Terms of Reference

The terms of reference for the study were as follows:

- Delineate the wetland/riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake the functional assessment of wetlands and/or riparian areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland areas on the site.

1.2 Assumptions and Limitations

The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

Furthermore, the assessment of wetlands/riparian areas is based on environmental indicators such as vegetation, that are subjected to seasonal variation as well as factors such as fire and drought. Although background information was gathered, the information provided in this report was mainly derived from what was observed on the study site at the time of the field survey. A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study. Description of the depth of the regional water table and geohydrological processes falls outside the scope of the current assessment. During the sit visit large areas of the wetland and surroundings was grazed very short and not all vegetation could be identified. It should also be noted that although the study was conducted during the summer, it was during an extreme drought period and some seasonal and temporary wetlands could have been missed during the study visit.

1.3 Definitions and Legal Framework

This section outlines the definitions, key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water Affairs (DWA). The NWA sets out a range of water use related principles that are to be applied by DWA when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the 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." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often perform important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). It is defined by the NWA as follows: "Riparian habitat includes 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".

Water uses for which authorisation must be obtained from DWA are indicated in Section 21 of the NWA.

Section 21 (c) and (i) is applicable to any activity related to a wetland:
Section 21(c): Impeding or diverting the flow of water in a watercourse; and
Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notice 509 of 2016 regarding Section 21(c) and (i). This notice grants General Authorisation (GA) for the above water uses on certain conditions. This regulation also stipulates that water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations, unless the impacts score as low in the requires risk assessment matrix (DWS, 2014) Such an activity requires a Water Use Licence (WUL) from the relevant authority.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA.
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).

1.4 Locality of the study site

The study area comprised portion 6. 8, 11, 12, 15 and 17 of the farm Roodewal 322 as well as portion 58 of the farm Elandsforntein 366 in the North-West Province. The site is situated east of the R52 road between Rustenburg and the town of Koster (Figure 2). The site lies about 15km south-west of Rustenburg, on the opposite side of the Magaliesberg and about 23km north-east of Koster. The Derby D3667 dirt road forms much of the western boundary of the study area. The study area is situated within the quarter degree square 2527CC, with a small northern portion of the study area within the quarter degree 2527CA. The additional chicken houses are proposed for the southern portion of the study area, while the existing chicken houses are situated on the northern portion of the study area.

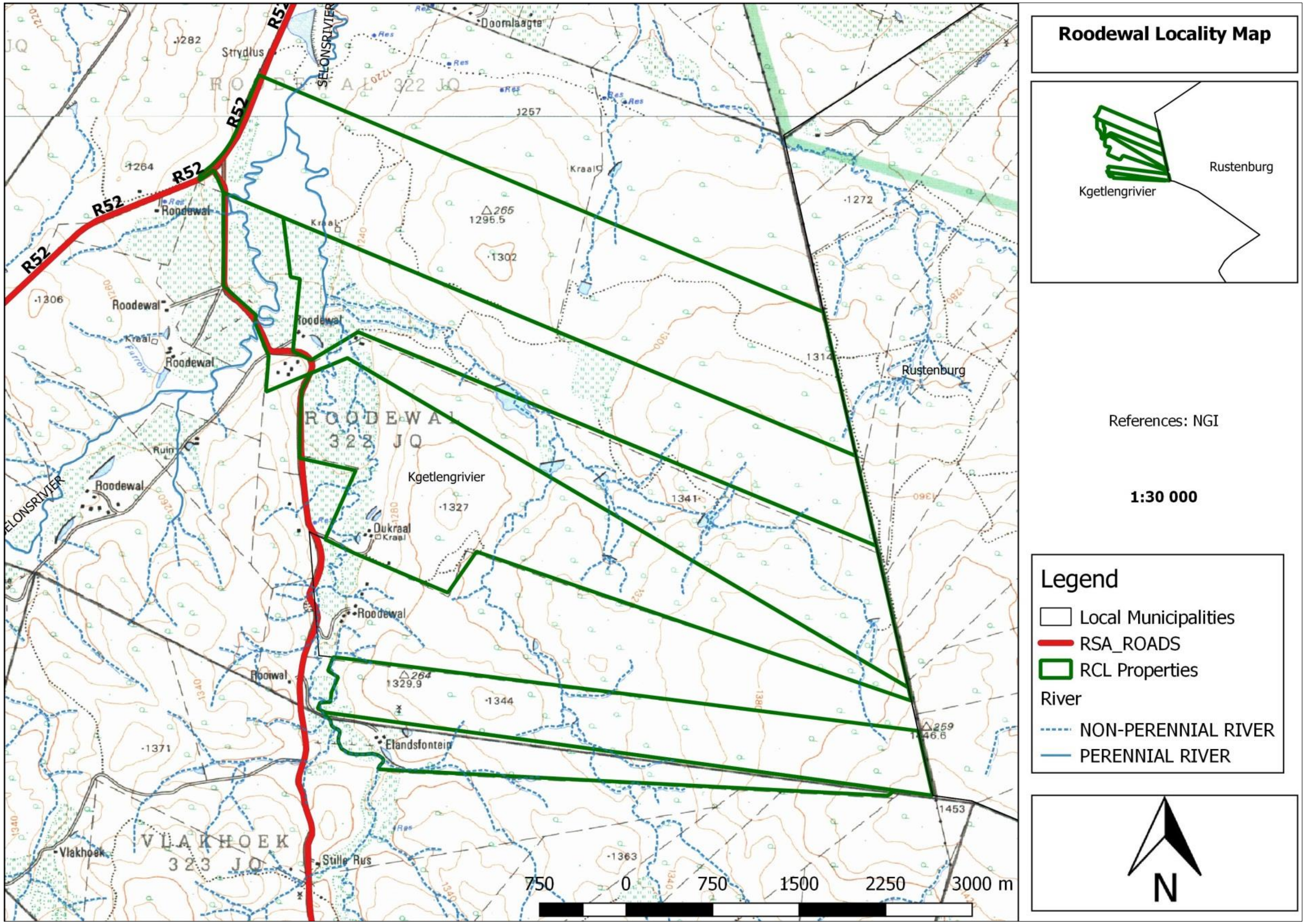

Figure 2: Locality Map

1.5 Description of the Receiving Environment

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Quaternary Catchments and Water Management Area (WMA):

As per Macfarlane *et al*, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available). The site is situated in Quaternary Catchments A22C. In this catchment, the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.26. The Median Annual Simulated Runoff (mm) is 46.1. Consequently, watercourses in these areas are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

The study area is located within Quaternary Catchments A22C and is in the third water management area, the Crocodile (West) and Marico. In this water management area, the major rivers include the Crocodile, Marico, Elands, Pienaars and Molopo River.

The proposed chicken runs footprints does not traverse any major rivers but is located in proximity to the natural water courses associated with the Selons River that drain into the Elands River.

Hydrology:

The altitude of the study area ranges from 1213 to 1450m.a.m.s.l which indicates a slope of 1.46° or 2.55% (Figure 3) indicating that most of the study area is located on a slope. A slope is an inclined stretch of ground located on the side of a mountain, hill or valley, not forming part of a valley floor (Ollis *et al*, 2013). However the lower parts of the site the North-West section include sections which can be classified as a plain (gradient less than 1%). This is also evident in the meandering effect of the lower reaches of the Selons River and its tributary near the confluence.

Surface water spatial layers such as the NFEPA Wetland Types for South Africa (SANBI, 2010), North-West wetland layers and Environmental Potential Atlas of South Africa (ENPAT) were consulted for the presence of wetlands, perennial and non-perennial rivers on or in proximity to the site. Based on these spatial layers several watercourses are located in the area including the Selons River (Figure 4). The Selons River is a tributary of the Elands River. According to the NFEPA data set (Nel *et al*, 2011), the Selons River is in a moderately modified condition (Present Ecological Status C determined in 1999). Figure 4 indicate the background hydrology of the study area and the surrounding areas. The study area does not have a NFEPA priority status (Nel *et al*, 2011).NFEPA wetland layer indicate some wetlands on the site although these were identified as earthen dams during the site visit.

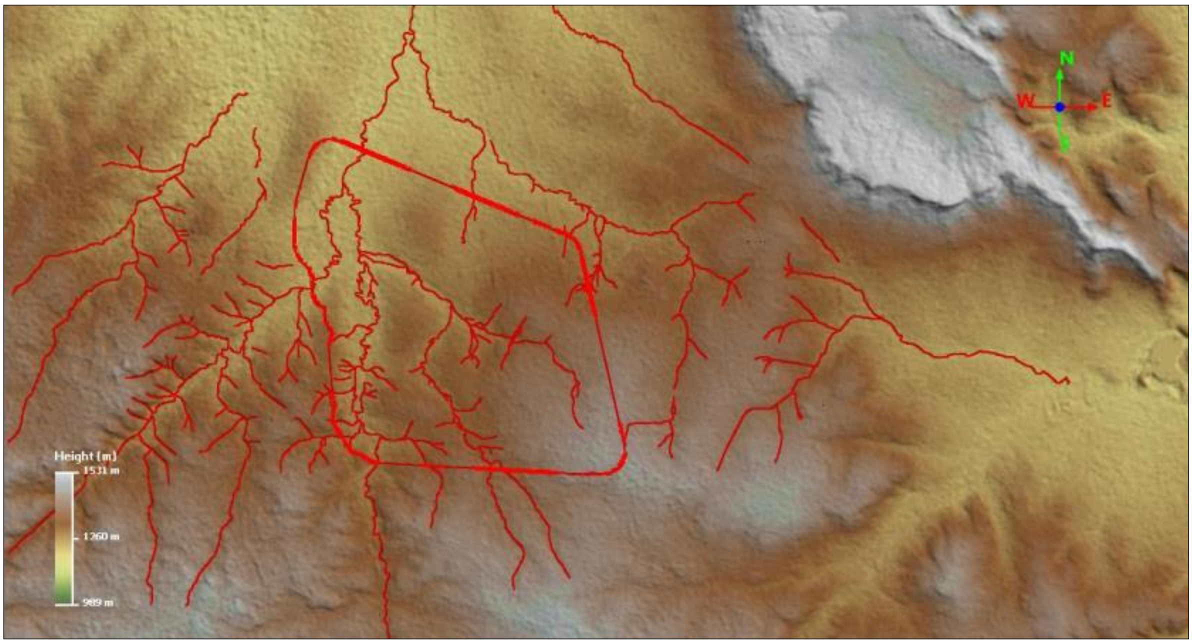

Figure 3: Digital Elevation Model indicating the landscape setting **("ASTER GDEM is a product of METI and NASA.").**

Regional Vegetation:

According to the Vegetation Map of South Africa, Lesotho and Swaziland, the study area is mostly situated in Moots Plains Bushveld (Vulnerable) and a small section in the north within the Zeerust Thornveld (least threatened). The Moots Plains Bushveld vegetation comprises open to closed, low, often thorny savanna dominated by various species of *Vachellia* and *Senegalia* in the bottomlands and plains, as well as woodlands of varying height and density on the lower hillsides. The herbaceous layer is dominated by grasses. The Zeerust Thornveld vegetation comprises deciduous, open to dense short thorny woodland, dominated by *Vachellia* and *Senegalia* species with herbaceous layer of mainly grasses on deep, high base-status and some clay soils on plains and lowlands, also between rocky ridges. (Mucina & Rutherford, 2006). The wetland vegetation comprise of Central Bushveld Group 5 vegetation (SANBI 2016).

Geology and soils:

The geology of the area is dominated by the Transvaal, Rooiberg, Griqualand-West groups (Council of Geoscience, 1997). According to the North-West layers of the Environmental Potential Atlas of South Africa (ENPAT) the area is dominated by shale.

The soils include Glenrosa and/or Mispah forms (other soils may occur). Lime is rare or absent in upland soils but generally present in low-lying soils. A small section on northern border include soils which is: vertic, melanic, red structured diagnostic horizons, undifferentiated (ENPAT). The soil type mostly associated with wetlands/riparian areas in the study area is Glenrosa which presents signs of wetness incorporated at the family level. The Glenrosa (hydromorphic soil) is subdivided, in addition to the bleached topsoil, on whether or not the B horizon is hard (more than 70% v/v is fresh or partly weathered bedrock with a hard consistence in all moisture states); has signs of wetness and is calcareous. Mispah and Glenrosa soils have generally high erosion risk mainly due to their (often) upslope landscape position (Fey, 2005).

North-West Biodiversity Sector Plan

A refined and updated CBA map for the planning domain was developed through integrating existing and new data to form the North-West Biodiversity Sector Plan (NWBSP2015_Terrestrial_CBA_v1_u35s) (READ, 2015). The use of CBAs here follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses.
- Ecological Support Areas (ESAs) are terrestrial and aquatic areas that are not essential for meeting biodiversity representation targets (thresholds), but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree or extent of restriction on land use and resource use in these areas may be lower than that recommended for CBAs.

From a land use planning perspective it is useful to think of the difference between CBAs and ESAs in terms of where in the landscape the biodiversity impact of any land use activity action is most significant:

- In CBAs where a change in land use results in a change from the desired ecological state, the impact on biodiversity as a result of this change is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- In ESAs, however, a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway. For example, removing a corridor results in a population going extinct elsewhere in the landscape due to loss of connectivity, or a new plantation locally results in a reduction in stream flow at the exit to the catchment, which affects downstream biodiversity.

Based on the described methods the study site is located on a section classified as (Figure 7):

- ESA 1 (majority of the site)
- CBA 2

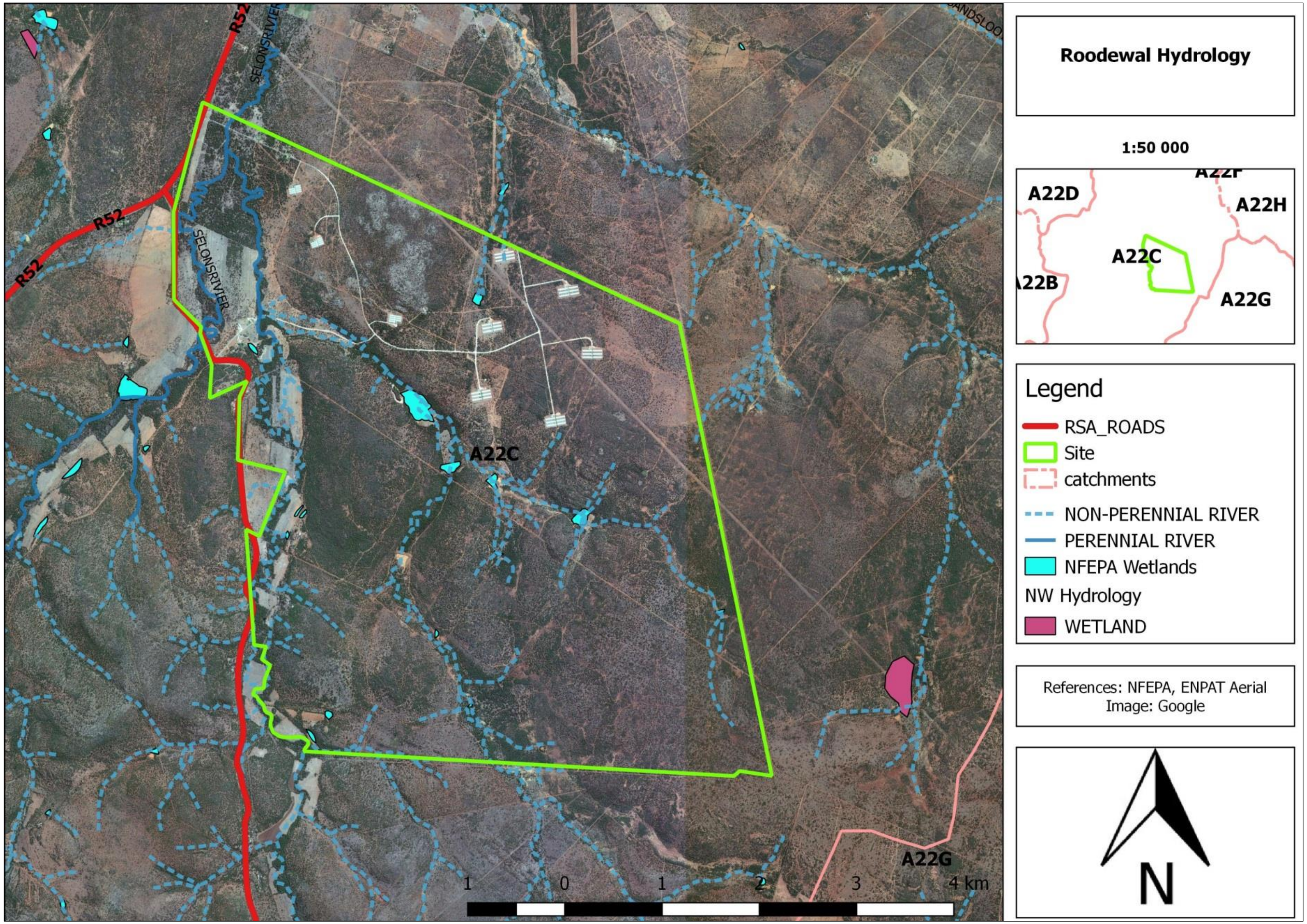

Figure 4: Regional hydrology

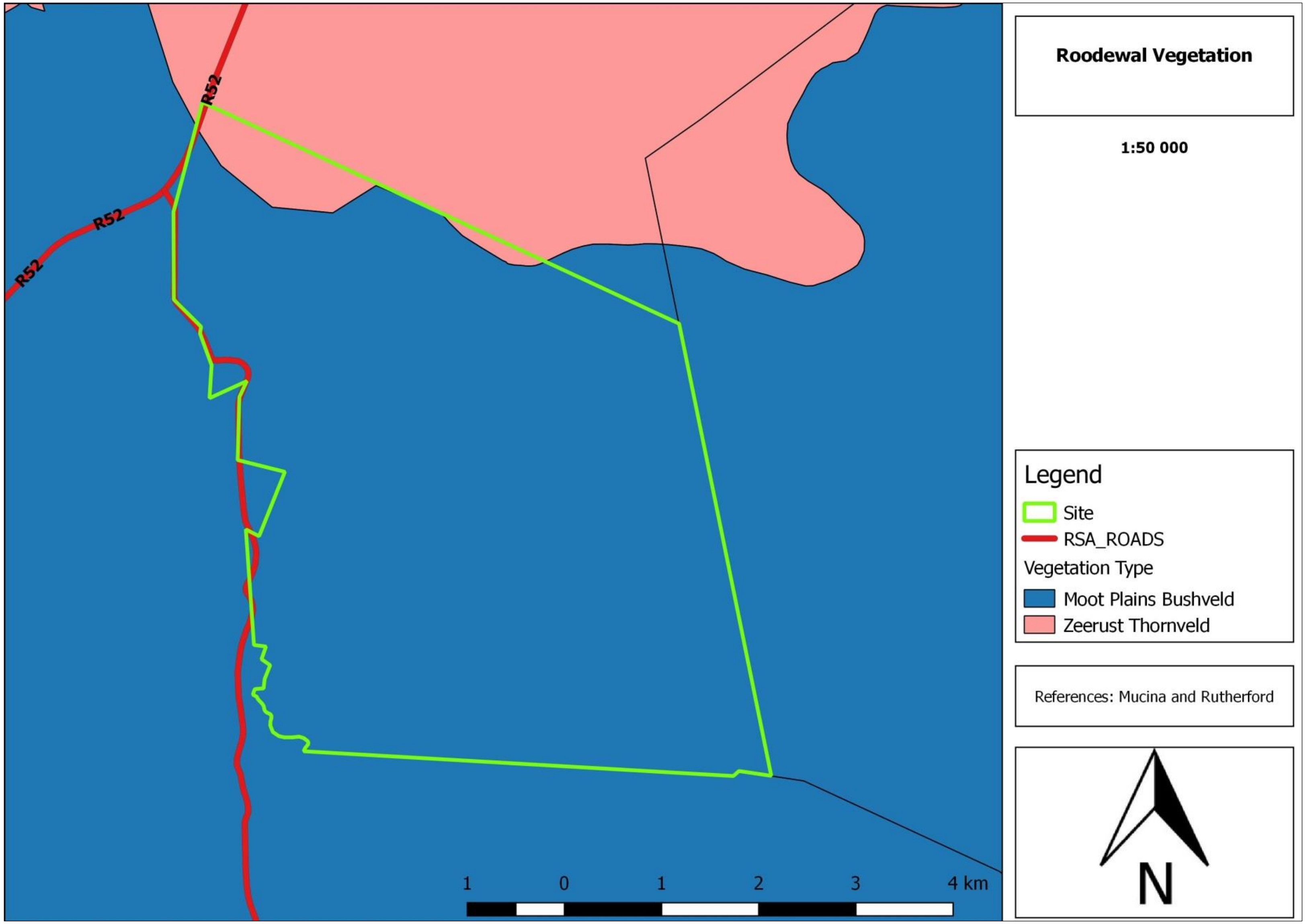

Figure 5: Vegetation types of the study area.

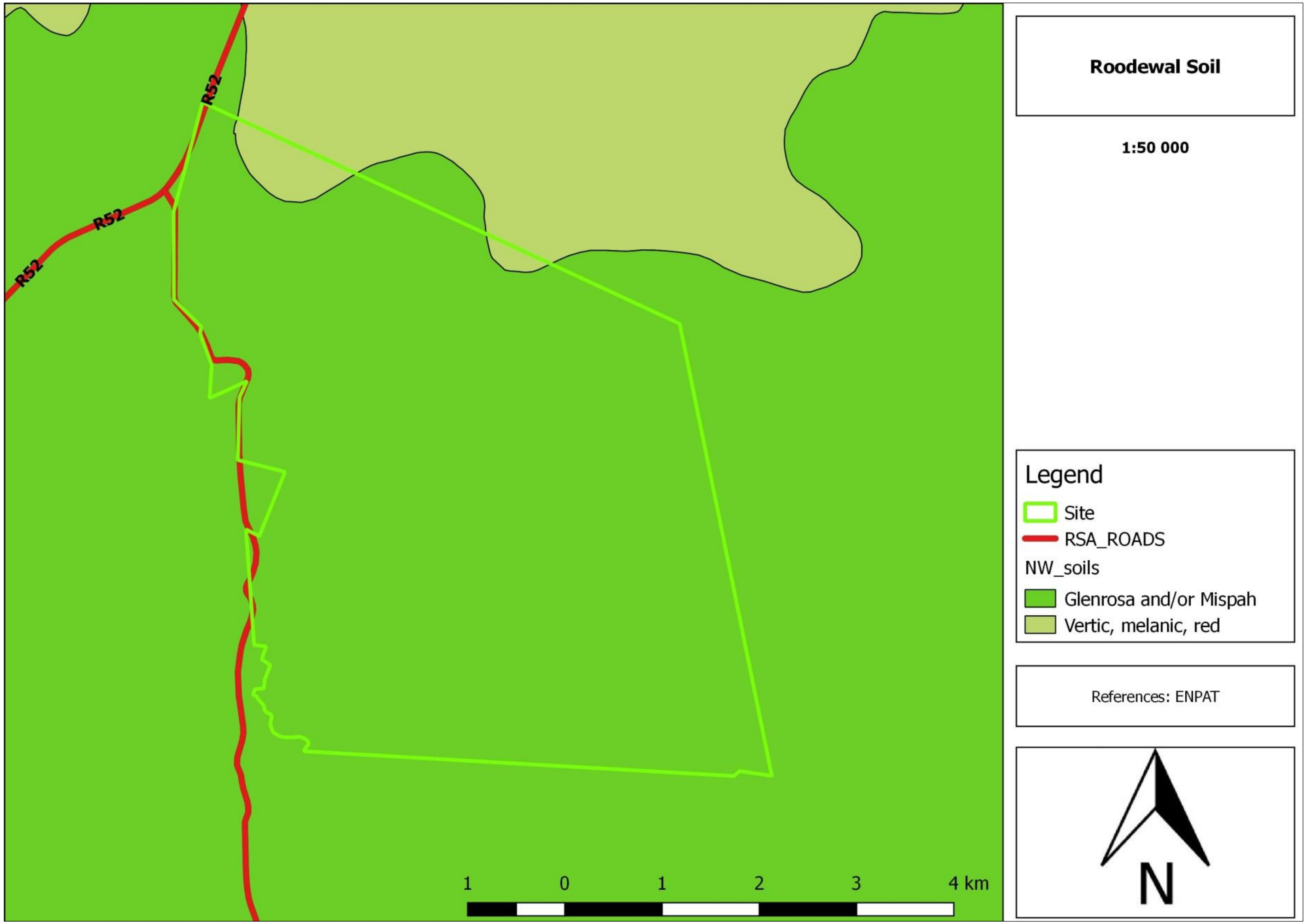

Figure 6: Soil classes of the study area.

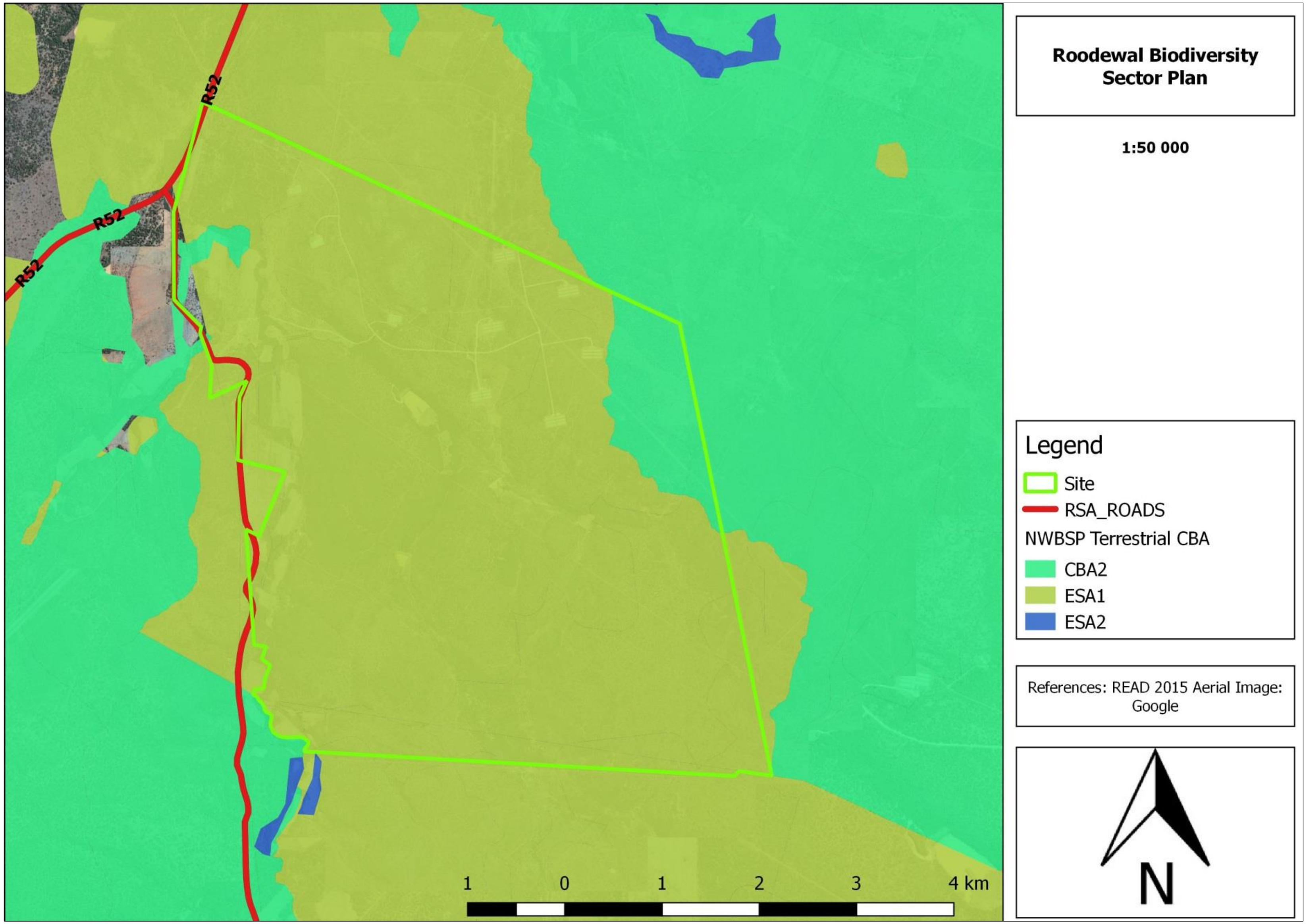

Figure 7: North-West Biodiversity Sector Plan associated with the study site.

2 METHODOLOGY

The delineation method documented by the Department of Water affairs and Forestry in their document "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2009) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al,* 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator.

A hand held Garmin etrex 20 was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey.

2.1 Wetland and Riparian Delineation

Wetlands are identified based on the following characteristic attributes (DWAF, 2005) (Figure 8):

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

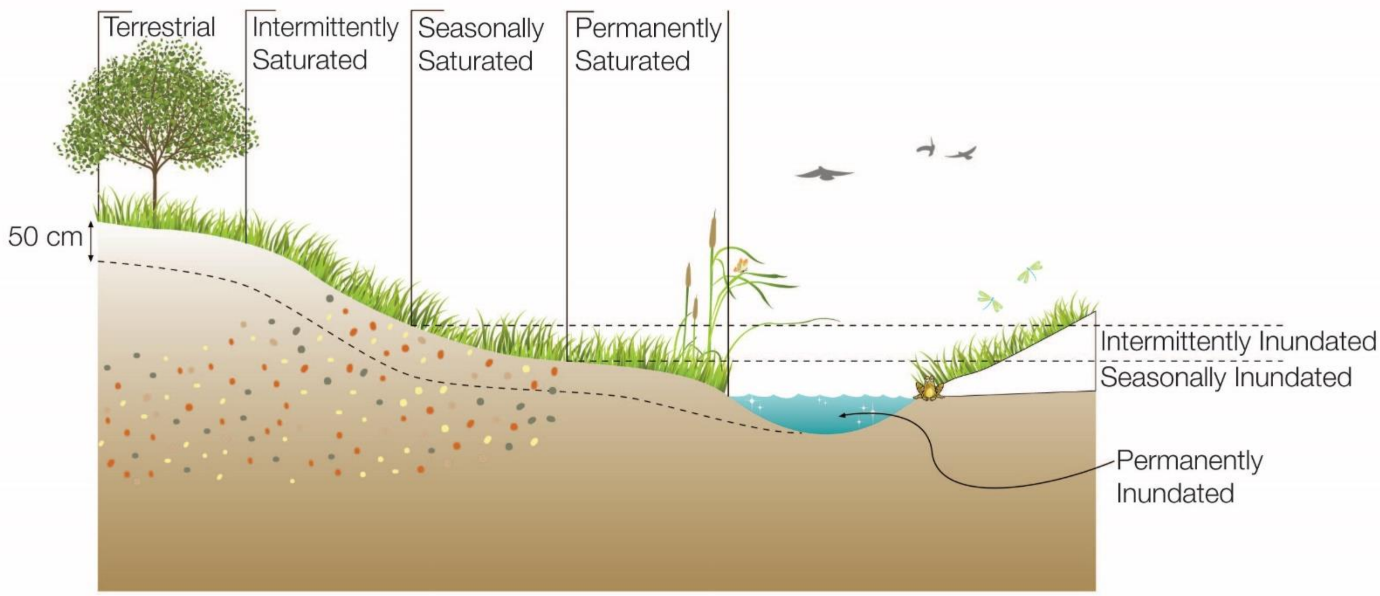

Figure 8: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 9) is an important guide for identifying the parts of the landscape where wetlands might possibly occur. Some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. An area with soil wetness and/or vegetation indicators, but not displaying any of the topographical indicators should therefore not be excluded from being classified as a wetland. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of Ollis, *et al*. (2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 10).

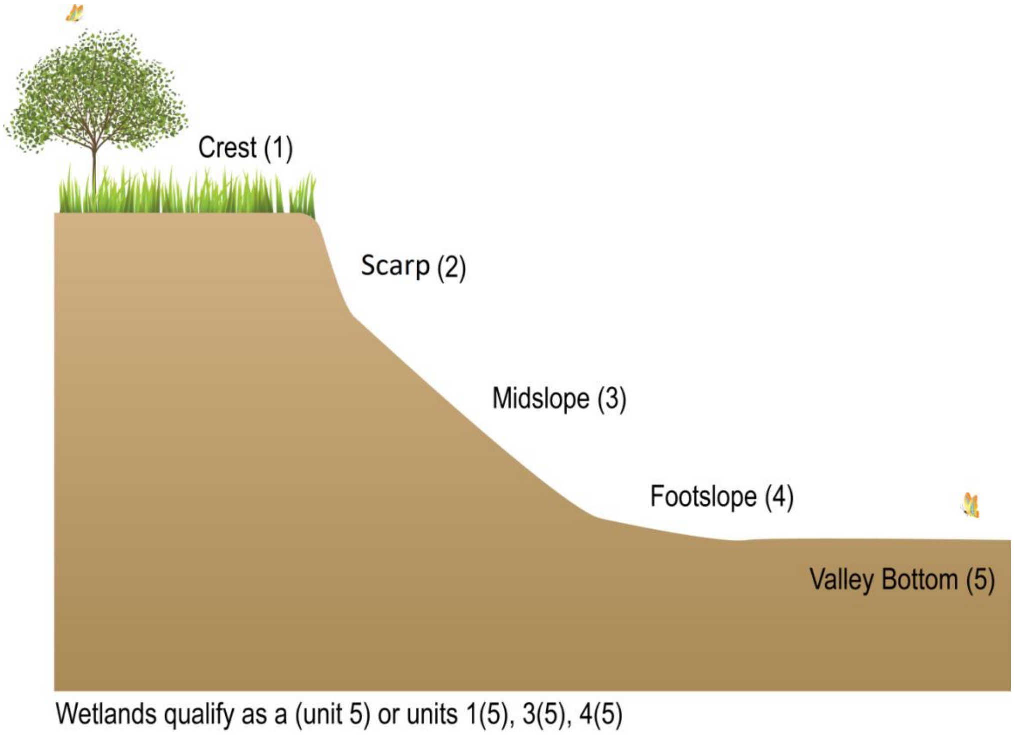

Figure 9. Terrain units (DWAF, 2005).

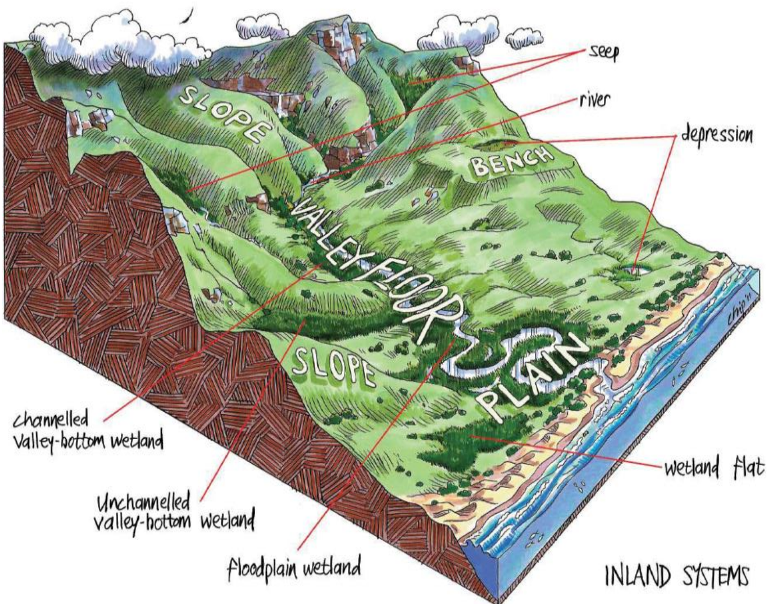

Figure 10: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

<u>Riparian Indicators</u>

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active river bank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). The marginal zone includes the area from the water level at low flow, to those features that are hydrologically activated for the greater part of the Year (WRC Report No TT 333/08 April, 2008). The non-marginal zone is the combination of the upper and lower zones (Figure 11).

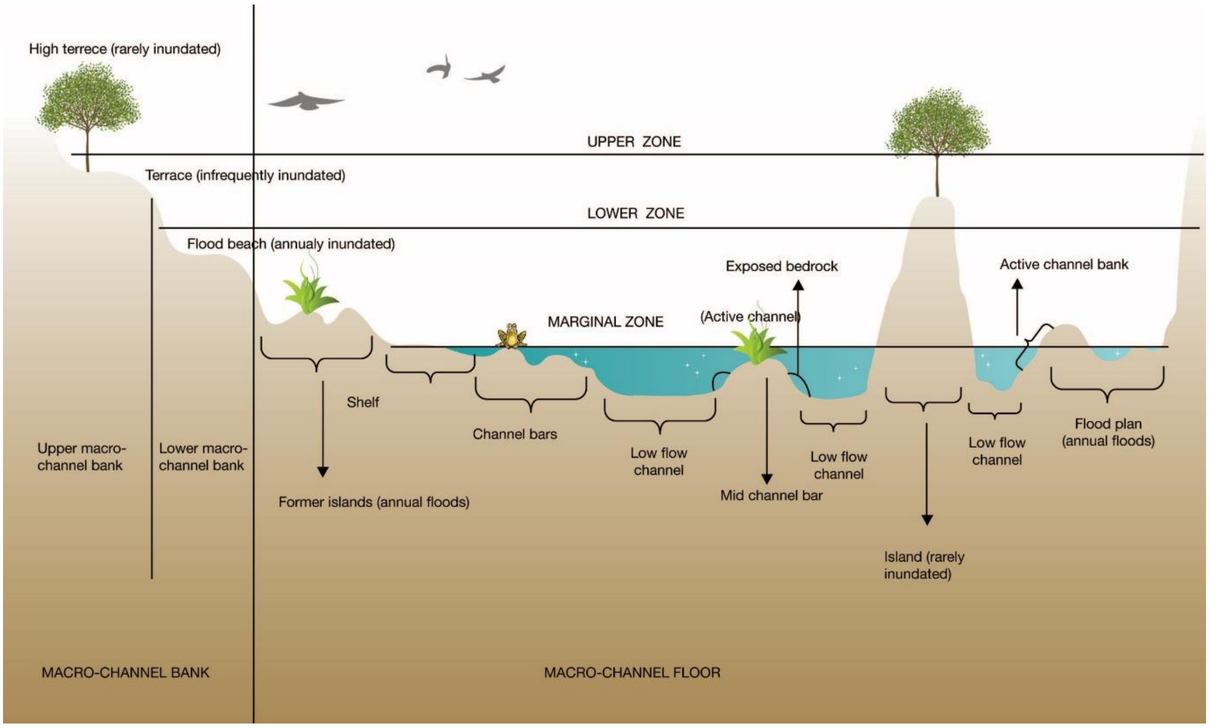

Figure 11: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

The vegetation of riparian areas is divided into three zones, the marginal zone, lower non-marginal zone and the upper non-marginal zone (Table 1). The different zones have different vegetation growth.

Table 1: Description of riparian vegetation zones (Kleynhans *et al*, 2007).

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the Greater part of the year.	Usually a marked increase in lateral Elevation.	Usually a marked decrease in lateral elevation
Characterized	See above ; Moist	Geomorphic features	Geomorphic features

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
by	substrates next to water's edge; water loving- species usually vigorous due to near permanent access to soil moisture	that are hydrologically activated (inundated or moistened) on a Seasonal basis. May have different species than marginal zone	that are hydrological activated (inundated or moistened) on an Ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

Riparian Area:

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 12) (Kotze, 1999).

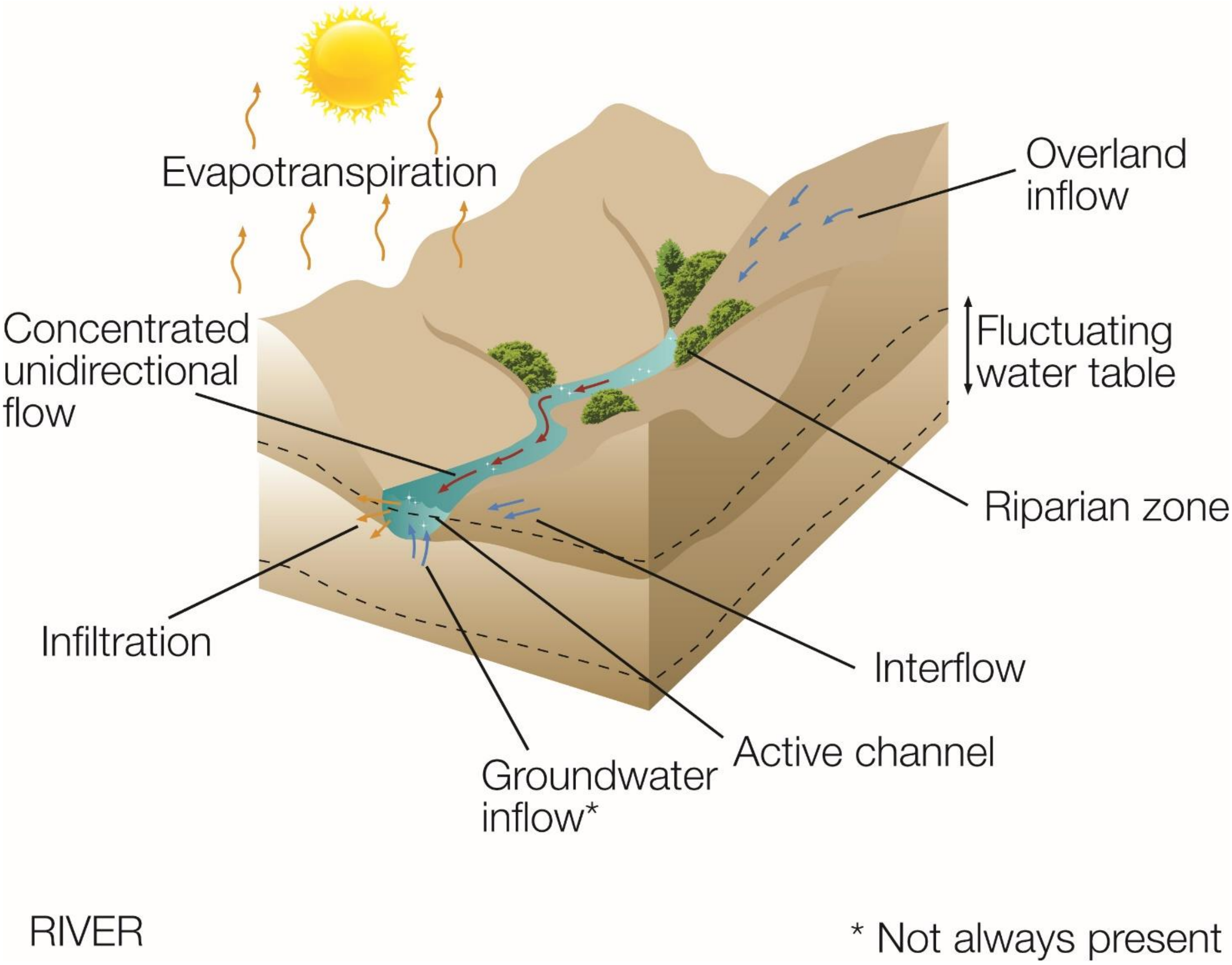

Figure 12: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel. Two types of temporary rivers are recognized, namely “ephemeral” rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and “episodic” rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman *et al*, 2010).

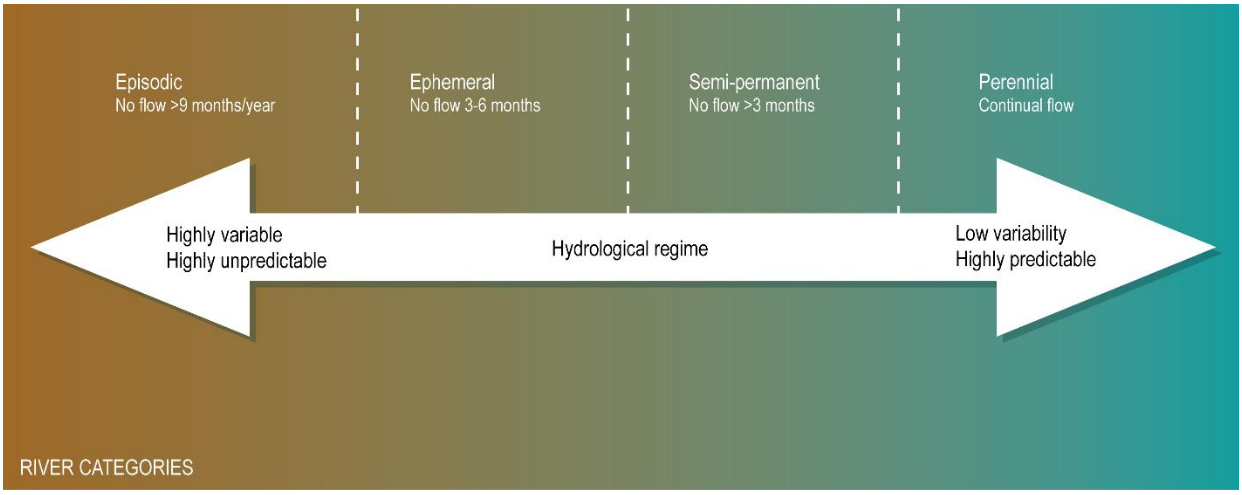

Figure 13: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

2.2 Wetland /Riparian Classification and Delineation

The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (SANBI, 2009). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line with a level three category recognised in the classification system proposed in SANBI (2009). HGM units take into consideration factors that determine the nature of water movement into, through and out of the wetland system. In general HGM units encompass three key elements (Kotze *et al*, 2005):

- Geomorphic setting - This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
- Water source - There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
- Hydrodynamics - This refers to how water moves through the wetland.

The classification of wetland/riparian areas found within the study site and/or within 500 m of the study site (Ollis et al, 2013) can therefore be described as rivers/riparian areas as presented in Figure 12.

2.3 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments. The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. A brief description of each of the functions and associated services is outlined in Table 2 below.

Table 2: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al*, 2010)

Primary Role	Buffer Functions
Maintaining basic aquatic processes, services and values.	• Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands.
Reducing impacts from upstream activities and adjoining land uses	• Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water from adjoining lands thus reducing the sediment load of surface waters. • Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use. • Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing the potential for excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments. • Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. These must however be considered in conjunction with other mitigation measures.

New buffer tools have been developed and been published as “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Consolidated Report” by the WRC (Macfarlane *et al* 2015). This new buffer tool aims to calculate the best suited buffer for each wetland or section of a wetland based on numerous on-site observations. The resulting buffer area can thus have large differences depending on the current state of the wetland as well as the nature of the proposed development. Developments with a high risk factor such as mining are likely to have a larger buffer area compared to a residential development with a lower risk factor. The minimum accepted buffer for low risk developments are however 15 meters from the edge of the wetland (Macfarlane, *et al* 2015) as opposed to the generic recommendation of 30 m for wetlands inside the urban edge and 50 m outside the urban edge (GDARD, 2012).

The proposed activities are likely to mostly occur outside the rivers/riparian areas delineated in this report. The calculated buffer for this study amounts to 15 m.

2.4 Impact Assessments

2.4.1 NEMA (2014) Impact Ratings

As required by the 2014 NEMA regulations, impact assessment should provide quantified scores indicating the expected impact, including the cumulative impact of a proposed activity. This assessment follows the format presented below:

The impact assessment score below are calculated using the following parameters:

- Direct, indirect and cumulative impacts of the issues identified through the specialist study, as well as all other issues must be assessed in terms of the following criteria:
    - The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
    - The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
    - The **duration**, wherein it will be indicated whether:
        - The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
        - The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
        - Medium-term (5–15 years) – assigned a score of 3;
        - Long term (> 15 years) - assigned a score of 4; or
        - Permanent - assigned a score of 5;
    - The consequences (magnitude), quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
    - The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
    - The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
    - The status, which will be described as either positive, negative or neutral.
    - The degree to which the impact can be reversed.
    - The degree to which the impact may cause irreplaceable loss of resources.

- The degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

- S=(E+D+M)P
- S = Significance weighting
- E = Extent
- D = Duration
- M = Magnitude
- P = Probability

The **significance weightings** for each potential impact will be determined as follows (Table3):

Table 3: Significance Weightings

Points	Significant Weighting	Discussion
< 30 points	Low	This impact would not have a direct influence on the decision to develop in the area.
31-60 points	Medium	The impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60 points	High	The impact must have an influence on the decision process to develop in the area.

2.4.2 DWS (2014) Impact Register and Risk Assessment

Section 21(c) and (i) water uses (Impeding or diverting low and/or impacts to the bed and banks of watercourses) are non-consumptive and their impacts more difficult to detect and manage. They are also generally difficult to clearly quantify. However, if left undetected these impacts can significantly change various attributes and characteristics of a watercourse, and water resources, especially if left unmanaged and uncontrolled.

Risk-based management has value in providing an indication of the potential for delegating certain categories of water use "risks" to DWS regional offices (RO) or Catchment Management Agencies (CMA). Risk categories obtained through this assessment serve as a guideline to establish the appropriate channel of authorisation of these water uses

The DWS has therefore developed a risk assessment matrix to assist in quantifying expected impacts. The scores obtained in this assessment are useful in evaluating how the proposed activities should be authorised.

The formula used to derive a risk score is as follows:

RISK = CONSEQUENCE x LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

Table 4 below provides a description of the classes into which scores are sorted, and their implication for authorization.

Table 4: An extract from DWS (2014) indicating the risk scores and classes as well as the implication for the appropriate authorization process

RATING	CLASS	MANAGEMENT DESCRIPTION	AUTHORISATION	DELEGATION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands are excluded.	GA	Regional Head
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.	WUL	Regional Head
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.	WUL	Director General

2.5 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al*, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999). The impacts observed for the affected wetlands on the study site are summarised for each wetland under section 3.2. These impacts are based on evidence observed during the field survey and land-use changes visible on aerial imagery.

The allocations of scores in the functional and integrity assessment are subjective and are thus vulnerable to the interpretation of the specialist. Collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that are predominantly addressed include hydrological and geomorphological function (subjective observations) and the integrity of the biodiversity component (mainly based on the theoretical intactness of natural vegetation) as directed by the assessment methodology.

2.5.1 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the rivers/drainage lines/riparian areas was assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans *et al*, 2007) Table 5 below provides a description of each EC category.

Table 5: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 1999)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

2.5.2 Quick Habitat Integrity Model

To accommodate a less-detailed process, a desktop habitat integrity assessment (using the Quick Habitat Integrity model) that allows for a coarse assessment was developed. This assessment rates the habitat according to a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics (Seaman *et al*, 2010):

- Bed modification.
- Flow modification.
- Introduced Instream biota.
- Inundation.
- Riparian / bank condition.
- Water quality modification.

3 RESULTS

3.1 Land Use, Cover and Ecological State

The study site is dominated by Thicket/Dense Bush, Woodland/Open Bush and with farming activities such as the chicken runs in the northern section and with the remainder of the study area comprising of game farming. Historically the area especially the northern section of the study area was used for cattle farming which might have been subjected to overgrazing and trampling (especially along the watercourses). Evidence of sedimentation and natural scouring can also be seen within the watercourses (Figure 16). The construction of earthen dams (farm dams) within the watercourses (Figure 16) lead to inundation of sections of the streams and formation of an erosion gully as a result of the failure of a dam wall (Figure 16).

Other direct land uses that may affect the watercourses include the provincial road to the west of the study site including the farm roads and associated bridges/stream crossings within the study area.

3.2 Wetland/Riparian Classification and Delineation

A total of five natural watercourses and numerous artificial waterbodies including farm (earthen) dams and artificial canals were found on site (Figures 14 & 15). Of the five natural watercourses only two, the Selons River and the downstream sections of a smaller tributary of the Selons River, are classified as perennial rivers in terms of information from National Geospatial Information (NGI) and National Freshwater Ecosystems Priority Areas (NFEPA). Site verification and information from the farm proved that these two watercourses are instead non-perennial ephemeral rivers. The remaining three watercourses are classified as ephemeral drainage lines (no flow for 3 – 6 months). It should however be noted that due to the current droughts some of these ephemeral rivers might even be classified as "episodic" as the indication is that they only flow in response to extreme rainfall events. It should further be noted that each of these natural watercourses/aquatic ecosystems identified, delineated and assessed in this study include various small tributaries/headwater streams that drain into the main watercourses. The drainage lines in the south-east corner of the study area located on the hillside (Figure 15). These watercourses are difficult to identify except during periods of rain although indicators such as topographic positon (low points in the landscape) and evidence of sediment deposition and debris can provide a sufficient indication. More watercourses not included in this assessment are located within the surrounding area. Another non-perennial ephemeral river not affected by the proposed chicken runs is located to the east and the north-east of the RCL properties. The rivers/watercourses that are likely to be impacted in some way by the proposed poultry farm are numbered as follows:

- Selons River (Non-Perennial River located in the north-west corner of the RCL properties);
- Non-Perennial 2 (tributary of the Selons River);
- Non-Perennial 3 (tributary of Non-Perennial 2);
- Non-Perennial 4 (tributary of Non-Perennial 3); and
- Non-Perennial 5 (tributary of a Non-Perennial River located to the North-East of the RCL properties).

A dense tree layer including larger shrubs is the dominant riparian vegetation along the watercourses which supress the development of a grass and herb layer (Figure 16). Historic overgrazing of the grass and herb layer together with periods of drought could have assisted with the formation of dense thickets (bush encroachment) evident from species such as *Dichrostachys cinerea* (Sickle Bush). Evidence of current grazing on the limited hydrophilic vegetation was also found during the site visit. The limited ground cover in the riparian areas resulted in little or no protection for the streambanks which resulted in channelization, channel collapse and headcut erosion (Figure 17). Grass species adapted to reduced light conditions such *as Panicum maximum* (Guinea Grass) were present along the watercourses. Other shade tolerant plants found along the banks of the watercourse included *Bryophyta* (Moss) (Figure 17) and *Pteridophyta* (Ferns and fern allies). Mosses play an important role in controlling erosion in riparian areas, and often do so by forming mats that bind the soil surface together and prevent it from being washed away. Dominant tree species found in the riparian areas included *Searsia lancea* (Sour Karee) and the diagnostic tree species within this vegetation group was *Combretum erytrophyllum* (River Bushwillow). The shrubs were dominated by *Buddleja saligna* (False Olive) and *Euclea undulata* (Common Guarri).

The most common riparian and wetland species recorded in these rivers are listed below:

- *Cyperus sexangularis*
- *Kylinga spp.*
- *Pteridophytes* (Ferns and fern allies)
- *Bryophyta* (Moss)
- *Typha capensis* (recorded in one of the earthen dams*)*

The watercourses recorded on the study area are classified up to level 6 according to the SANBI guidelines (Ollis *et al,* 2013) and summarised in Tables 6 to 8:

Table 6: Level 1- 4 classification of the aquatic ecosystems recorded on the study site (adapted from Ollis *et al*, 2013).

Level 1: System Type	**Level 2: Regional Setting**	**Level 3: Landscape Setting**	**Level 4: HGM Unit**		
System	**DWA Ecoregion**	**Landscape Unit**	**Level 4A:Wetland Type**	**Level 4B: Longtitudinal zonation**	**Level 4C: Inflow drainage**
Inland	Western Bankenveld (7) & Bushveld Basin (8)	Plain	Selons River (Non-Perennial)	Upper Foothills	Active Channel
			Non-Perennial 2: River	Upper Foothills	Active Channel
		Slope	Non-Perennial 3: River	Transitional zone	Riparian Zone
			Non-Perennial 4: River	Transitional zone	Riparian Zone
			Non-Perennial 5: River	Upper foothills	Riparian Zone

Table 7: Level 5 classification of the aquatic ecosystems recorded on the study site (adapted from Ollis *et al*, 2013).

Level5: Hydroperiod and depth of inundation					
Level 5A	**Proportional Rating (0-6) for wetlands on site**				
Inundation Peroid					
	Selons River (Non-Perennial)	Non-Perennial 2	Non-Perennial 3	Non-Perennial 4	Non-Perennial 5
Permanently Inandated	1	1	0	0	0
Seasonally Inandated	2	2	1	1	1
Intermittently Inandated	2	2	1	1	1
Never/Rarely Inandated	2	2	3	3	3
Unknown					
Level 5A	**Proportional Rating (0-6) for wetlands on site**				
Saturartion periodicity (within 50 cm of the soil surface)					
Permanently Inandated					
Seasonally Inandated	2	2	1		
Intermittently Inandated	3	3	2	1	1
Never/Rarely Inandated			3	4	4
Unknown					
Level 5C: Inundation depth-class					
	n/a	n/a	n/a	n/a	n/a

Table 8: Level 6 classification of the wetland recorded on the study site (adapted from Ollis *et al*, 2013).

Component	Dominant categories for selected descriptorss (Level 6)							
	Natural vs Artificial		Substratum Type	Vegetation Cover, Form and Status				
						Detailed Vagetation From		
	6A: NAtural vs Artificial	6B: Artificial Categories	6A: Primary Categories	6A: Vegetation Cover	6B: Primary Vegetation Cover	6C: Herbaceous Vegetation	6D: Forest Vegetation	6E: Vegetation Status
Selons River (Non-Perennial)	Natural	N/A	Cobbles, gravel including Clayey Soil	Vegetated	Herbaceous,Forest & Shrubs/Thicket	Riparian Forest,Herbs/forbs, Grasses	Riparian Vegetation	Indigenous
Non-Perennial 2	Natural	N/A	Clayey Soil ,gravel, cobbles	Vegetated	Herbaceous,Forest & Shrubs/Thicket	Riparian Forest,Herbs/forbs, Grasses	Riparian Vegetation	Indigenous
Non-Perennial 3	Natural	N/A	Silt,gravel, cobbles	Vegetated	Shrubs/Thicket & Herbaceous	Riparian Forest,Herbs/forbs, Grasses	Riparian Vegetation	Indigenous
Non-Perennial 4	Natural	N/A	Silt,gravel, cobbles	Vegetated	Shrubs/Thicket & Herbaceous	Herbs/forbs, Grasses	Riparian Vegetation	Indigenous
Non-Perennial 5	Natural	N/A	Silt,gravel, cobbles	Vegetated	Shrubs/Thicket & Herbaceous	Herbs/forbs, Grasses	Riparian Vegetation	Indigenous

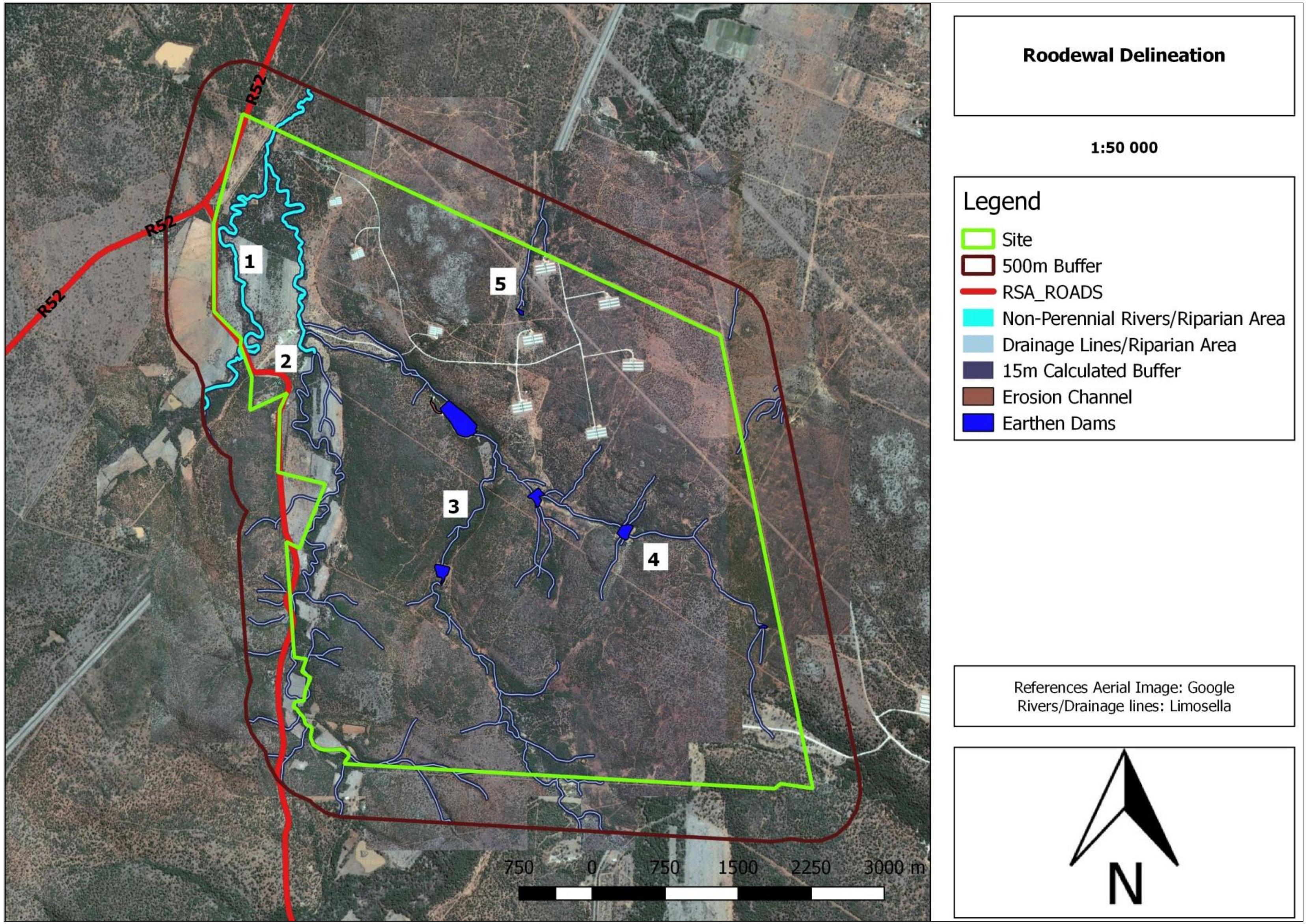

Figure 14: Riparian areas associated with the study site.

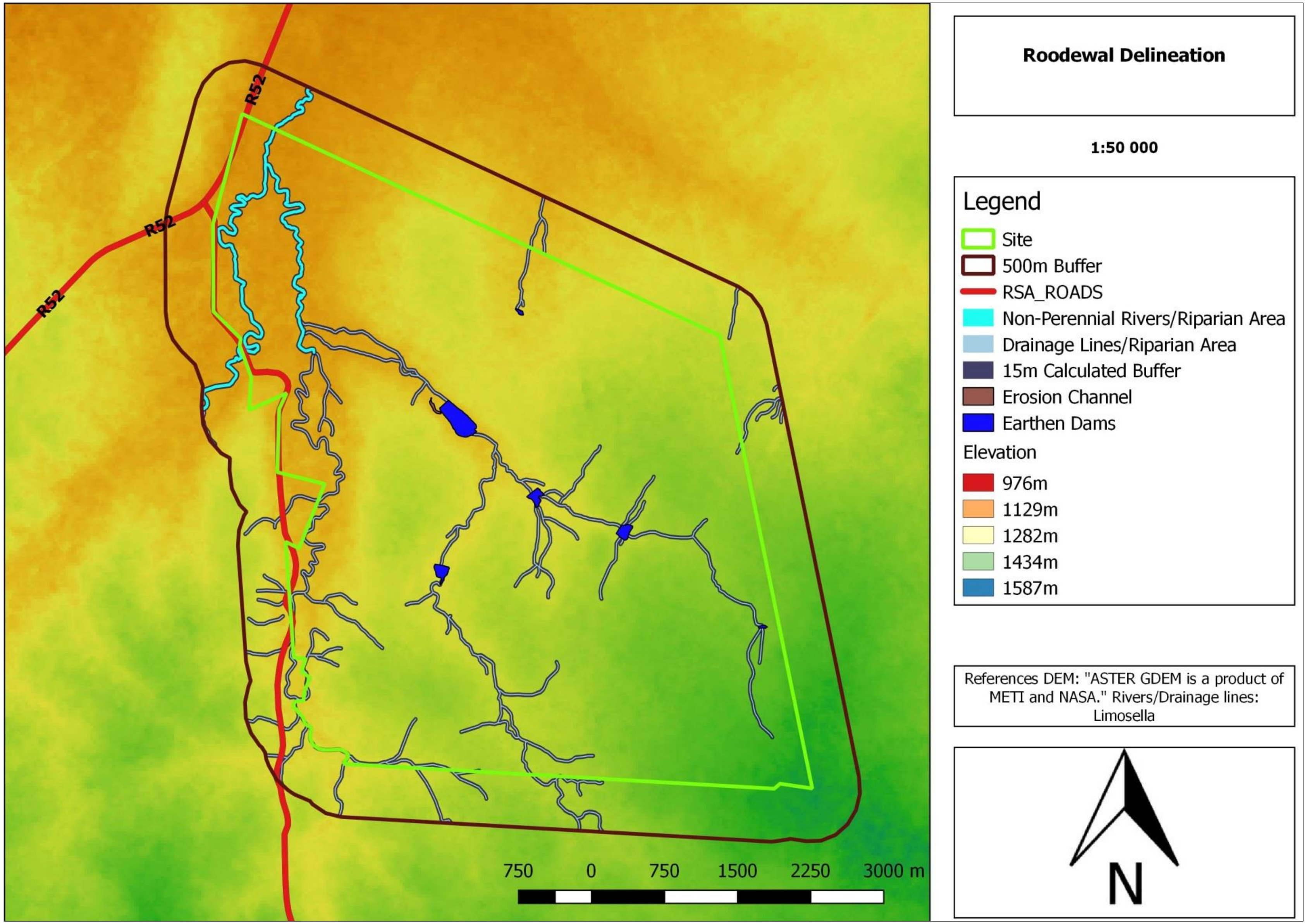

Figure 15: Riparian areas delineated and their position in the landscape.

Riparian Vegetation Response Assessment Index (VEGRAI) & Quick Habitat Integrity (QHI)

Riparian Vegetation Response Assessment Index_(VEGRAI and the Quick Habitat Integrity (QHI) assessment was done do determine the Ecological Category (EC) of the perennial and non-perennial systems and the drainage areas (Tables 9-14):

Table 9: Results of the Ecosystem Services provided by the Selons River (non-perennial) (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	58.2	29.1	2.5	1.0	100.0
NON MARGINAL	67.3	33.6	2.5	2.0	40.0
	2.0				140.0
LEVEL 3 VEGRAI (%)				60.8	
VEGRAI EC				**C/D**	
AVERAGE CONFIDENCE				2.5	

Table 10: Results of the Ecosystem Services provided by the non-perennial River 2 (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	58.5	41.8	2.5	1.0	100.0
NON MARGINAL	67.3	19.2	2.5	2.0	40.0
	2.0				140.0
LEVEL 3 VEGRAI (%)				61.0	
VEGRAI EC				**C/D**	
AVERAGE CONFIDENCE				2.5	

Table 11: Results of the Ecosystem Services provided by the non-perennial River 3 (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	80.0	61.5	2.5	1.0	100.0
NON MARGINAL	80.0	18.5	2.0	2.0	30.0
	2.0				130.0
LEVEL 3 VEGRAI (%)				80.0	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				2.3	

Table 12: Results of the Ecosystem Services provided by the non-perennial River 4 (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	77.0	59.2	2.5	1.0	100.0
NON MARGINAL	77.0	17.8	2.0	2.0	30.0
	2.0				130.0
LEVEL 3 VEGRAI (%)				77.0	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				2.3	

Table 13: Results of the Ecosystem Services provided by the non-perennial River 5 (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	76.4	58.7	2.8	1.0	100.0
NON MARGINAL	76.4	17.6	2.0	2.0	30.0
	2.0				130.0
LEVEL 3 VEGRAI (%)				76.4	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				2.4	

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Table 14: QHI for the non-perennial and drainage areas on the study site (Seaman *et al*, 2010).

QUATERNARY CATCHMENT	**RIVER**	Bed modification (0-5)	Flow modification (0-5)	Inundation (0-5)	Riparian/Bank condition (0-5)	Water quality modification (0-5)	**DESKTOP HABITAT INTEGRITY**	**INSTREAM EC%**	**INSTREAM EC**	Vegetation Rating (0-5)	**ECOSTATUS %**	**ECOSTATUS EC**	CONFIDENCE (1-5)
A22C	Selons River	2.5	2	2	3	1	**67.0**	**67.0**	**C**	4	**58.0**	**C/D**	**3:MODERATE**

A22C	Non-Perennial 2	2.5	2	2	3	1	**67.0**	**67.0**	**C**	4	**58.0**	**C/D**	**3:MODERATE**
A22C	Non-Perennial 3	1.5	1	3	2.5	0	**74.0**	**74.0**	**C**	3	**66.0**	**C**	**3:MODERATE**
A22C	Non-Perennial 4	2	1.5	2.5	2.5	0.5	**72.0**	**72.0**	**C**	3	**68.0**	**C**	**3:MODERATE**
A22C	Non-Perennial 5	1.5	2	2	2.5	0.5	**74.0**	**74.0**	**C**	3	**66.0**	**C**	**3:MODERATE**

Figure 16 a. Evidence of sedimentation and natural scouring can also be seen within the watercourses. b. Earthen dams (farm dams) within the watercourses c. Erosion gully as a result of the failure of a dam wall d. Dominant dense tree layer along the watercourses which prevent the development of grass and herb species.

a b. c. d.

Figure 17 a. Channelization and channel collapse visible in the Selons River. b. Erosion visible in the downstream area of the Selons River near the R52. c. Shade tolerant plants such as *Bryophyta* (Moss) found along the banks of Non-Perennial 2 d.Biesiesgras/Matjiesgoed (*Cyperus sexangularis*) at the Selons River..

3.3 Impacts and Mitigations

A development has several impacts on the surrounding environment and particularly on an aquatic ecosystems such as rivers and riparian areas. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater run-off, and therefore the hydrological regime of the site. Site specific mitigation measures should be included in an Environmental Management Plan.

The proposed development aims to avoid the streams although some impacts may occur in the short term such as sedimentation and erosion it is likely that these impacts will be rectified during rehabilitation.

The impacts relevant to the proposed development is likely to include:

- Changing the quantity and fluctuation properties of the watercourse by for example stormwater/ surface water runoff input, or restricting water flow. The sources of this impacts include the compaction of soil, the removal of vegetation, surface water redirection and construction of infrastructure.
- Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the wetland and increase the turbidity of the water.
- The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a wetland, and outcompete natural vegetation, decreasing the natural biodiversity.
- Construction and operational activities will result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in wetland function as well as human and animal waste. Could possibly impact on groundwater.

Suggested primary management procedures are summarised in Table 15– 17.

Table 15: Changes in water flow regime impact ratings

Nature: Changing the quantity and fluctuation properties of the watercourse by for example stormwater/surface water runoff input, or restricting water flow

ACTIVITY: Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow. The sources of this impacts include:

- The compaction of soil, the removal of vegetation, surface water redirection and construction of infrastructure

	Without mitigation	With mitigation
	CONSTRUCTION PHASE	
Probability	Highly probable (4)	Probable (3)
Duration	medium term (3)	Short term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**44 (medium)**	**24 (low)**
Status (positive or negative)	Negative	Negative
	OPERATIONAL PHASE	
Probability	Improbable (2)	Improbable (2)
Duration	medium term (3)	medium term (3)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**22 (low)**	**16 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only the construction footprint and no access roads can be considered. This is subjected to authorization by means of a water use license
- Construction must be restricted to the dryer winter months where possible.
- A temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse.
- Effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP. High energy stormwater input into the watercourses should be prevented at all cost. Changes to natural flow of water (surface water as well as water flowing within the soil profile) on the site above the river/wetland area resulting from the proposed chicken run development should be taken into account.

Cumulative impacts: Construction activities throughout the farm for the chicken runs and access roads may result in cumulative impact to the water courses within the local catchments and beyond. It is very important that protective measures should be put into place and monitored. A rehabilitation plan should be put into action should any degradation be observed as a result from stormwater or sediment input.

Residual Risks: Impacts to the flow characteristics of this watercourse are likely to be permanent unless rehabilitated.

Table 16: Changes in sediment entering and exiting the system impact ratings

Nature: Changes in sediment entering and exiting the system.		
Activity: Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the wetland and increase the turbidity of the water. Possible sources of the impacts include: • Earthwork activities during construction of the chicken runs and associated infrastructure such as access roads. • Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil. • Disturbance of soil surface • Disturbance of slopes through creation of roads and tracks adjacent to the watercourse • Erosion (e.g. gully formation, bank collapse)		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**36 (medium)**	**18 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Permanent (4)	Permanent (4)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Low (4)	Low (4)
Significance	**30(low)**	**18 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • Water may seep into earthworks. It is likely that water will be contaminated within these earthworks and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Effective sediment traps should be installed. • Construction in and around watercourses must be restricted to the dryer winter months where possible.		

- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover.
- Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- During the construction phase measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
- Runoff from the construction area must be managed to avoid erosion and pollution problems.
- Implementation of best management practices
- Source-directed controls
- Buffer zones to trap sediments
- Monitoring should be done to ensure that sediment pollution is timeously dressed

Cumulative impacts: Expected to be moderate. Should mitigation measure not be implemented and changes made to the bed or banks of watercourse unstable channel conditions may result causing erosion, meandering, increased potential for flooding and movement of bed material, which will result in property damage adjacent to and downstream of the site. Reversing this process is unlikely and should be prevented in the first place.

Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 17: Introduction and spread of alien vegetation impact ratings.

Nature: Introduction and spread of alien vegetation.

- ***Activity:*** The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a wetland, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plans can easily colonise and impact on downstream users.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**36 (Medium)**	**16 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Improbable (2)	Very Improbable (1)
Duration	Short-term (2)	Very Short (1)
Extent	Limited to Local Area (2)	Limited to the Site (1)

Magnitude	High (6)	Low (4)
Significance	**20 (low)**	**6 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Weed control
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area and returning it where possible afterwards.
- Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish.
- Rehabilitate or revegetate disturbed areas

Cumulative impacts: Expected to be moderate to high. Construction areas within the watercourses along the proposed servitude can experience an increased invasion if mitigation is not implemented or implemented correctly. Regular monitoring should be implemented during construction, rehabilitation including for a period after rehabilitation is completed.

Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 18: Changes in water quality due to foreign materials and increased nutrients impact ratings.

Nature: Changes in water quality due to foreign materials and increased nutrients impact ratings.

- ***Activity:*** Construction, operational and decommissioning activities will result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in wetland function as well as human and animal waste. Could possibly impact on groundwater

	Without mitigation	**With mitigation**
	CONSTRUCTION PHASE	
Probability	Probable (3)	Improbable (2)
Duration	Short duration (2)	Very short duration (1)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (medium)**	**14 (low)**
Status (positive or negative)	Negative	Negative
	OPERATIONAL PHASE	
Probability	Probable (3)	Very Improbable (1)
Duration	Short duration (2)	Very short duration (1)
Extent	Limited to Local Area (3)	Limited to the Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (medium)**	**6 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate

<table>
<tr><td>Irreplaceable loss of resources?</td><td>Low</td><td>Low</td></tr>
<tr><td>Can impacts be mitigated?</td><td colspan="2">Yes</td></tr>
<tr><td colspan="3">Mitigation:

Provision of adequate sanitation facilities located outside of the watercourse/riparian area or its associated buffer zone.
Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation and to prevent contaminated runoff into the watercourse.
During decomissioning activities, workers are not allowed to use watercourse and associated buffers as ablution facilities.
Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone
The development footprint must be fenced off from the watercourse and no related impacts may be allowed into the watercourse e.g. water runoff from cleaning of equipment, vehicle access etc.
After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use.
Maintenance of construction vehicles / equipment should not take place within the watercourse or watercourse buffer.
Control of waste discharges
Maintenance of buffer zones to trap sediments with associated toxins
Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects.
Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse
Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects.
Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse
Regular independent water quality monitoring should form part of operational procedures in order to identify pollution
Treatment of pollution identified should be prioritized accordingly.
</td></tr>
<tr><td colspan="3">Cumulative impacts: Expected to be moderate. Once in the system it may take many years for some toxins to be eradicated.</td></tr>
<tr><td colspan="3">Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.</td></tr>
</table>

In addition to the impact ratings a risk assessment was completed establish and quantify the 'uncertainty of the outcome' associated with a particular section 21(c) or (i) water use as specified in DWS (2014). An extract from the Risk Matrix spreadsheet presented in Tables 19 to 21 below show that the expected risk score falls within the Low (4 activities) to Moderate(2 activities) risk category.

<u>Low Risk category:</u> The risk and impact on watercourses are acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

<u>Moderate Risk category:</u> Activities that are notable and require mitigation measures on a higher level, which costs more and require specialist input. Activities which fall within this category should be authorised through a Water Use Licence.

Table 19: The severity score derived from the DWS (2014) risk assessment matrix for the proposed powerline construction and operation

Activity	Aspect	Phase	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+ Vegetation)	Biota	Severity
Construction and development of 17 additional chicken runs at Roodewal	Access roads (assuming possible crossing of drainage lines/rivers)	Construction	Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow, loss of vegetation and habitat, erosion, sedimentation, pollution	3	2	2	2	**2.25**
	Earthwork activities (near or within the catchment of the watercourses)			2	1	1	1	**1.25**
	Construction of infrastructure (near or within the catchment of the watercourses)			2	1	1	1	**1.25**
	Storm Water Management			3	1	1	1	**1.75**
Operation of the chicken runs	Day to day use operation of the chicken runs	Operation	Loss of river/riparian areas, changed hydrology, erosion, changes to sediment movement	2	2	1	2	**1.75**
	Maintenance of infrastructure			2	2	2	2	**2**

RISK = CONSEQUENCE x LIKELIHOOD
CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION
LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

Table 20: The significance score derived from the DWS (2014) risk assessment matrix for the proposed activities

Activity	Aspect	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
Construction and development of 17 additional chicken runs at Roodewal	Access roads (assuming possible crossing of drainage lines/rivers)	**2.25**	2	2	**6.25**	1	2	4	2	9	**56.25**	**M**
	Earthwork activities (near or within the catchment of the watercourses)	**1.25**	2	2	**5.25**	1	3	4	2	10	**52.5**	**L**
	Construction of infrastructure (near or within the catchment of the watercourses)	**1.25**	2	2	**5.25**	2	3	4	2	10	**52.5**	**L**
	Storm Water Management	**1.75**	2	2	**5.75**	2	3	4	2	10	**57.5**	**M**
Operation of the chicken runs	Day to day use operation of the chicken runs	**1.75**	2	2	**5.75**	1	2	4	2	**9**	**51.75**	**L**
	Maintenance of infrastructure	**2**	2	2	**6**	1	2	4	2	**9**	**54**	**L**

Table 21: Severity scores with mitigation measures

Aspect	Risk Score	Control Measure	Type of Watercourse
Access roads (assuming possible crossing of drainage lines/rivers)	M	• **During the design phase, the footprint and design of road infrastructure should aim to have the least impact on habitat quality and hydrology of the downstream river** • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Adequate provision should be made for water movement underneath the road and walkways. The design of culverts should take into account the energy of water flow and not lead to canalization of the wetland downstream. • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas) • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005). • During the construction phase measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • Runoff from the construction area must be managed to avoid erosion and pollution problems. • Buffer zones to trap sediments • Active rehabilitation • The required mitigation measures to limit the impacts on the watercourse and associated buffers should be contained within the method statement. • Plan construction camps to be placed outside of watercourses and their associated buffer zones • No stockpile areas should be located within riparian/wetland boundaries, or within the associated buffer zone. • No vehicles and access of persons should be allowed through any riparian area, except where approved by the relevant authority	Non-Perennial Rivers, Drainage Lines and Riparian Areas
Earthwork activities (near or within the catchment of the watercourses)	L		
Construction of infrastructure (near or within the catchment of the watercourses)	L		

		• Only use access roads as designated during the planning phase • Only cross watercourses at designated points • Crossings to be undertaken with only one vehicle that have the minimum footprint as decided on during planning • All equipment should be parked overnight and/or fuelled at least 500 meters from a watercourse • Drip trays (minimum of 10cm deep) must be placed under all vehicles that stand for more than 24 hours. Vehicles suspected of leaking must not be left unattended, drip trays must be utilised. • Drip trays must be utilised during repairs and maintenance of all machinery. The depth of the drip tray must be determined considering the total amount / volume of oil in the vehicle. The drip tray must be able to contain the volume of oil in the vehicle. • Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone • Remove all construction equipment and material on completion of construction • The contractor shall ensure that excessive quantities of sand, silt and silt-laden water do not enter watercourses. Appropriate measures, e.g. erection of silt traps, or drainage retention areas to prevent silt and sand entering drainage or watercourses must be taken • Sediment barriers should be installed immediately after initial disturbance of the watercourse or adjacent upland • Where wetlands are adjacent to the construction areas and these areas slopes toward the wetland, install sediment barriers along the edge of the construction areas as necessary to prevent sediment flow into the wetland. • Sediment barriers must be properly maintained throughout construction and reinstalled as necessary until replaced by permanent erosion controls or restoration of adjacent upland areas is complete • Construction equipment must be cleaned prior to site access. This will prevent alien invasive seed from other sites to spread into disturbed soils • Cement should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase • The mixing of concrete should only be done at specifically selected sites on mortar boards or similar structures to contain run-off into drainage lines, streams and natural vegetation • Materials such as fuel, oil, paint, herbicide and insecticides must be sealed and stored in bermed	

		areas or under lock and key, as appropriate, in well-ventilated areas • These substances must be confined to specific and secured areas within the contractor's camp, and in a way that does not pose a danger of pollution even during times of high rainfall • Storage of materials as described above may not be within the 1:100 floodline, watercourses or associated buffer areas • In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately and corrective action taken • With the input of a vegetation specialist, conduct a search and rescue of all conservation worthy bulbs and ensure that they are suitably relocated • A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not be stacked on top of each other or within sensitive environs. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks. • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction. • Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. • Monitoring should be done for at least five years after completion of the construction of the chicken runs to highlight any erosion or other negative changes to downstream hydrology. Should such negative impacts be observed, a rehabilitation plan should be implemented to correct this impact. • If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent livestock and pedestrians from entering rehabilitated areas • If re-vegetation is not successful at the end of a 3-year period, develop and implement (in consultation with a professional wetland ecologist) a remedial re-vegetation plan to actively re-

		vegetate the wetland. Continue re-vegetation efforts until wetland re-vegetation is successful	
Storm Water Management	**M**	• Other than approved and authorized structure (where stormwater structures is required), no other development or maintenance infrastructure is allowed within the delineated river/riparian area or associated buffer zones • Construct any necessary erosion protection works where infrastructure such as roads intersects the channel of the wetland in order to prevent scouring or bank erosion. Gabions, reno mattresses or other stabilising structures and materials could be considered (Teixeira-Leite, 2009) • River sediments/debris are not to be used for construction (e.g.: rocks for use in gabion baskets/reno mattresses) or to be permanently removed from the system (Teixeira-Leite, 2009) • Removed sediment should be stockpiled for rehabilitation • Do not allow excavations to stand open for longer than 2 days where at all possible. Excavations should preferably be opened and closed on the same day (DWAF, 2005)	
Day to day use operation of the chicken runs	**L**	• **During the design phase, the footprint and design of structures/infrastructure should aim to have the least impact on habitat quality and hydrology of the river**	Non-Perennial Rivers, Drainage Lines and Riparian Areas
Maintenance of infrastructure	**L**	• Ensure that the activity does not result in downstream erosion or sedimentation • In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately and corrective action taken • Management of point discharges • Pollution control • Maintenance activities should follow best practice • Monitoring for downstream degradation	

4 CONCLUSION

A total of five natural watercourses and numerous artificial waterbodies including farm (earthen) dams and artificial canals were found on site. Of the five natural watercourses only two, the Selons River and the downstream sections of a smaller tributary of the Selons River, is classified as a perennial river in terms of information from National Geospatial Information (NGI) and National Freshwater Ecosystems Priority Areas (NFEPA). Site verification and information from the farm proved that these two watercourses are instead non-perennial ephemeral rivers. The remaining three watercources are classified as ephemeral drainage lines (no flow for 3 – 6 months). It should however be noted that due to the current droughts some of these ephemeral rivers might even be classified as “episodic” as the indication is that they only flow in response to extreme rainfall events. It should further be noted that each of these natural watercourses/aquatic ecosystems identified, delineated and assessed in this study include various small tributaries/headwater streams that drain into the main watercourses. The drainage lines in the south-east corner of the study area located on the hillside. These watercourses are difficult to identify except during periods of rain although indicators such as their topographic positon (low points in the local landscape) and evidence of sediment deposition and debris can provide a sufficient indication. More watercourses not included in the assessment are located within the surrounding area. Another non-perennial ephemeral river not affected by the proposed poultry farm is located to the east and the north-east of the RCL properties.

Details pertaining to the watercourses are summarised in the table below:

Table 22: Summary of findings

	Wetland Type	Quaternary Catchment and WMA area	Linked to an important River System	Coordinates and Relation to study area	Riparian Vegetation Response Assessment Index (VEGRAI)	Quick Habitat Integrity (QHI)	Buffers	Is the watercourse likely to be impacted by the proposed activity
	Non-Perennial 1	A22C - Crocodile (West) and Marico	Yes – Elands River	25°45'32.90"S and 27° 4'22.78"E	**EC: C/D**	**C/D**		No
	Non-Perennial 2	A22C - Crocodile (West) and Marico	Yes – Elands River	25°46'43.75"S and 27° 5'2.33"E	**EC: C/D**	**C/D**	**15 m** from the edge of the wetland	No
	Non-Perennial 3	A22C - Crocodile (West) and Marico	Yes – Elands River	25°46'34.73"S and 27° 5'54.64"E	**EC: B/C**	**C**		Yes (access roods)
	Non-Perennial 4	A22C - Crocodile (West) and Marico	Yes – Elands River	25°47'8.43"S and 27° 6'44.44"E	**EC: C**	**C**		Yes (access roods)
	Non Perennial 5	A22C - Crocodile (West) and Marico	Yes – Elands River	25°45'46.15"S and 27° 6'10.99"E	**EC: C**	**C**		No
NEMA Impact assessment	Most activities have a medium impact score before implementation of mitigation measures and a low score after mitigation							
DWS Impact assessment	Most of the activities associated with the poultry farm fall in the low category. Construction of access roads and stormwater management fall in the medium category. This is primarily due to the long term effect of potential impacts, such as altered surface water runoff and potential changes to water flowpaths that sustain the watercourses. It is possible that, during the detailed design phase, with the input of stormwater engineers and a geohydrologist or hydropedologist, it can be shown that mitigation for changes to the runoff properties of the infrastructure does not have a net effect on the regional hydrograph. The score may then be lowered to fall in the Low category. The DWS should be consulted regarding the necessity for application for a Water Use Lisence							

Does the specialist support the development?	Yes. However it should be done in a manner that does not further alter the natural watercourses (rivers) and their catchments, particularly in terms of potential pollution from animal waste The proposed development traverse ecological support areas (ESA1) and critical biodiversity areas (CBA2) and care should be taken to limit impacts in these areas to a minimum.
Major concerns	• Changing the quantity and fluctuation properties of the watercourse • Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount) • Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate) • Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons • Changing the physical structure within a water resource (habitat) • Erosion in the Selons River and downstream rivers
Recommendations	The placement of the chicken runs should exclude the natural watercourses/aquatic ecosystems as far as possible. Where alternatives have been investigated and watercourses and associated tributaries/headwater streams are in close proximity it is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology.
Vegetation Type and Importance	The proposed development traverses ecological support areas (ESA1) for the largest part of the site and critical biodiversity areas (CBA2) for the remainder. The Moot Plains Bushveld vegetation type which include most of the site is vulnerable.
CBA and other Important areas	Yes. However it should be done in a manner that does not further alter the natural watercourses (rivers) and their catchments. The proposed development traverse ecological support areas (ESA1) and critical biodiversity areas (CBA2) and care should be taken to limit impacts in these areas to a minimum.

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APPENDIX A: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area
Hydrophyte	any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats
Hydromorphic soil	soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils)
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991)
Wetland:	"*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the 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*." (National Water Act; Act 36 of 1998).
Wetland delineation	the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables

Appendix B: Abbreviated CVs of participating specialists

Name:	**ANTOINETTE BOOTSMA nee van Wyk**
ID Number	7604250013088
SACNASP Status:	Professional Natural Scientist # 400222-09 Botany and Ecology

EDUCATIONAL QUALIFICATIONS

- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- Short course in wetland soils, Terrasoil Science (2009)
- MSc Ecology, University of South Africa (2010 - ongoing). Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management

PUBLICATIONS

- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Comission KSA 2: K5/2346
- A.P. Grootjans, A.J.M Jansen , A, Snijdewind, P.C. de Hullu, H. Joosten, A. Bootsma and P.L. Grundling. (In Press). In search of spring mires in Namibia: the Waterberg area revisited
- Haagner, A.S.H., van Wyk, A.A. & Wassenaar, T.D. 2006. *The biodiversity of herpetofauna of the Richards Bay Minerals leases.* CERU Technical Report 32. University of Pretoria.
- van Wyk, A.A., Wassenaar, T.D. 2006. *The biodiversity of epiphytic plants of the Richards Bay Minerals leases.* CERU Technical Report 33. University of Pretoria.
- Wassenaar, T.D., van Wyk, A.A., Haagner, A.S.H, & van Aarde, R.J.H. 2006. *Report on an Ecological Baseline Survey of Zulti South Lease for Richards Bay Minerals*. CERU Technical Report 29. University of Pretoria

KEY EXPERIENCE

The following projects provide an example of the application of wetland ecology on strategic as well as fine scale as well as its implementation into policies and guidelines. (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- More than 250 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape. 2007, ongoing.
- Scoping level assessment to inform a proposed railway line between Swaziland and Richards Bay. April 2013.
- Environmental Control Officer. Management of onsite audit of compliance during the construction of a pedestrian bridge in Zola Park, Soweto, Phase 1 and Phase 2. Commenced in 2010, ongoing.
- Fine scale wetland delineation and functional assessments in Lesotho and Kenya. 2008 and 2009;
- Analysis of wetland/riparian conditions potentially affected by 14 powerline rebuilds in Midrand, Gauteng, as well submission of a General Rehabilitation and Monitoring Plan. May 2013.
- Wetland specialist input into the Environmental Management Plan for the upgrade of the Firgrove Substation, Western Cape. April 2013
- An audit of the wetlands in the City of Johannesburg. Specialist studies as well as project management and integration of independent datasets into a final report. Commenced in August 2007
- Input into the wetland component of the Green Star SA rating system. April 2009;
- A strategic assessment of wetlands in Gauteng to inform the GDACE Regional Environmental Management Framework. June 2008.
- As assessment of wetlands in southern Mozambique. This involved a detailed analysis of the vegetation composition and sensitivity associated with wetlands and swamp forest in order to inform the development layout of a proposed resort. May 2008.
- An assessment of three wetlands in the Highlands of Lesotho. This involved a detailed assessment of the value of the study sites in terms of functionality and rehabilitation opportunities. Integration of the specialist reports socio economic, aquatic, terrestrial and wetland ecology studies into a final synthesis. May 2007.
- Ecological studies on a strategic scale to inform an Environmental Management Framework for the Emakazeni Municipality and an Integrated Environmental Management Program for the Emalahleni Municipality. May and June 2007

Name:	**MARINUS AXEL BOON**
ID Number	811015 5053 084
Name of Firm:	Limosella Consulting
Position:	Wetland Specialist

SACNASP Status:	Cert. Nat. Sci (Reg. No. 200083/15)
Nationality:	South African
Marital Status:	Married
Languages:	Afrikaans (mother tongue), English, basic Dutch

EDUCATIONAL QUALIFICATIONS

- National Diploma Nature Conservation, University of South Africa (2008)
- B. Sc (Hons) Environmental Management University of South Africa (2012)
- Tools for Wetland Assessment – Certificate of Competence, Rhodes University (2012)
- Environmental Law for Environmental Managers, North-West University (NWU), 2011
- ISO 14001:2004 Lead Auditor (DQS German Association for Accreditation), 2010
- XXIII International Society for Photogrammetry and Remote Sensing (ISPRS) 2016 Summer School (Czech Republic): Natural Resource Management from data to publishing
- MSc Aquatic Health, University of Johannesburg (2016). Project Title: Unmanned Aerial Vehicle (UAV) Photogrammetry as a Tool in Aquatic ecosystem mapping, assessment and planning

PUBLICATIONS

- Boon, M., Greenfield, R., and Tesfamichael, S., 2016. Wetland Assessment Using Unmanned Aerial Vehicle (UAV) Photogrammetry. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Prague, Czech Republic, Vol. XLI-B1, pp. 781-788
- Boon, M.A., Greenfield, R. and Tesfamichael, S., 2016. Unmanned Aerial Vehicle (UAV) photogrammetry produces accurate high-resolution orthophotos, point clouds and surface models for mapping wetlands. South African Journal of Geomatics, 5(2), pp.186-200.

KEY EXPERIENCE

Marinus has more than 11 years' experience in Environmental Management and compliance monitoring by working for both the government and the private sector. Marinus developed himself in the field of Wetland specialist Studies over the last years. He completed a competency course for wetland assessments at Rhodes University in 2012. He completed and still currently undertook a number of wetland delineation and functional assessments including wetland rehabilitation and monitoring plans. Marinus is also responsible for construction projects which require a wetland specialist for detailed site planning and design as part of Water Use License requirements. He is a member of the South African Wetland Society and Gauteng Wetland Forum. Marinus recently completed his MSc in Aquatic Health at the University of Johannesburg (UJ). This MSc enables knowledge in a wide field in terms of aquatic ecosystems including: functional freshwater and wetland ecology; wetland and river management; estuaries and near shore marine environment; monitoring of wetlands and rivers; legislative aspects related to rivers and wetlands; water quality and pollution; wetland and river remediation and rehabilitation. Marinus completed his MSc thesis in a new field, which involves the use of drones (Unmanned Aerial Vehicles) for the enhancement of aquatic ecosystem studies. Project Title: Unmanned Aerial Vehicle (UAV) Photogrammetry as a Tool in Aquatic ecosystem mapping, assessment and planning (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- April 2016 to current Mhkondo Township development: Mpumalanga Wetland Delineation and Functional Assessment at Dirkiesdorp and Amsterdam
- March 2016 Dunsby Bridge, Pietermaritzburg Rehabilitation: Wetland Delineation, Functional Assessment and Rehabilitation Plan for Msunduzi Local Municipality
- September 2015: Wetland Delineation and Functional Assessment (current project) for the Matjhabeng 500MW PV Project at Odendaalrus for Sunelex
- October 2015: Wetland Delineation and Functional Assessment for the Reserve Bank Development at the Mint, City of Johannesburg, Gauteng Province for South African Reserve Bank
- March 2012 to current: Wetland Specialist (detailed site planning, design and wetland rehabilitation) for the N11 Section 10 Rehabilitation Project (current project) for SANRAL.
- March 2012 to November 2015: Wetland Specialist (detailed site planning, design and wetland rehabilitation) for the N14 Baberspan Bridge Project located within the Baberspan RAMSAR site (current project) for SANRAL
- September 2014: Wetland/Riparian Delineation and Functional Assessment for the Proposed mixed-scheme development in Ga-Rankuwa on Erf 8873, Ga-Rankuwa Unit 5, City of Tshwane , City of Tshwane, Gauteng Province.
- September 2014: Ecological Importance and Sensitivity (EIS) classification of the Klip River Wetland system and wetlands in the catchment for the Eskom Taunus Reef alignment; Gauteng.
- November 2014: Wetland rehabilitation- and monitoring plan to mitigate the construction related impacts for the Diversion of Crownwood Road, City of Johannesburg, Gauteng Johannesburg Roads Agency.
- December 2014: Wetland rehabilitation- and monitoring plan for the Doornkop Stormwater Pipes, Thulani, City of Johannesburg, Gauteng in terms of Section 24G of the National Environmental Management Act (Act No. 107 of 1998) NEMA.
- March 2014: Wetland Delineation and Functional Assessment for the Weltevreden Park Erosion Mitigation Project, City of Johannesburg, Gauteng Province..
- February 2015 Wetland Specialist for the Louieville Pipeline Project, Mpumalanga Province.
- January 2014 August 2014: Surface Water Specialist Scoping Study for the Environmental Impact Assessment of Weskusfleur Substation at Koeberg.
- March 2012: Environmental Screening Report for Kielder and Witvlei, Northern Cape for the proposed 1GW Siyathemba Solar Park for CEF (SOC).
- March 2012: Completed the Surface Water Specialist Scoping Study for the 1GW Upington Solar Park for CEF (SOC) Ltd
- March 2012 to June 2012: Completed the Wetland Delineation Specialist Study for the Closure of the existing Landfill and the opening of the new Danielskuil Landfill for Kgatelopele Municipality.

MEMBERSHIPS

- Gauteng Wetland Forum
- SAWS (South African Wetland Society) Founding member
- SACNASP (Cert. Nat. Sci. Reg. No. No 200083/15 in Ecological Science
- Certified Environmental Assessment Practitioner (EAP) with the ICB
- Member of the International Association of Impact Assessment of South Africa (IAIAsa)
- Member of the African Association of Remote Sensing of the Earth (AARSE)