Access Road for the Dwarsrug Wind Energy Facility near Loeriesfontein

Northern Cape Province

Freshwater Delineation and Impact Assessment Report

February 2019

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EXECUTIVE SUMMARY

This freshwater delineation and impact assessment report focused on providing an assessment of the affected freshwater resources along the proposed access road alternatives for the Dwarsrug Wind Energy Facility (WEF) near Loeriesfontein, Northern Cape Province.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that numerous drainage lines could be observed intersecting with the proposed alternative access roads. In addition, two wetlands were identified in nearby proximity (within 500m) of the proposed alternative access roads. These freshwater resources were further investigated by means of field verification and delineation. The in-field investigation and assessment confirmed the presence of the drainage lines, of which **sixteen (16) watercourses** in total were delineated. The watercourses were sub-divided into **thirteen minor drainage lines and three major drainage lines**. The in-field investigation also confirmed the presence of **one nearby ephemeral depression wetland**. These freshwater resources were delineated using the indicators as stipulated in the national guidelines, and were assessed further accordingly.

The present ecological state of the ephemeral depression wetland was assessed to gain an understanding of the condition of the wetland. This was assessed using the WET-Health methodology. The results showed that the wetland was assessed to be a **Class C (moderately modified) ephemeral depression wetland system**.

The potential wetland ecosystem services of the wetland were assessed to determine the functionality of the wetland. This was undertaken using the WET-Ecoservices methodology. The **ecosystem services which scored highest included sediment trapping and erosion control**. These are typical functions provided to society by such wetlands. Although, the wetland was assessed to have a relatively low significance in this regard overall.

The ecological condition of the riparian habitat for the drainage lines were assessed to gain an understanding of the condition of the habitat. This was assessed using the VEGRAI methodology. The results showed that the Ecological Condition (EC) of the riparian habitat of the minor drainage lines were assessed to be 90% unmodified and therefore, a **Class A unmodified system**. The EC of the riparian habitat of the major drainage lines were assessed to be 88% unmodified and therefore, a **Class B largely natural systems with few modifications**.

A qualitative assessment of the potential ecosystem services that could be provided by the drainage lines followed the ecological condition assessment. It was found that the primary potential ecosystem services assessed included **sediment trapping, bank stabilisation and maintenance, flood attenuation, maintenance of biotic diversity, erosion control and functioning as an ecological corridor for the migration of species**. The drainage lines were deemed relatively significant in providing these ecosystem services to society.

The ecological importance and sensitivity (EIS) of the wetland and watercourses were assessed taking into account the various determinants of each freshwater resource. The most important determinants of the wetland, which scored relatively high, were i) being ecologically sensitive as a result of any change in the natural hydrological regime, and ii) important from a migration route or breeding area, and iii) feeding site for invertebrates, amphibians and waterfowl, despite being ephemeral in nature. In addition, the wetland was identified to serve an important role in performing sediment trapping, erosion control and flood

attenuation function for the local catchment. The wetland was classified as an ESA (in terms of the Northern Cape Conservation Plan, 2016) and was assessed to be a Class C moderately modified system in terms of the present ecological state, which also raised the ecological important score. Overall however, many of the other determinants scored fairly low, and the end result was that the EIS of **the wetland was assessed to be a Class C system** which is considered to be moderately ecologically important and sensitive on a provincial or local scale. For the watercourse, the most important determinants of the wetland which scored relatively high, were i) being important as a migration route/breeding, and ii) as a feeding site for reptiles, invertebrates and waterfowl, despite being intermittent in nature. In addition to this, the watercourses were identified to serve an important role in performing sediment trapping, attenuation of storm water and energy dissipation for the local catchment. The watercourses were also identified to be sensitive to changes in the natural hydrological regime, influenced by supply reductions and alteration of flood peaks (commonly the reduction thereof) which leads to drying out of the landscape and disturbance, respectively. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring high due to the fact that the watercourses were assessed to be Class A/B systems in terms of the vegetation ecological condition. Despite these relatively high scores, **the watercourses were classed as Class C systems** due to the low scores for the remaining determinants, which averaged out the final score.

As the proposed development is to include the construction of a linear feature (dirt road) through a watercourse, a buffer zone was deemed to be impractical and ineffective, as the proposed road would need to cross the relevant watercourses regardless. **A buffer zone was therefore not recommended for the watercourses**.

The impact assessment identified potential impacts during the construction phase only. These included **potential impacts to the in-stream and riparian habitat (post-mitigation rating – medium), to the geomorphology and hydrology (post-mitigation rating – medium), and water quality (post-mitigation rating – low) of the watercourses**. Suitable **mitigation measures were proposed to minimise potential impacts** as far as possible.

A comparative assessment of the proposed alternatives for the access road was undertaken. The results showed that **Alternative Access Road 1 was preferred** given the expected reduced impact to freshwater resources.

With consideration of the condition and functionality of the watercourses identified, and the potential impacts anticipated to affect the watercourses in terms of the proposed access road, the following recommendations are made from a freshwater perspective:

- Construction stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off issues;
- Alien invasive control and management plan is to be compiled for the construction and post-construction phases by a suitably qualified ecological specialist;
- Alternative Access Road 1 should be authorised given the expected reduced impact to freshwater resources;
- Prior to construction, a risk assessment is to be undertaken on the proposed access road. This is to be undertaken to determine the need for appropriate water use authorisation with the Department of Water and Sanitation, should a preferred alternative be authorised by the Northern Cape Department of Environment and Nature Conservation.

Ultimately, the proposed access road was assessed to have a moderate to low negative potential impact significance on the watercourses to be affected, and with the implementation of the mitigation measures and recommendations stipulated. **The proposed construction of the access road is therefore supported, and should be allowed to proceed on condition that the mitigation measures proposed are implemented, in addition to obtaining the necessary water use authorisation from the Department of Water and Sanitation prior to construction.**

PROJECT DETAILS

Title	:	Freshwater Delineation and Impact Assessment Report: Access Road for the Dwarsrug Wind Energy Facility near Loeriesfontein, Northern Cape Province
Authors	:	Savannah Environmental (Pty) Ltd Shaun Taylor Gideon Raath Pr.Sci.Nat. (SACNASP) – Member No. 117178
Client	:	South Africa Mainstream Renewable Power Developments (Pty) Ltd
Report Revision	:	Revision 1
Date	:	February 2019

When used as a reference this report should be cited as: Savannah Environmental (2019). Freshwater Delineation and Impact Assessment Report: Access Road for the Dwarsrug Wind Energy Facility near Loeriesfontein, Northern Cape Province.

SPECIALIST DECLARATION OF INTEREST

I, Shaun Taylor, declare that –

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

Shaun Taylor
Name

Signature

February 2019
Date

I, Gideon Raath, declare that –

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

Gideon Raath
Name

Signature

February 2019

SHORT SUMMARY OF THE SPECIALISTS AND THEIR EXPERTISE

Shaun's highest qualification is a Master of Science Degree in Aquatic Health. Shaun has an in-depth understanding of environmental and water related South African legislation. Applicable legislation includes the National Environmental Management Act, 1998 (Act No. 107 of 1998), the Environmental Impact Assessment (EIA) Regulations (2006, 2010 and 2014, as amended) and the National Water Act, 1998 (Act No. 36 of 1998). Within the water field, Shaun has undertaken and completed numerous Water Use License Applications (WULAs), General Authorisations (GAs), Risk Assessments and Water Use License (WUL) compliance monitoring for various developments. Shaun also specialises in wetland ecology and operates as a wetland specialist, having also undertaken and completed numerous wetland and riparian assessments for renewable energy developments, linear projects as well as site specific projects. Lastly, Shaun has undertaken several wetland rehabilitation plans for various developments and a wetland offset plan.

A selection of recent specialist studies undertaken, include the following:

- Fibre Optic Line from the Aggeneys Photo-Voltaic Facility to the Aggeneis Substation, Northern Cape Province: Freshwater Delineation and Impact Assessment Report.
- Proposed Wilmar Oil Processing Facility in Phase 1A Richards Bay Industrial Development Zone in Richards Bay, Kwa-Zulu Natal Province: Wetland Delineation Assessment.
- Proposed construction of the De Wildt Solar Photovoltaic Power Plant, Gauteng Province: Surface Water Assessment;
- Proposed construction of up to a 5MW Solar Photovoltaic (PV) Energy Facility on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad, North West Province: Surface Water Assessment;
- Proposed construction of the Rietkuil Coal Railway Siding near Bronkhorstspruit, Gauteng Province: Surface Water Assessment;
- Proposed maintenance of the Water Pipeline in Parys, Ngwathe Local Municipality, Free State Province: Surface Water Assessment;
- Proposed construction of a 140MW Wind Farm and Associated Infrastructure near Hutchison, Northern Cape Province: Surface Water Assessment;
- Proposed construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province: Surface Water Assessment;
- Proposed construction of the Xha! Boom Wind Farm, Northern Cape Province: Surface Water Assessment;
- Proposed construction of the Gras Koppies Wind Farm, Northern Cape Province: Surface Water Assessment;
- Proposed construction of the Ithemba Wind Farm, Northern Cape Province: Surface Water Assessment;
- Proposed construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province;
- Proposed construction 132kV Power Lines and a Substation for Tsakane Ext 10 and 22, Gauteng Province: Surface Water Assessment;
- Proposed construction of a Linking Station, Power Lines and Substations for the Mainstream Wind Energy Facilities near Beaufort West, Western Cape Province; and
- Proposed expansion of the Mountain Valley "A" Grade Chicken Abattoir on the Remainder of Subdivision of Portion 17 (of 16) of the Farm Leeuw Poort 1120 FT, KwaZulu-Natal Province: Surface Water Assessment.

Shaun Taylor is the author of this report.

Gideon holds an MSc (Geography and Environmental Management; SU), a BSc Honours (Ecology and Environmental Studies - Cum laude; Wits) and a BSc (Geography and Environmental Management; UJ). His MSc thesis focused on the hydrological impact on the spatial distribution of invasive Eucalyptus trees along the Breede River, while his honours thesis evaluated ethnobotanical relationships around the Rio Tinto copper mine in Phalaborwa. Most recently he has worked as an Environmental Consultant at EOH Coastal and Environmental Services (EOH CES), conducting environmental authorisations applications (NWA, NEMA, MPRDA), Public Participation Processes, GIS specialisation as well as Ecological and Wetland specialist studies. Previously, Gideon worked as the Monitoring & Evaluation Project Manager for the City of Cape Town's invasive species unit (Environmental Resources Management Department).

A selection of recent specialist studies undertaken, include the following:

- City of Johannesburg nature reserve proclamation (Phase II), Johannesburg, Gauteng
- SANRAL Bierspruit R510 road upgrade Water Use Licence, Basic Assessment, Thabazimbi, Limpopo Province
- Kibler Park Church Development Ecological Assessment, Johannesburg, Gauteng
- SANRAL Caledon N2 Section 3 road upgrade project Basic Assessment, Water Use Licence and Specialist reports, Caledon, Western Cape Province
- iGas integrated biodiversity screening, Saldanha, Western Cape
- Bloekombos (Kraaifontein) botanical baseline and impact assessment, Cape Town, Western Cape
- Ancuabe baseline vegetation monitoring assessment and programme, Ancuabe, Cabo Del Gado Province, Mozambique
- Mayfield Quarry rehabilitation plan, Grahamstown, Eastern Cape
- Boshoek Loop Rail Upgrade BAR and Water Use Licence, Rustenburg, North-West Province
- Barberton IAPS Waste Water Treatment Works development BAR, water use licence and SASS 5 assessment, Barberton, Mpumalanga Province
- Wijnberg Trust Dam 2 expansion Aquatic Impact Assessment, Greyton, Western Cape

Gideon Raath is the reviewer of this report.

Curriculum vitae's (CV's) for the above specialists are attached as **Appendix A**.

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ACRONYMS

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agency
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ESA	Ecological Support Area
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
FEPAs	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GPS	Global Positioning System
GN. R	Government Notice Regulation
HGM	Hydrogeomorphic
I&AP	Interested and Affected Party
km	Kilometre
LC	Least Concern
LM	Local Municipality
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NEMA	National Environmental Management Act (No. 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Area
ONA	Other Natural Areas
PES	Present Ecological State
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
WEF	Wind Energy Facility
WUL	Water Use License

1. INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) is proposing an access road for the Dwarsrug Wind Energy Facility (WEF) near Loeriesfontein, Northern Cape Province. The Dwarsrug WEF received environmental authorisation (Reference Number: 14/12/16/3/3/2/690) on 28 September 2015 from the Department of Environmental Affairs (DEA). However, Mainstream would like to apply for environmental authorisation (EA) for an access road from the existing Granaatboskolk Road to the authorised Dwarsrug WEF, which if approved, would provide access to and from the WEF for construction and operation. The proposed access road will be ~11km in length and will be up to 12m wide.

Mainstream has requested that a freshwater delineation and impact assessment be undertaken to determine whether the proposed access road will impact on any freshwater resources along the proposed route. Shaun Taylor of Savannah Environmental (Pty) Ltd has been appointed as the independent freshwater consultant responsible for undertaking the delineation and impact assessment for the proposed access road.

1.1. Project Description and Location

South African Mainstream Renewable Power Developments (Pty) Ltd is proposing the construction of an Access Road for the Dwarsrug Wind Energy Facility near Loeriesfontein, Northern Cape Province (**Figure 1.1**).

Two alternative access roads which will be assessed are proposed, including:

- Alternative 1 - Gravel road from Granaatboskolk to the project site (approx. 11km);
- Alternative 2 - Gravel road from Granaatboskolk to the project site (approx. 8km).

The proposed access road is approximately 60km north of Loeriesfontein, in the Northern Cape Province, and falls within the jurisdiction of the Hantam Local Municipality and within the greater Namakwa District Municipality. The potentially affected properties will include the following:

- Remainder of the Farm Brakpan No. 212;
- Stinkputs No. 229;
- Portion 1 of the Farm Aan de Karee Doorn Pan No. 213;
- Remainder of the Farm Sous No. 226; and
- Narosies No. 228.

At present, untarred roads are planned for a maximum of 12m width, which will be rehabilitated to approximately 6 to 8m wide road following construction (and the agricultural use and zoning thereof restored following decommissioning). The planned power purchasing agreement and project life cycle (unless extended at a later point in time), will most likely be 20 years, for the entirety of which the proposed access road will be actively used (i.e. operational lifetime of approximately 20 years).

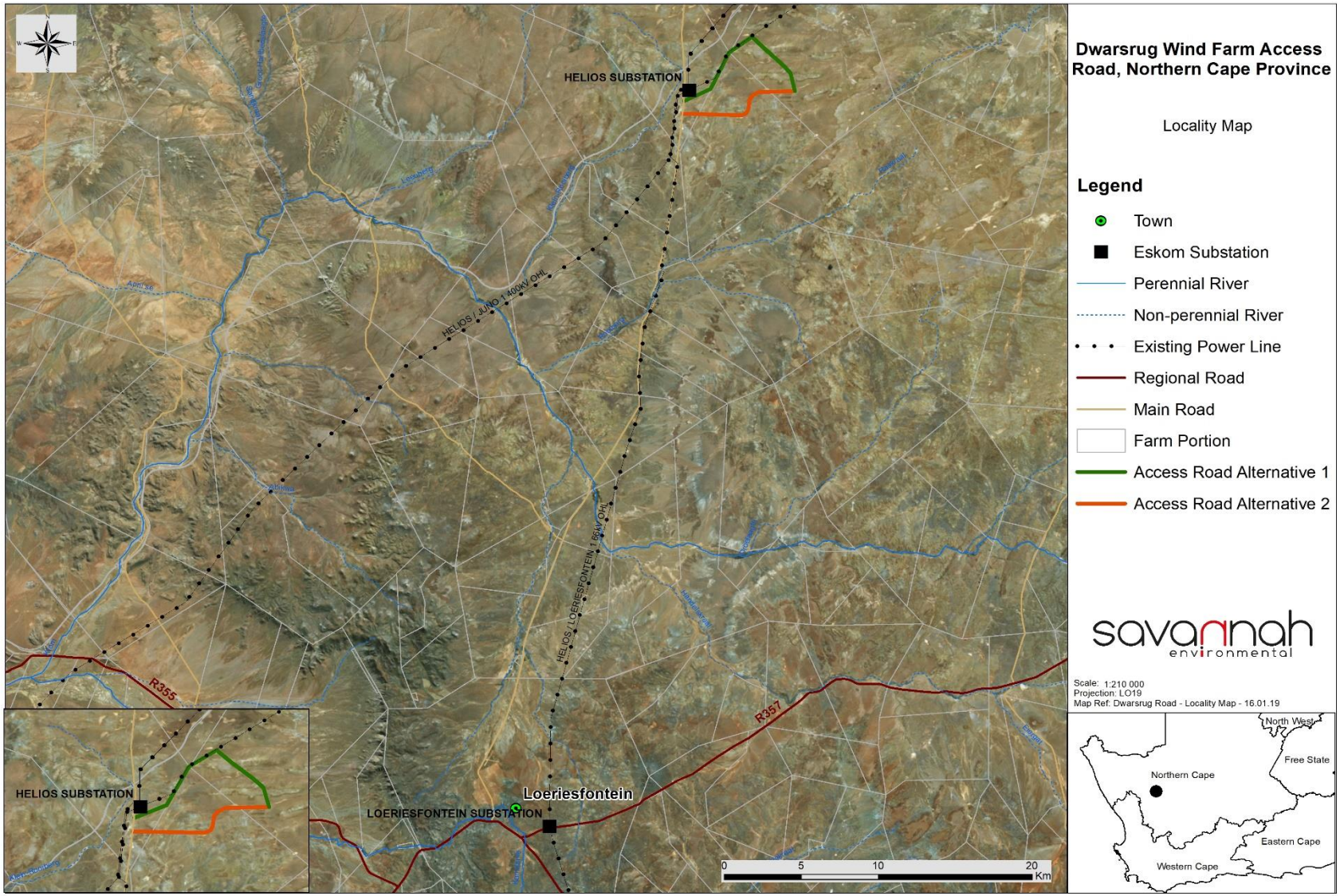

Figure 1.1: Project Locality map

Laydown areas required for the project will be identical to those for the already approved Dwarsrug WEF, and as such no additional laydown, storage or site camp facilities will be employed or required for this component of the project – i.e. the only novel infrastructure proposed is the actual road itself. Alternative 1, the preferred alternative, is approximately 11km long, while alternative 2 is approximately 8km long.

The construction period for the proposed access road is approximately 3 months, which will need to be wholly completed to enable access provision for the construction of the associated Dwarsrug WEF. The WEF has a proposed, approved, 132kV steel monopole evacuation power line that would be connecting the onsite substation at the Dwarsrug WEF to the Helios Substation, for connection and further distribution into the national grid. The preferred road alternative occurs along that route, which coincides partially with the existing Eskom 400kV lines to and from Helios Substation. The proposed access road will thus be adjacent this Eskom service road for a moderate portion of the proposed road length. While negotiations are ongoing regarding the potential thereof, the applicant aim to combine this proposed road (for which this Basic Assessment process is being submitted), and the existing Eskom distribution line service road. This road will then service both the Eskom power line and the Dwarsrug WEF traffic for the portion where they align. Should combining the road with the Eskom service road not be possible, the road will be constructed immediately adjacent the existing Eskom service road, with sufficient space provided to avoid the Eskom road and power line servitude.

The proposed access road will service the construction phase traffic for the associated Dwarsrug WEF. Thereafter it will be reduced to an approximately 6 to 8m wide road which will be utilised during the operation phase. Topsoil material will be removed and stockpiled in an appropriate manner adjacent the road, where it is sufficiently far away from the road to not prove an obstacle during operation of the road, or hampers the road safety. This topsoil will, as far as possible, be utilised for the rehabilitation of the road at both at the end of construction and decommissioning. Solid wastes produced during the construction phase of the road will be either utilised in the construction phase of the associated Dwarsrug WEF, or collected on site and disposed of at a licenced disposal facility. Should the amount of available construction fill material be insufficient, commercially sourced material may be utilised to make up the shortfall, or a separate, approved borrow pit will be utilised (to be authorised under a separate process).

The precise method statements for the development of the road will be determined prior to construction following the completion of engineering assessments and design, and contractor appointment, however the following general activities may be involved:

» Staking;
» Clearing and grubbing;
» Subgrade development;
» Fill and cut operations (if necessary);
» Compaction;
» Levelling and grading; and
» Signage or markings (if necessary).

The following machinery may likely be employed during construction:

» Bulldozers;
» Front end Loader;
» Hydraulic excavators;

» Dump trucks or scrapers; and
» Farm tractors.

The road will be suitably maintained, in line with municipal/provincial requirements or approvals, during both the construction and operation phase. Any waste material from the road construction will firstly be reused, where possible, in the larger construction of the Dwarsrug WEF, or alternatively disposed to the nearest licensed waste disposal site.

1.2. Structure of this Freshwater Delineation and Impact Assessment Report

This freshwater delineation and impact assessment report has been structured as follows:

» **Chapter 2** provides an overview of the legislative framework applicable to the proposed development from a freshwater perspective;
» **Chapter 3** provides an overview of the methodology and approach utilised in preparing this freshwater delineation and impact assessment report;
» **Chapter 4** provides the findings of the desktop assessment using the available database information;
» **Chapter 5** provides the findings of the site visit and freshwater delineation results, including the various assessments related to the identified freshwater resources;
» **Chapter 6** provides the results of the impact assessment;
» **Chapter 7** provides a comparative assessment of the alternative access roads for the proposed development;
» **Chapter 8** provides the recommendations from a freshwater specialist perspective; and
» **Chapter 9** provides the conclusion of the freshwater delineation and impact assessment report.

2. LEGISLATIVE FRAMEWORK

The applicable legislative framework plays an important role in contextualising the proposed development from a freshwater perspective. In this regard, a key component of the freshwater legislative context is to assess the proposed development in terms of the suitability of the project in accordance with the key legislation.

The following key legislation was reviewed as part of this review process:

National Legislative Context:

- Constitution of the Republic of South Africa (1996);
- National Environmental Management Act (No. 107 of 1998) (NEMA);
- Environmental Impact Assessment Regulations (2014), as amended; and
- National Water Act, 1998 (Act No. 36 of 1998) (NWA).

2.1. Constitution of the Republic of South Africa (1996)

The Constitution of the Republic of South Africa, 1996 is the supreme law of South Africa, and forms the foundations for a democratic society in which fundamental human rights are protected. The Bill of Rights contained in Chapter 2 of the Constitution enshrines the rights of all people in South Africa, and affirms the democratic values of human dignity, equality and freedom. Section 24 of the Constitution pertains specifically to the environment. It states that:

24. Everyone has the right –

(a) To an environment that is not harmful to their health or well - being; and

(b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

(i) Prevent pollution and ecological degradation.

(ii) Promote conservation.

(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The Constitution also however outlines the need to promote social and economic development. Section 24 of the Constitution therefore requires that development be conducted in such a manner that it does not infringe on an individual's environmental rights, health, or well-being and to have the environment protected. This is relevant with regards to freshwater environments, which are protected under national legislation in South Africa (see section below).

2.2. National Environmental Management Act (No. 107 of 1998) (NEMA)

The National Environmental Management Act (No. 107 of 1998) (NEMA) is South Africa's key piece of environmental legislation, and sets the framework for environmental management in South Africa. It provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. NEMA is founded on the principle that everyone has the right to an environment that is not harmful to their health or well-being as contained within the Bill of Rights. In accordance with this, it states that:

- *The State must respect, protect, promote and fulfil the social, economic and environmental rights of everyone and strive to meet the basic needs of previously disadvantaged communities.*
- *Sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations.*
- *Everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*

In addition, the National environmental management principles contained within NEMA state that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Wetlands and similar systems (such as watercourses) are specifically mentioned with regards to requiring specific attention in management and planning procedures, and therefore need to be identified within planning developments, such that adequate management procedures can be put in place to ensure negative impacts are avoided, minimised or remedied appropriately.

2.3. Environmental Impact Assessment Regulations (2014), as amended

The Environmental Impact Assessment Regulations (2014), as amended, were promulgated *inter alia* with the purpose of regulating the procedure and criteria relating to the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities subjected to environmental impact assessment, in order to avoid or mitigate detrimental impacts on the environment, and to optimise positive environmental impacts. The activities identified for which environmental authorisation is required are included in Government Notice Regulation (GN. R) 327 Listing Notice 1, GN. R 325 Listing Notice 2 and GN. R 324 Listing Notice 3. Included in the listing notices, are activities related specifically to watercourses (including wetlands). Possible activities that can be triggered are identified below in **Table 2.1**. The reasons that these activities are triggered, are included in the table below.

Table 2.1: Activities not triggered in terms of the EIA Regulations (2014), as amended, in terms of watercourses for the proposed ADSS fibre optic line

Activity No(s):	Potentially applicable Basic Assessment Activity(ies) as set out in Listing Notice 1 (GN R327)	Reason why the potentially listed activity is applicable
12(ii)(a)(c)	The development of – (ii) Infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs- (a) within a watercourse; (c) within 32 metres of a watercourse.	The proposed access road will route through several watercourses and also be within 32m of the edge of the identified watercourses (see **Section 6**). The total cumulative footprint will exceed the 100m² threshold. **This activity is therefore triggered as a result.**
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, san, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	The proposed access road will route through several of the identified watercourses (see Section 6). Activities for the construction of the access road will include *inter alia* clearing and grubbing, subgrade development, fill and cut operations (if necessary), compaction, levelling and grading. These activities are associated with the excavation, removal or moving of soil, pebbles or rock which will exceed the threshold of 10m³. **This activity is therefore triggered as a result.**

No impacts related to watercourses (including wetlands) fall within the ambit of GN. R 325 Listing Notice 2. Activities under this listing notice are therefore not applicable. Lastly, the proposed access road is not located within a sensitive area (see **Section 4**), and also do not trigger the activities under GN. R 324 Listing Notice 3.

2.4. National Water Act, 1998 (Act No. 36 of 1998) (NWA)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was developed in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. In accordance with the provisions of the National Water Act (No. 36 of 1998) (NWA), all "water uses" must be licensed with the Competent Authority (i.e. the Regional Department of Water and Sanitation (DWS) or the relevant Catchment Management Agency (CMA) where applicable). At a general level, the DWS is ultimately responsible for the effective and efficient water resources management to ensure sustainable economic and social development in line with the NWA. DWS is also responsible for evaluating and issuing licenses pertaining to water use (i.e. Water Use Licenses (WULs) and / or registration of General Authorisations (GAs)) where this is applicable to developments.

"Water use" is defined in Section 21 of the NWA and includes for the following:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38(1) of the NWA;

f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

With the above in mind, should any water resource be affected by any proposed development, the necessary WUL application and / or registration of GA(s) will become relevant where applicable. Note that a WUL application is generally applied for where the above water uses are required as a result of direct impact to watercourses. However, it must be noted indirect impacts are also taken into consideration through the applicable Government Notices. In particular, Government Notice (GN) 509 of 2016 is relevant where a watercourse is affected and is within the "regulated area (of a watercourse)". The regulated area of a watercourse is defined as:

"a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
b) In the absence of a determined 1 in 100 year flood line or riparian area, the area within 100m from the edge of a watercourse where the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to Section 144 of the Act); or
c) A 500m radius from the delineated boundary (extent) of any wetland or pan".

As such, an assessment of impacts to watercourses must be evaluated in terms of the Risk Assessment Protocol developed by the DWS in GN 509 of 2016. This protocol is implemented where a proposed development directly affects a watercourse, and may have implications for those watercourses that fall within the above-mentioned proximities ("regulated area"), when applying for authorisation from the DWS. The risk assessment should be undertaken following environmental authorisation of the proposed development once a final route and construction method is available to determine adequate control measures. The risk assessment has therefore, not been provided in this report.

3. METHOD AND APPROACH OF THE STUDY

3.1. Purpose and Objective of the Freshwater Assessment

This freshwater report has been prepared at the request of Mainstream for the purposes of establishing whether the proposed access road will affect any freshwater resources.

The objectives of the freshwater report include:

» Desktop identification of freshwater sensitivities along the proposed access road through the review of existing desktop and database information;
» Site visit, including delineation of any freshwater resources along the proposed access road route; and
» Mapping of the identified freshwater resources (from the site visit and existing data).

3.2. Approach to the Study

This freshwater report provides a snapshot of the freshwater context within which the proposed access road is proposed. It provides an overview of the freshwater environment and to which extent the current status quo is likely to change should the proposed access road development proceeds. Available information was therefore consulted to determine the status quo - which was based on desktop sources as well as field investigation and verification.

The desktop freshwater baseline was established using available database information, which comprised the following:

» Collection and review of existing database information, including:
  - South African Vegetation Types (Mucina & Rutherford, 2012);
  - National Freshwater Ecosystems Priority Areas (NFEPA) database, 2011;
  - Northern Cape Conservation Plan, 2017.
» Use of satellite imagery to identify any potential wetland areas (Google Earth™); and
» Existing freshwater related studies which cover the same study area (SiVEST, 2015).

A site visit was then conducted to investigate and verify the available desktop information. The site visit included the assessment of watercourses within the regulated area of a watercourse (see **Section 2.3**), as well as those directly along the proposed access road alternative routes.

The delineation of freshwater resources was undertaken in accordance with the DWAF (2005) guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". The draft DWAF (2008) guidelines, "Update Manual for the Identification and Delineation of Wetlands and Riparian Areas" was also consulted as a supplementary guideline.

3.3. Freshwater Definition and Classification

For the purposes of this assessment, the classification of freshwater resources was undertaken by applying the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al*., 2013). This classification system applies to inland freshwater resources or systems, which are defined as, "an aquatic ecosystem with no existing connection to the ocean". Three broad types of inland systems exist that are dealt with by the classification system, including:

- Rivers, which are 'lotic' aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically;
- Open waterbodies, which are permanently inundated 'lentic' aquatic ecosystems where standing water is the principal medium within which the dominant biota live. In the Classification System, open waterbodies with a maximum depth greater than 2 m are called limnetic (lake-like) systems; and
- Wetlands, which are transitional between aquatic and terrestrial systems, and are generally characterised by (permanently to temporarily) saturated soils and hydrophytic vegetation. These areas are, in some cases, periodically covered by shallow water and/or may lack vegetation.

The inland system classification works on a six-tiered structure (**Table 3.1**). The tiered structure progresses from Systems at the broadest spatial scale (Level 1), through Regional Setting (Level 2) and Landscape Units (Level 3), to Hydrogeomorphic (HGM) Units at the finest spatial scale (Level 4). At Level 5, Inland Systems are distinguished from each other based on the hydrological regime and, in the case of open waterbodies, the inundation depth class. At Level 6, six 'descriptors' have been incorporated into the Classification System. These descriptors allow for distinguishing between aquatic ecosystems with different structural, chemical, and/or biological characteristics. For the purposes of this assessment only a Level 4 classification was undertaken. The Level 4 classification is shown in **Table 3.2**. below.

Table 3.1: Inland System Classification (adapted from Ollis *et al*., 2013).

Distinguishing between Marine, Estuarine and Inland Systems	**Wetland/Aquatic Ecosystem Context**		**Functional Unit**		**Wetland/Aquatic Ecosystem Characteristics**
Level 1: Type of System	**Level 2: Regional Setting**	**Level 3: Landscape Unit**	**Level 4: Hydrogeomorphic (HGM) Unit**	**Level 5: Hydrological Regime**	**Level 6: Descriptors**
» Marine » Estuarine » Inland System	» Department of Water Affairs (DWA) Ecoregions » NFEPA WetVeg Groups » Other Spatial Framework	» Valley Floor » Slope » Plain » Bench	River Floodplain Wetland Channelled Valley Bottom Wetland Depression Seep Wetland Flat	Perenniality » Period and Depth of Inundation » Period of Saturation	» Natural vs Artificial » Salinity » pH » Substratum Type » Vegetation Cover Type » Geology

Table 3.2: Hydrogeomorphic Units for Inland Systems (taken from Ollis *et al*., 2013)

Level 4: Hydrogeomorphic (HGM) Unit		
HGM Type	**Longitudinal Zonation/Landform/Outflow Drainage**	**Landform/Inflow Drainage**
A	**B**	**C**
River	Mountain Headwater Stream	Active Channel
		Riparian Zone
	Mountain Stream	Active Channel
		Riparian Zone
	Transitional	Active Channel
		Riparian Zone
	Upper Foothills	Active Channel
		Riparian Zone
	Lower Foothills	Active Channel
		Riparian Zone
	Lowland River	Active Channel
		Riparian Zone
	Rejuvenated Bedrock Fall	Active Channel
		Riparian Zone
	Rejuvenated Foothills	Active Channel
		Riparian Zone
	Upland Floodplain	Active Channel
		Riparian Zone
Channelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Unchannelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Floodplain Wetland	Floodplain Depression	Not Applicable
	Floodplain Flat	Not Applicable
Depression	Exorheic	With Channelled Flow
		Without Channelled Flow
	Endorheic	With Channelled Flow
		Without Channelled Flow
	Dammed	With Channelled Flow
		Without Channelled Flow
Seep	With Channelled Flow	Not Applicable
	Without Channelled Flow	Not Applicable
Wetland Flat	Not Applicable	Not Applicable

3.3.1. Wetland Definition, Classification & Delineation

The lawfully accepted definition of a wetland, in South Africa, is that within the NWA. Accordingly, 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*".

However, for an area to be considered a wetland, the soil signatures (see Soil Wetness Indicator definition below) that are associated with wetlands must be present within the top 50cm of the soil profile (Collins, 2005). This understanding, and the above definition of a wetland, is applied in this report.

It must be noted that there are a number of wetland types in South Africa. Wetland types in South Africa have therefore been classified within a classification system as described in **Section 3.3** above. This classification system refers to inland wetlands which have been categorised into hydrogeomorphic (HGM) units. Ollis *et al*. (2013) defines the different wetland HGM units, as follows:

- *Channel* (river, including the banks): a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit;
- *Channelled valley-bottom wetland*: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a "river";
- *Un-channelled valley-bottom wetland*: a valley-bottom wetland without a river channel running through it;
- *Floodplain wetland*: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a "river";
- *Depression*: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates;
- *Flat*: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat; and
- *Hillslope seep*: a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

In terms of the delineation guidelines, four wetland indicators are used to determine the outer boundaries of a wetland.

These include:

- **Terrain Unit Indicator** – An important practical index for identifying those parts of the landscape where wetlands are likely to occur. Wetlands typically qualify as a valley bottom unit, occurring on the crest (i.e. in depressions) of the landscape, or the mid-slope and / or foot-slope;
- **The Soil Form Indicator** – Identifies the soil forms, as defined by the Soil Classification Working Group (1991, or latest version), which are associated with prolonged or frequent saturation;
- **The Soil Wetness Indicator** – Identifies the morphological "signatures" which have developed in the soil profile as a result of prolonged and frequent saturation. Soils which are saturated for prolonged periods can become depleted of oxygen when roots and / or microorganisms consume the oxygen present in soil between pore spaces. Once depleted, the soils are effectively anaerobic (little to no oxygen present). Under prolonged anaerobic conditions, a change in the chemical characteristics of soil minerals (such as iron and manganese) takes place, whereby the minerals become soluble and can leach out of the soils producing a leached soil matrix. Where most of the iron, being one of the most abundant minerals, is dissolved out of the soils, leaving a greyish, greenish, bluish soil matrix, the soils can be said to be "gleyed". However, under a fluctuating water table, where conditions in the soil change from anaerobic (under saturated conditions) to aerobic (where oxygen is present in soils, under dry conditions), dissolved minerals (typically, iron and manganese) return to an insoluble state forming

patches or mottles which represent distinct wetland soil signatures associated with wetlands. The soil signatures can include orange, yellow or black mottles or spots that have formed through the anaerobic and aerobic conditions associated with fluctuating water tables. Soils which display these unique characteristics are termed hydromorphic soils.

» **The Vegetation Indicator** – Identifies hydrophilic (water-loving) / hydrophytic (water plant) vegetation associated with frequently saturated soils. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are (DWAF, 2005):
  - Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
  - Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
  - Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
  - Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

3.3.2. Watercourse Definition, Classification & Delineation

Ollis *et al*., (2013) provides a definition for rivers, as referred to in **Section 3.3** above. However, this assessment will use an adapted version of the definition of a watercourse to define hydrological flowing systems (rivers and drainage lines), as per the NWA, which *inter alia* states the following:

"*a) a river or spring;*
b) a natural channel in which water flows regularly or intermittently".

Note that the NWA definition of a "watercourse" also includes wetlands, lakes or dams into which or from which waterflows, as well as any collection of water which the Minister may, by notice in the *Gazette*, declare a watercourse. However, this has not been included here, as a more specific definition for wetlands has been provided in **Section 3.3.1** above, that is consistent with the NWA. As such, this report addresses both these components separately. In addition, no collection of water declared by the Minister is relevant for this assessment, and is not provided for herein. Note also, that although the above definition is slightly different to that provided by Ollis *et al*., (2013), the watercourses that are defined in accordance with the above can still be applied to the classification system, and which has been applied as such in this report.

For watercourses, it is possible to determine the hydrological regime of the watercourse, which provides information on the functionality of the systems. Ollis *et al*., (2013) states that the hydrological regime can be characterised by the frequency and duration of flow (i.e. perenniality), classified as follows:

» **Perennial** – flows continuously throughout the year in most years;
» **Non-perennial** – does not flow continuously throughout the year, although pools may persist. Can be sub-divided as follows:
  - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;
  - Intermittent – water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;
  - Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.; and
» **Unknown** – for rivers where the flow type is not known.

Once identified, it is possible to classify rivers into three channel types. The channel types are based on the changing frequency of saturation of soils in the riparian zone which can be classified inter alia as follows (DWAF, 2005):

- **A Section** – Least sensitive watercourses in terms of impacts on water yield from the catchment. They are situated in the unsaturated zone and do not have riparian habitats or wetlands. Not as hydrologically sensitive as the B and C Sections of a watercourse;
- **B Section** – In the zone of the fluctuating water table, and only has base flow at any point in the channel when the saturated zone is in contact with the channel bed. Base flow is intermittent in this section of the watercourse, with flow at any point in the channel dependent on the current height of the water table. The gradient of the channel bed is flat enough for deposition of material to take place, and initial signs of flood plain development may be observed; and
- **C Section** – Always in contact with the zone of saturation and therefore, always has base flow. These are perennial streams with flow all year round, except perhaps in times of extreme droughts. Channel gradients in these sections are very flat, and a flood plain is usually present.

In terms of the guidelines, the assessment for riparian habitats requires the following aspects to be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

The topography associated with a watercourse can comprise (but, is not always limited to) the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat.

The riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the vegetation species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the plant species from the adjacent terrestrial area (DWAF, 2005).

Riparian habitats are usually associated with alluvial soils (relatively recent deposits of sand, mud or any type of soil sediment) (DWAF, 2005). This indicator is not commonly viewed as the primary indicator but rather as a supplementary indicator to confirm either topographical or vegetation indicators, or both.

Where riparian habitats occur, the above-mentioned indicators were used to identify the outer edge. A Global Positioning System (GPS) device was used to record the points taken in the field to inform the delineation process.

3.4. Wetland Present Ecological State

To determine that ecological state that a wetland is in, the WET-Health tool was designed to provide a rapid assessment on the Present Ecological State (PES). This tool examines the deviation from the natural reference ecological condition of a wetland by analysing the hydrological, geomorphological and vegetation components of a wetland in a spreadsheet designed information sheet which assesses a wetland in terms

of the extent, intensity and magnitude of an impact (Macfarlane *et al*., 2008). This is done by assigning a score on a scale of 1 to 10 which is classified into one of six health classes ranging from A to F, with A representing completely unmodified (natural) and F representing modifications that have reached a critical level (Macfarlane *et al*., 2008). The health classes are provided in **Table 3.3** below.

Table 3.3: WET-Health Impact Scores and Categories for the Wetland Present Ecological State (Macfarlane *et al*., 2008).

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

The WET-Health tool includes for a Level 1 (desktop) and Level 2 (detailed field) PES assessment. This study included for a Level 2 detailed assessment.

3.5. Wetland Ecosystem Services

Individual wetlands can supply different ecosystem services to society, as each system will have its own respective hydro-geomorphic characteristics. The wetland ecosystem services that were assessed in this study through the WET-EcoServices (Kotze *et al*., 2007) tool, are listed in **Table 3.4** below.

Table 3.4: WET-Ecoservices (Kotze *et al*., 2007).

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Streamflow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
			Carbon storage	
		Biodiversity maintenance		
	Direct benefits	*Provision of water for human use*		
		Provision of harvestable resources[2]		
		Provision of cultivated foods		
		Cultural significance		
		Tourism and recreation		
		Education and research		

3.6. Riparian Habitat Ecological Condition

The riparian Vegetation Response Assessment Index (VEGRAI) is designed for a qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleyhans *et al*., 2007). As Kleynhans *et al* (2007) explains, the VEGRAI model firstly describes the status of riparian vegetation in both the current and reference states and secondly, compares differences between the two states as a measure of vegetation response to an impact regime. When assessing the state of the riparian habitat, the habitat can be broken down into two components including, the marginal zone and non-marginal zone (**Figure 3.1**). The marginal zone includes the area from the water level at low flow, if present, to those features that are hydrologically activated for the greater part of the year (Kleynhans *et al*., 2007). The non-marginal zone collectively includes the lower and upper zone. The lower zone extends from the marginal zone and usually ends where a marked increase occurs in lateral elevation, whilst the upper zone extends from the end of the lower zone to the end of the riparian corridor which is usually characterised by steeper slopes and the presence of both riparian and terrestrial vegetation species (Kleynhans et al., 2007). It must be noted that not all zones are necessarily present in all watercourses. The identified riparian vegetation zones (Marginal, Non-marginal (Lower and Upper zones)) are used as the metric groups which are then rated, weighted and an Ecological Category (A-F) can then be determined (see **Table 3.5** below).

Table 3.5: Ecological Categories for VEGRAI Index (Kleyhans *et al*., 2007).

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

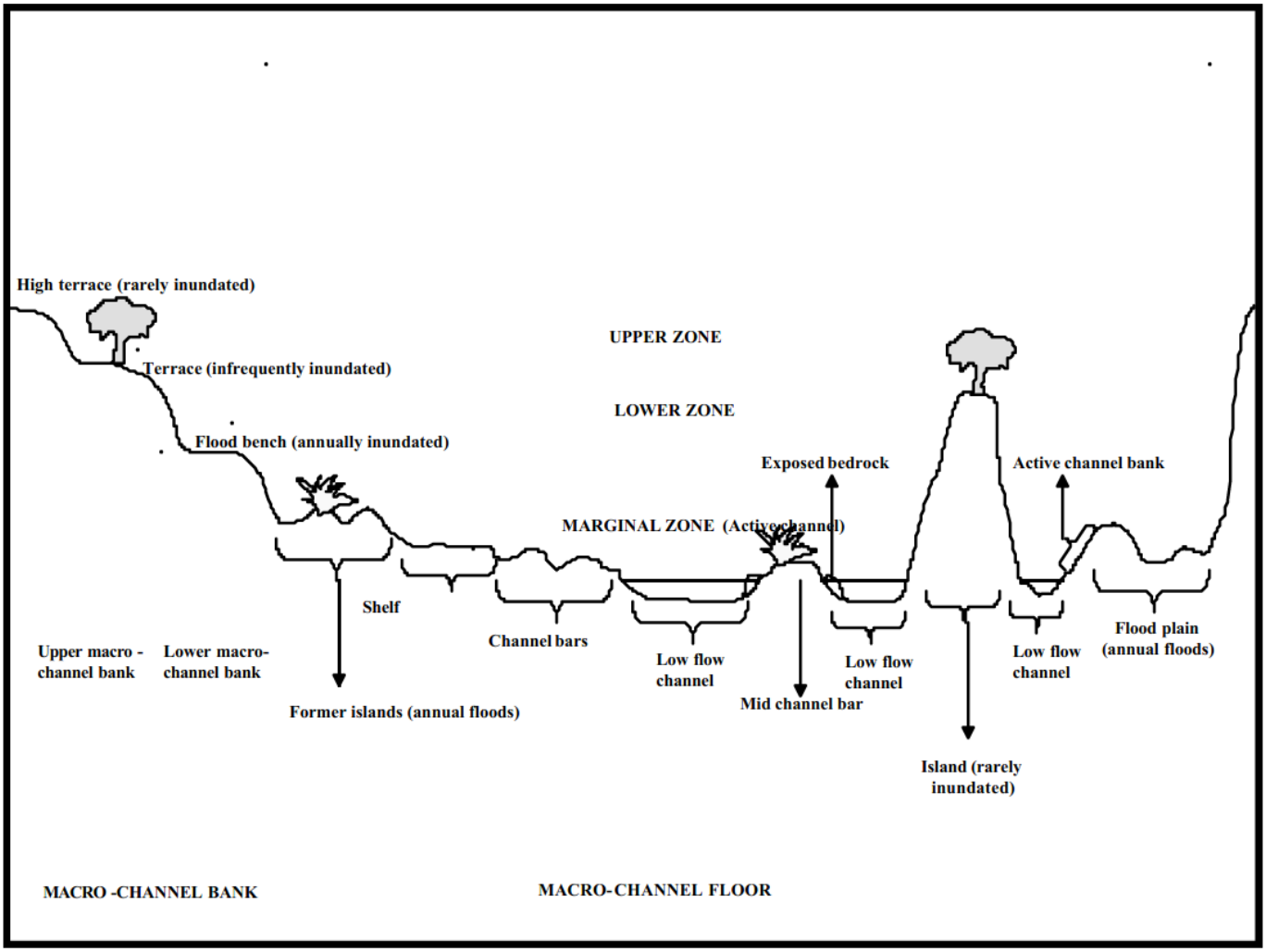

Figure 3.1: Illustration of the Marginal and Non-marginal Zones (taken from Kleynhans *et al.*, 2007).

There are two levels that can be applied to the index assessment including a Level 3 and Level 4 assessment. The Level 3 index is aimed at general aquatic ecologists, whilst a Level 4 assessment is aimed at specialist riparian vegetation ecologists. A Level 3 assessment was applied to this study. The metric groups for a Level 3 assessment includes the following:

- Woody:
  - Cover;
  - Abundance; and
  - Species Composition.
- Non-woody:
  - Cover;
  - Abundance; and

- Species Composition.

Through application of the above VEGRAI index assessment, the ecological condition (state) of the riparian habitat of the freshwater resources were determined.

3.7. Riparian Habitat Ecosystem Services

To assess the importance of the riparian habitat and the ecosystem services supplied to society, the following functions of the riparian habitat were considered:

» Sediment Trapping;
» Nutrient Trapping;
» Bank Stabilisation and Bank Maintenance;
» Flood Attenuation;
» Maintenance of Biotic Diversity;
» Primary Production;
» Erosion Control; and
» Ecological Corridor for Migration.

As no currently applicable methodology is available for the assessment of riparian zone ecosystem services, a qualitative assessment was therefore undertaken based on the above functionality of the identified freshwater resources.

3.8. Freshwater Ecological Importance and Sensitivity

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (**DWAF, 1999**). The ecological sensitivity refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (**DWAF, 1999**). The ecological importance and sensitivity (EIS) can be calculated according to the determinants listed in **Table 3.6** below and attributing a suitable [1]score to each determinant. Information, where relevant, was taken from the Wetland and Riparian Ecosystem Services assessments (i.e. biodiversity maintenance information) and applied to this assessment. Additionally, information on the conservation planning importance of wetlands and rivers were also used. Wetlands and rivers are important in contributing to biodiversity targets which can be informed by the ecosystem threat status and protection level, the level of priority as assessed through the National Freshwater Ecosystem Priority Areas project (**Nel *et al*., 2011**), fine-scale biodiversity plans and in bioregional plans (**Macfarlane *et al*., 2016**). This information was therefore also used to inform the assessment. Once calculated the EIS category (EISC) was determined (**Table 3.7**). The category can range from an A to D, with A being Very High and D being Low/Marginal.

[1]Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Table 3.6: Environmental Importance and Sensitivity Biotic and Habitat Determinants (DWAF, 1999).

Determinant	Score	Confidence
Primary Determinants		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		
5. Migration route/breeding and feeding site for wetland and riparian species		
6. Sensitivity to Changes in the Natural Hydrological Regime		
7. Sensitivity to Water Quality Changes		
8. Flood Storage, Energy Dissipation & Particulate/Element Removal		
Modifying Determinants		
9. Protected Status		
10. Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE		

Table 3.7: Environmental Importance and Sensitivity Categories for Biotic and Habitat Determinants (DWAF, 1999).

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high Wetlands and riparian habitat that are considered ecologically important and sensitive on a national or even international level.	>3 and <=4	A
High Wetlands and riparian habitat that are considered to be ecologically important and sensitive.	>2 and <=3	B
Moderate Wetlands and riparian habitat that are considered to be ecologically important and sensitive on a provincial or local scale.	>1 and <=2	C
Low/marginal Wetlands and riparian habitat that are not ecologically important and sensitive at any scale.	>0 and <=1	D

3.9. Freshwater Resources Buffer Zones

An ecological resource buffer zone is typically an area of vegetated, un-developed land surrounding a resource that is maintained to protect, support and screen flora and fauna associated with a resource from the disturbances associated with neighbouring land uses and / or a proposed development (i.e. 'edge effects'). As freshwater resources (including riparian habitats) are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of these habitat units that could potentially emanate from terrestrial-based anthropogenic activities. Buffer zones are therefore, typically required to protect and minimise the edge impacts to the identified freshwater resources.

However, as the proposed development will include the construction of linear feature through a watercourse, a buffer zone will be impractical and ineffective as the proposed road will need to cross the relevant watercourses regardless. A buffer zone has therefore not been recommended for the watercourses that will be affected by the proposed access road. In addition, where any feature (such as nearby wetlands

within 500m) has been assessed as being within the regulated area of a watercourse, but will not be directly affected by the proposed access road, no buffer zone has been applied, as no direct impact will affect these resources.

3.10. Impact Assessment Method

The potential impacts were identified based on the proposed project and the potential impacts that may result from the proposed development. Direct, indirect and cumulative impacts of the potential impacts identified were 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 **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 are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria were included.

Example of Impact table summarising the significance of impacts (with and without mitigation)

Nature:		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**36 (Medium)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Mitigation Measures		
Cumulative impacts: Cumulative Impacts		
Residual Impacts: Residual Impacts		

3.11. Limitations and Assumptions

The following assumptions and limitations are applicable:

» Freshwater resources were initially identified and delineated at a desktop level using either database information or satellite imagery (Google Earth™). This information was then ground-truthed using a GPS device and verified in the field work phase. The GPS used is expected to be accurate from 3-5m depending on meteorological conditions. Where initial delineations were undertaken at a desktop level, these were refined based on findings made in the field and the relevant GPS points recorded.
» The site visit was undertaken on 24 October 2018. Due to seasonal vegetation growth preferences, vegetation species can grow at different times / seasons of the year. As such, some hydrophytic (water-loving) vegetation species may not have been present at the time of the assessment. Seasonal variation of vegetation and associated identification limitations therefore apply to this assessment given the short term once-off nature of the fieldwork component. Therefore, the assessment should not be taken to be a fully comprehensive study on hydrophytic vegetation species occurrence within the freshwater resources delineated. Rather, this study provides a snapshot of the vegetation occurrence at the time of the assessment.

- This study has focused on the delineation of freshwater resources that are likely to be directly affected by the proposed access road, as well as freshwater resources that are within the regulated area of a watercourse (as defined in **Section 2.3** above). Identification and delineation of freshwater resources in the wider area was not undertaken.
- The delineation of the riparian habitat was limited to the reach of the riparian habitat associated with the watercourse to be affected by the proposed access road. A delineation of the riparian habitat of the entire watercourse was therefore not undertaken.
- This study is limited to providing a freshwater delineation, riparian vegetation response assessment index, riparian ecosystem services assessment and environmental importance and sensitivity assessment. No other assessments were undertaken or formed part of this study. Aquatic assessments (including fish, invertebrates, amphibians, water quality, hydrological, floodline or groundwater studies) have not been included. These are to be undertaken separately, if and where necessary for the project.
- The WET Health methodology (Macfarlane *et al*., 2009) focuses on wetlands that are connected to the drainage network in some way, and it therefore excludes endorheic pans. The geomorphological component of any endorheic depression wetlands cannot be evaluated until a methodology exists for this purpose. The geomorphological component of the Present Ecological State for any endorheic depression wetlands was therefore excluded.
- Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (NFEPA, 2011) database. This database is a national scale database. Some smaller freshwater resources may therefore not be contained in the database. Furthermore, mainly permanently saturated wetlands and perennial rivers are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles as well as ephemeral watercourses may not be included in the database. The fieldwork component was included in the assessment to verify the desktop database information in order to address these potential shortcomings where wetlands and watercourses may have been overlooked in the database information.

4. FRESHWATER DESKTOP ASSESSMENT

The proposed access road alternatives can be found within quaternary catchments D53F (Orange Primary Catchment) and E31C (Olifants – Cape Primary Catchment). The proposed access road alternatives are located within the Lower Orange Water Management Area (WMA) and the Olifants/Doorn WMA, respectively. The results of the freshwater desktop assessment are shown in **Figure 4.1** below. The desktop findings according to the various databases and existing studies consulted, are provided below.

4.1. National Level Database Information

4.1.1. National Freshwater Ecosystems Priority Areas (2011) Database

The National Freshwater Ecosystems Priority Areas (NFEPA) (2011) database is an outcome of a three-year partnership project between South African National Biodiversity Institute (SANBI), Council for Scientific and Industrial Research (CSIR), Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks) (Nel *et al*. 2011). The NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports sustainable use of water resources. The spatial priority areas are known as Freshwater Ecosystem Priority Areas (FEPAs).

FEPAs were identified based on:

- Representation of ecosystem types and flagship free-flowing rivers
- Maintenance of water supply areas in areas with high water yield
- Identification of connected ecosystems
- Representation of threatened and near-threatened fish species and associated migration corridors
- Preferential identification of FEPAs that overlapped with:
    - Any free-flowing river
    - Priority estuaries identified in the National Biodiversity Assessment 2011
    - Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

According to the NFEPA (2011) database, there are **no wetlands or rivers** that could be identified along the proposed access road alternatives. **There are however, two possible wetlands that are in relatively close proximity (~250m) to the proposed road alternatives**. This includes a depression wetland to the north west of access road alternative 1, approximately mid-point of the route where the proposed route deviates sharply from a north east direction to a south easterly direction towards the Dwarsrug WEF Substation. The other feature is identified as a seep wetland located to the north west of the start of access road alternative 2, where it begins from Granaatboskolk road. Neither wetland is regarded as a wetland FEPA. Wetland FEPAs are wetlands that are intended to stay in good condition to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria, some of which include existing protected areas and focus areas for protected area expansions identified in the National Protected Areas Expansion Strategy (NPAES). As such, the wetlands are not significant in terms of the above. However, these two features were earmarked for investigation in the fieldwork component given their close proximity to the proposed alternatives.

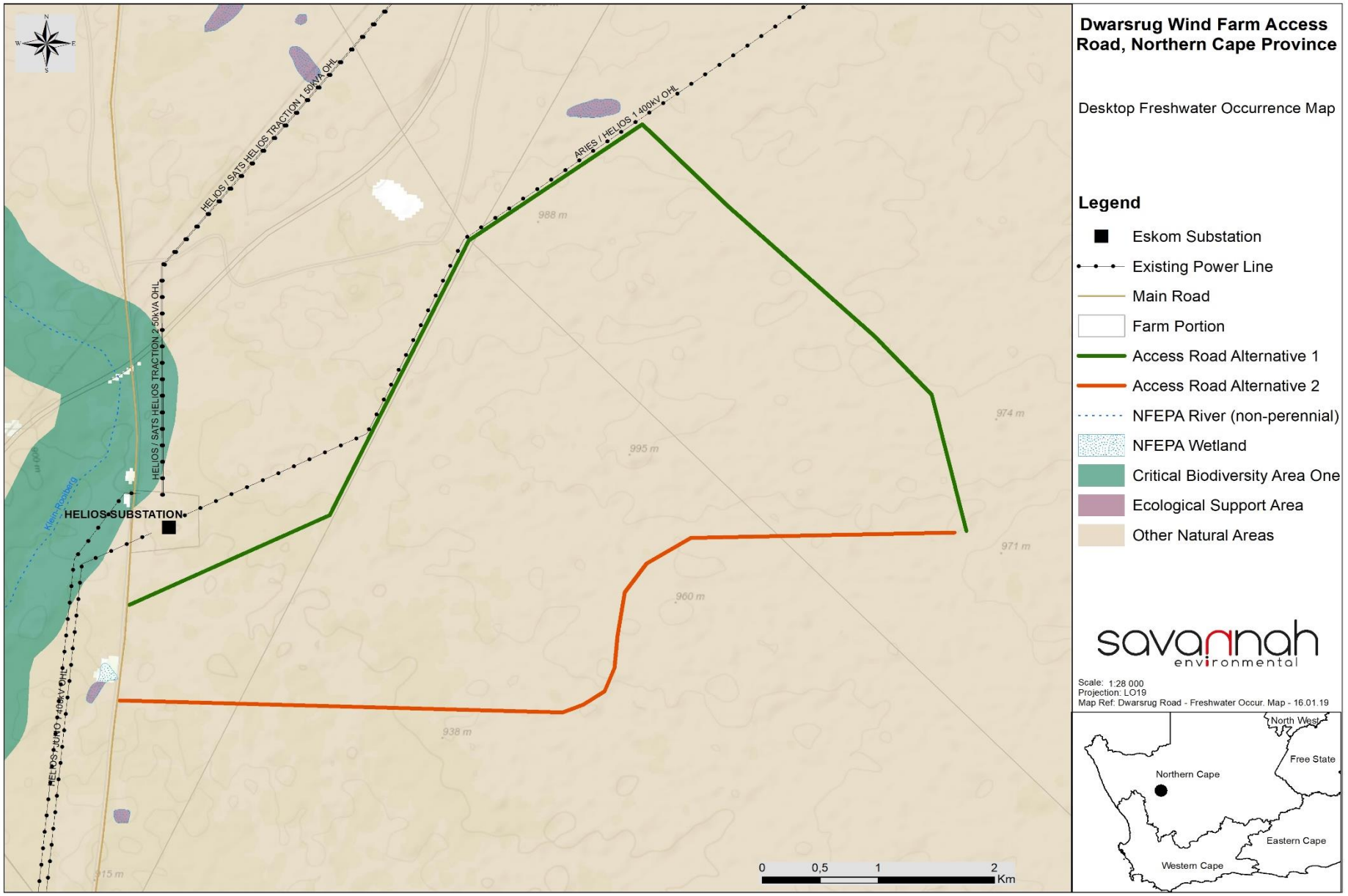

Figure 4.1: Freshwater Desktop Map

In terms of rivers, the nearest linear hydrological feature according to the NFEPA (2011) database is the ephemeral Klein-Rooiberg River, which can be found ~1km west of the two proposed access road alternatives. This watercourse has been classified in terms of the Present Ecological Status (PES) 1999 as a Class B system which is largely natural. However, given the distance to the proposed access roads and the fact that the Granaatboskolk road fragments the connectivity of the landscape, it is unlikely that the watercourse will be directly, or indirectly impacted. The watercourse will therefore not be included in the assessment.

4.1.2. Vegetation Types (Mucina & Rutherford, 2012)

In terms of the vegetation characteristics, the proposed access road is situated within the Nama-Karoo Biome according to Mucina & Rutherford, 2012. The specific vegetation type within this Biome is the Bushmanland Basin Shrubland – Nkb 6, which is considered least threatened in terms of the conservation status and is not a protected in terms of ecosystem protection status. This vegetation type is described in detail below as adapted from Mucina and Rutherford (2012).

The distribution of this vegetation type includes Northern Cape Province of which a large area of the Bushmanland Basin is centred on Brandvlei and van Wyksvlei area, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt vicinity in the north to Williston vicinity in the south. Altitude ranges within this vegetation type ranges mostly from 800-1200m.

The landscape associated with this vegetation type can be described as slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometime succulent) shrubs (*Rhigozum*, *Salsola*, *Pentzia*, *Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as *Gazania* and *Leysera*.

The geology is characterized by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of early Karoo age, and which dominate. About 20% of rock outcrop is formed by Jurrasic intrusive dolerite sheets and dykes. Soils are shallow Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high.

4.1.3. National Biodiversity Assessment Database (2012)

No wetlands or rivers were identified in terms of the National Biodiversity Assessment (2012) database along or within 500m of the proposed access road alternatives.

4.1.4. Google Earth Satellite Imagery (2016)

Google Earth™ satellite imagery was used to inspect the proposed access road alternatives to visually identify any possibly affected freshwater features that were not contained in the consulted databases. From the imagery dated 2016, no wetlands could be identified along the proposed access road alternatives. However, numerous **drainage lines** were identified along the proposed access road alternative routes. The drainage lines appeared to range from diffuse drainage systems to more developed watercourses with defined channels. The drainage lines therefore warranted field verification in the fieldwork phase to ground-truth and delineate these hydrological features.

4.2. Provincial Level Database Information

4.2.1. Northern Cape Conservation Plan (2016)

The Northern Cape Conservation Plan (NCCP) (2016) (yet to be released to the public, but considered herein) is a provincial level environmental database. The NCCP (2017) has replaced the Namakwa Biodiversity Sector Plan of 2008. At a regional level, the NCCP (2016) identifies Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) within the Northern Cape Province, based on a systematic biodiversity sector plan.

Spatial data of the Northern Cape Conservation Plan (2016) is available on SANBI BGIS website and has been used for the desktop assessment. A Critical Biodiversity Areas of the Northern Cape: Technical Report has been released, however no definitions or limits of acceptable loss has been included in the technical report. Therefore, considering the current lack of information regarding the CBAs in the Northern Cape, specifically related to the Northern Cape Conservation Plan of 2016, the previous definitions as per the Namakwa District Biodiversity Sector Plan, 2008 are used in this report. The Namakwa District Biodiversity Sector Plan, 2008, defines a Critical Biodiversity Area (CBA) as "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 conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses". CBAs are also categorised into CBA 1 and CBA 2, where CBA 1 is a natural landscape where ecosystems and species are fully intact and undisturbed. These areas are considered to have high irreplaceability or low flexibility in terms of meeting the biodiversity pattern targets – if the biodiversity features are lost then the targets will not be met. CBA 1 landscapes are at, or past, their limits for acceptable change. CBA 2 areas are considered to be near-natural landscapes where the ecosystem and species are largely intact and undisturbed. These areas have an intermediate irreplaceability or some flexibility in terms of the extent of the area required to meet the biodiversity targets – there are options for loss of some biodiversity components without compromising the ability to achieve the targets. CBA 2 landscapes are approaching but have not passed their limits of acceptable change.

In terms of Ecological Support Areas (ESA), these are defined as "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 of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas". In general terms, an ESA is usually a corridor or buffer area linked to a CBA which provides support in terms of the conservation and protection of the CBA. Therefore, ESAs are not considered to be as ecologically sensitive as CBAs, but are still to be considered as areas where development is to be minimised in order to achieve conservation targets.

Other Natural Areas (ONA) also form part of the Namakwa District Biodiversity Sector Plan, 2008. These areas are considered to be in a natural state, however the condition of the area does not qualify it to form part of either an ESA or a CBA.

Consultation with the Northern Cape Department of Environmental and Nature Conservation was undertaken in order to obtain a better understanding of the CBAs associated with the Northern Cape Conservation Plan of 2016. The Department indicated that the Conservation Plan considers a CBA 1 area as a no-go area for development. Areas classified as CBA 2 have some options for development (through negotiation, depending on the nature of the area), and ESA areas are less restrictive in terms of development. However, formal definitions of the CBAs included in the Northern Cape Conservation Plan were not provided by the Department at this time.

According to the NCCP (2017), the proposed access road alternatives are located within an **ONA**. **No CBAs or ESAs** were however identified along the proposed access road alternatives in terms of the database information. However, the two possible wetland areas (which correspond with the NFEPA (2011) information) that are within ~200m of the proposed access road alternatives **were both identified to be ESAs,** and are therefore deemed ecologically significant.

4.3. Literature Review

Partridge *et al.* (2010) define thirty-four (34) geomorphic provinces (including 12 sub-provinces) for South Africa, Lesotho and Swaziland drawing on previous attempts to define geomorphic provinces, but also based on more recent geological and geomorphological evolution of Southern African fluvial systems, Digital Terrain Model (DTM)-derived data and statistical techniques. The geomorphic provinces reflect spatial units which group river longitudinal profiles (divided into smaller macro-reaches) and valley cross-sectional characteristics. River longitudinal profiles were used as they reflect influence of lithological change, tectonics, river capture, climate change and historical changes in base-level and provide a common focal point for physical scientists and ecologists in selecting physical signatures as surrogates for freshwater ecosystem biodiversity at a scale appropriate to national and sub-national biodiversity planning initiatives (Partridge *et al*., 2010). Valley cross-sectional characteristics not only reflect longer term geological and geomorphological processes, but also influence physical processes acting on the macro-reach template, and hence the spatial organisation of ecosystems (Partridge *et al*., 2010).

The study area falls within the **Northern Cape Pan Veld** geomorphic province, as determined by Partridge *et al.* (2010). The main feature of this geomorphic province is the frequency of pans that are remnants of earlier (Cretaceous) drainage systems (De Wit, 1993). Each pan has its own endorheic drainage net and can be regarded as discontinuous groundwater windows, in which substantial excess of evaporation over precipitation under prevailing hot, dry climate leads to rapid concentration of dissolved solids within each discrete basin (Partridge *et al*., 2010). According to Partridge *et al.* (2010), some of the pans are linked by now defunct palaeo-valleys which, under more humid conditions of the Miocene, contained substantial rivers. The Koa Valley, Commissioner's Valley and Carnarvonleegte are among these relict features (Dollar, 1998). These drainage systems were disrupted both by progressive aridification and by uplift along the Griqualand-Transvaal axis, causing the dismembering of several rivers such as the Koa River (Partridge & Maud, 2000).

The characteristics of the hydrological features described above were taken into consideration in the assessment of freshwater resources for the proposed access roads.

4.4. Existing & Relevant Freshwater Specialist Study Information

SiVEST (2015) undertook a surface water impact assessment for the approved Dwarsrug WEF, which included a delineation assessment of the freshwater resources within the associated power line corridors for the Dwarsrug WEF. The power line corridors overlap with the currently proposed access road alternative 1 for which this assessment is applicable to. The delineation of surface water features as well as associated descriptive information was used accordingly to inform this assessment, where relevant. The selection of relevant features was however **limited to the description of the characteristics and delineation of the ephemeral wetland identified to the north west of access road alternative 1** which was also identified at a desktop level as per **Section 4.1.1** and **Section 4.2.1** above. This was used as it was consistent with the delineation undertaken as well as the observations made in the field for the current assessment, and did not need to be revised. **All other delineations of watercourses were revised** according to the most recent field assessment. Note however, that the descriptions of the watercourses and drainage lines as per SiVEST (2015) were found to be consistent with that which was observed in the current field investigation, and were also used and referenced where applicable (see **Section 5.1** below).

5. FRESHWATER SITE VISIT FINDINGS

The field investigation and delineation exercise was undertaken on 24 October 2018. Conditions were hot and mostly sunny, with minimal afternoon cloud cover and some wind. No surface water was visible within the identified drainage lines along the proposed access road alternatives, at the time of the assessment. The access road alternatives routed along undulating terrain over low hills and hill crests in some areas, whereas other sections routed through broad valley bottoms and some flat, open plain areas. The proposed access road routes were typically vegetated with scattered scrub and grass species, but were also affected by anthropogenic impacts including grazing (sheep and game) impacts, existing farm roads and fence lines.

5.1. Freshwater Delineation Results

The freshwater resources identified from a desktop level that were identified in the field directly along the proposed access road alternatives, and that were ground-truthed, delineated and assessed included **sixteen (16) watercourses**. The watercourses identified can be better described as ephemeral drainage lines however, and which could be differentiated into thirteen (13) minor and three (3) major drainage lines. These were mapped as such in **Figure 5.1** below.

In addition to the above, only one of the two wetlands identified at a desktop level was verified in the field. Therefore, only one **(1) ephemeral depression wetland** was found on site, which was located north west of access road alternative 1 (approximately mid-point of the route where the proposed route deviates sharply from a north east direction to a south easterly direction towards the Dwarsrug WEF Substation), and was identified in both the Northern Cape Conservation Plan (2017) and the NFEPA (2011) databases. As this wetland falls within the regulated area of a watercourse (development directly affects a minor drainage line 7 and is within 500m of a wetland), this wetland formed part of this assessment. However, the other wetland that was identified at a desktop level as a seep wetland according to the NFEPA (2011) database, which was located to the north west of the start of access road alternative 2 off Granaatboskolk road, was not deemed a wetland as it was found to be associated with an excavation pit within a drainage line, as opposed to a natural wetland feature. As this area does not fall within the regulated area of a watercourse (proposed access route is not within the outer edge of the riparian habitat or the area within 100m from the edge of a watercourse), this feature was not included in this assessment.

The findings of the delineation assessment are provided below.

5.1.1. Wetlands

5.1.1.1. Wetland Physical Drainage and Vegetation Characteristics

Findings taken from the surface water study undertaken by SiVEST (2015) were used to inform the wetland characteristics of the ephemeral wetland identified, as these were consistent with that identified during the field assessment. This includes the following:

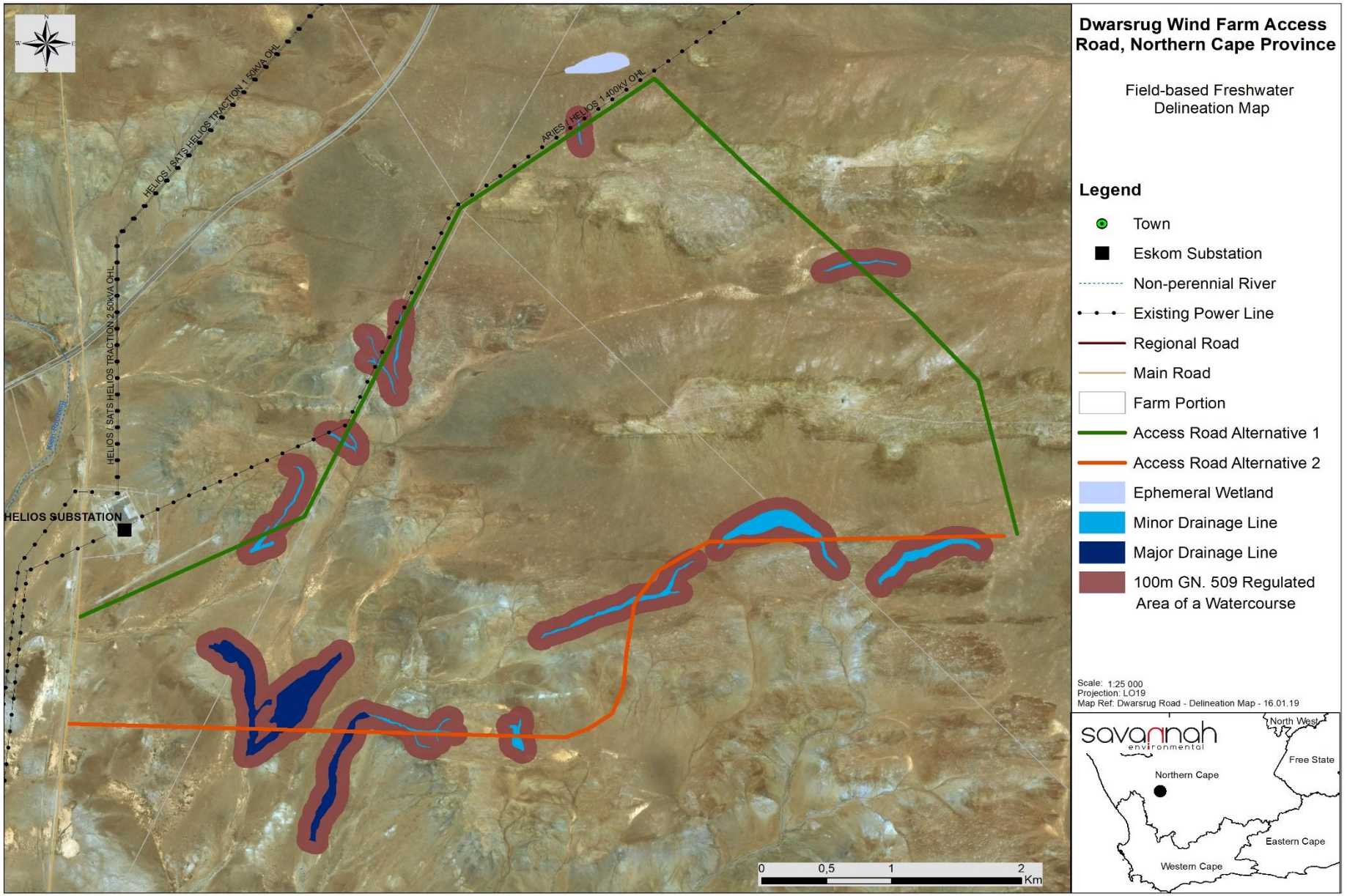

Figure 5.1: Freshwater Delineation Map

» Terrain and Soil Characteristics – the ephemeral wetland was in the form of a depression in a broad valley-bottom. Soil samples taken from within the ephemeral wetland revealed fine-grained sandy particles with carbonate precipitates present within the matrix of the B horizon. No distinct signs of wetness could be observed however. The soil form that could be associated with this soil type is the Addo Soil Form, which comprises of an Orthic A, overlying Neocarbonate B and Soft Carbonate Horizons (**Photograph 5.1** – left). Ultimately, the soils did not show distinct signs of hydromorphism. However, the chemical constituency of these particular soils are not considered to be conducive to the formation of wetland soil characteristics of other more seasonally and permanent wetland systems found in other areas of the country with higher rainfall which typically express mottling and gleying signatures. This explains the perceived absence of these characteristics in the soils. Importantly, this does not mean that the pedological processes responsible for these characteristics are not being undertaken. Rather, it is suspected that the geochemical constituency of the sediment particles, coupled with the high salt content, pH and physic-chemical characteristics of the soils mask the formation of the typical mottling characteristics observed in wetlands in other parts of the country. This is a limitation not expressed in the guideline for delineation of wetlands.
» Vegetation Characteristics – Vegetation found in the ephemeral wetland could be visually distinguished from the vegetation outside of the feature. The vegetation coloration, density and composition were distinct from vegetation in terrestrial areas. The vegetation in the ephemeral wetland was predominantly made up of small to medium shrubs adapted to survive in the ephemeral wetland area (**Photograph 5.1** – right). No specifically hydrophytic vegetation was identifiable which was not surprising given the ephemerality of the wetland.

Photograph 5.1: Soil sample taken from the ephemeral wetland (left). Image of an ephemeral wetland (right) (photos taken from SiVEST, 2015).

In addition to the above, it must be mentioned that the vegetation characteristics of the ephemeral depression wetland were observed to be aligned with the Bushmanland Vloere vegetation unit (Mucina & Rutherford, 2006). According to Mucina and Rutherford (2006), this vegetation unit is embedded in the Bushmanland Basin Shrubland vegetation type and is found in flat and very even surfaces of pans which contain loosely patterned scrub dominated by *Rhigozum trichotomum*. These characteristics fit with the characteristics identified within the ephemeral depression wetland.

5.1.2. Riparian Habitat

5.1.2.1. Topography Associated with the Watercourse

The topography associated with the watercourses include areas with some relief in which drainage from undulating terrain and rocky outcrops are confined to narrow (~1-5m channel width) and incised but relatively shallow (~0.5-1.5m depth) and rocky channels (**Photograph 5.2** – left). These topographical characteristics are consistent with the majority of the minor drainage lines delineated. There are however, minor drainage lines (Minor Drainage Lines 9, 10 and 12) that can be found in the flatter broader valley bottom areas as well in which developed channels are largely absent (**Photograph 5.2** – right). These drainage lines are therefore weakly developed but do indicate intermittent flow of water due to depositional features and associated vegetation observed that is consistent with the Bushmanland Vloere vegetation unit.

Photograph 5.2: Photo of narrow small drainage line from a low hill (left); and photo of open drainage line found in wide valley bottom area (right).

The topography associated with the major drainage lines are characterised by broad open valley bottoms. The watercourses are not very well developed over some of the flatter areas where flow is diffuse and primarily overland, whereas in some areas along the reach of the watercourses, flow is more confined to distinct channels, albeit braided and shallow channel networks over a floodplain (**Photograph 5.3**). The channel morphology appears to change with topographical influence along the course of the major drainage channels varying from diffuse open drainage to more confined but braided channel networks in a relatively open floodplain downstream.

Photograph 5.3: Photo of a typical shallow and braided channel within a major drainage line.

5.1.2.2. Alluvial Soils and Deposited Materials

The minor drainage channels associated with areas of relief are typically characterised by rocky substrate which exhibit larger and platy stone to gravel sized deposited sediments over either a rocky (higher reaches) or alluvial-based (lower reaches) channel bed (**Photograph 5.4**). The major and few minor drainage channels in the broad valley bottom areas consist mainly of alluvial soils with gravel to sandy sized deposited sediments.

Photograph 5.4: Photo showing platy stone to gravel sized sediments in an alluvial bed of the watercourse.

5.1.2.3. Riparian Habitat Vegetation

Todd (2018) states that the typical and dominant species in the drainage lines affected by the proposed access road alternatives include *Stipagrostis namaquensis, Stipagrostis obtusa, Osteospermum armatum, Arctotis fastuosa, Deverra denudata, Melianthus comosus, Salvia disermas, Lycium pumilum, Lycium oxycarpum, Galenia sarcophylla, Salsola aphylla* and *Sesamum capense* (**Photograph 5.5**). The riparian habitat for the minor drainage lines identified contain denser thickets of shrubland vegetation, whilst the major drainage lines tend to exhibit more loosely patterned thickets. In terms of the functional role of the vegetation component of the watercourses, Todd (2018) explains that although the drainage lines are not well developed, which can be ascribed to the aridity of the area, they are ecologically important because the higher cover and productivity of these areas is important for fauna forage, habitat availability, and they also play an important hydrological role, and regulate flow following occasional strong rainfall events.

Photograph 5.5: *Rhigozum trichotomum* and *Stipagrostis obtusa* observed in a watercourse.

5.2. Wetland Present Ecological State

The ephemeral wetland identified was assessed on the basis of the hydrological and vegetation components. The combined health class was assessed to be a **Class C (moderately modified) ephemeral depression wetland system**. The hydrological component was found to be minimally affected by the change in surface roughness which was as a result of a decrease in vegetation cover due to grazing and vehicle tracks in the wetland. The hydrological component was therefore largely unmodified. In terms of the vegetation component, the same existing impacts were found to affect the state of vegetation in that overgrazing and vehicle track degradation was evident. These impacts were found to affect the state of vegetation to a higher degree than that which was assessed in the hydrological component. Overall, an impact score of 2 was assessed when combining the two components which resulted in the Class C rating. Importantly, the Class C rating is expected to slowly deteriorate over time should over grazing and continued vehicle degradation affect the wetland.

5.3. Wetland Ecosystem Services

The potential wetland ecosystem services assessed to be provided by the ephemeral wetland are shown in **Figure 5.2** below. As can be seen, the **ecosystem services which scored highest included sediment trapping and erosion control**. These are common functions which a typical depression wetland performs and is no different in this case. Furthermore, there are a number of other potential wetland ecosystem services which the wetland can provide. These include biogeochemical cycling in the form of phosphate trapping and limited toxicant removal, a relatively important role in maintenance of biodiversity in the landscape as well as a flood attenuation function. In general, the ephemeral wetland was not found to offer a high number of potential ecosystem services to a high degree, but nonetheless plays an important functional (albeit to a

limited extent) and ecological role in the landscape given the aridity of the environment and dependence of faunal and floral species on this feature as an intermittent water resource.

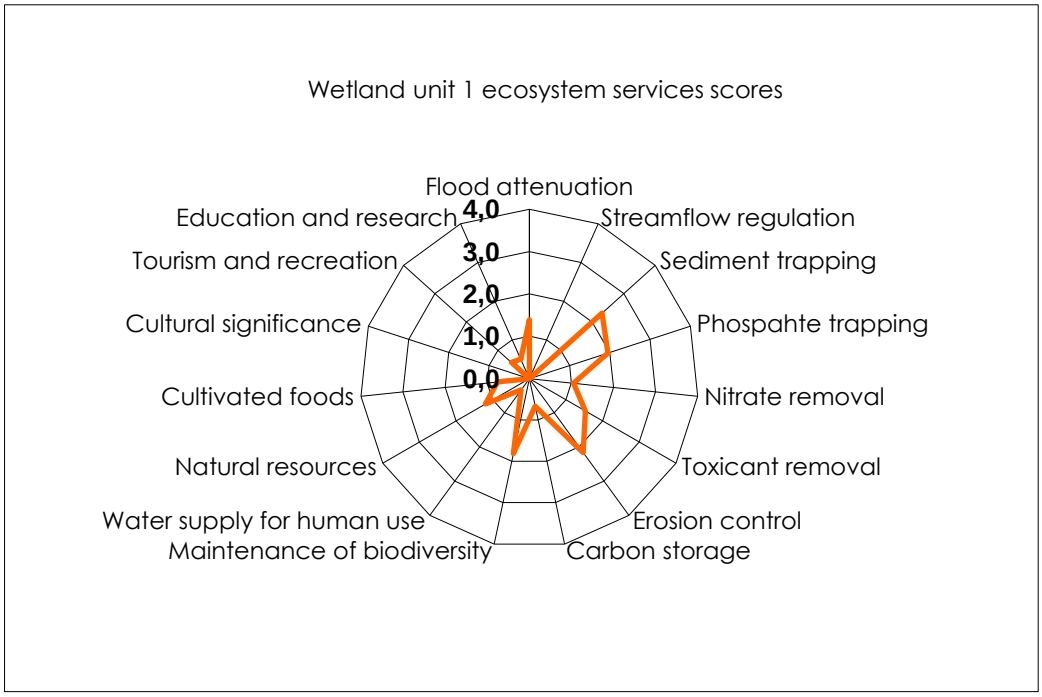

Figure 5.2: Potential Wetland Ecosystem Services for Ephemeral Wetland 1

5.4. Wetland Ecological Importance and Sensitivity (EIS)

The ecological importance and sensitivity (EIS) of the ephemeral wetland was assessed taking into account the various determinants of the wetland. The determinants assessed and results of the assessment are provided in **Table 5.1** below.

Table 5.1: Ephemeral Wetland 1 Ecological Importance and Sensitivity Results

Wetland Name	**Ephemeral Wetland 1**		**Reason**
Determinant	**Score**	**Confidence**	
Primary Determinants			
1. Rare & Endangered Species	1	3	No rare or endangered species are expected to occur in the wetland. Nor were any rare or endangered species identified at the time when the field investigation was undertaken. It is therefore generally anticipated that there is a very low potential for any rare or endangered species to be present in the wetland.

2. Populations of Unique Species	1	3	Considering the vegetation type which was assessed to be aligned with the Bushmanland Vloere vegetation unit as described by Mucina & Rutherford (2006), there are no populations of unique species given the vegetation of the broader landscape. From a faunal perspective, Todd (2018) identifies a number of mammal and reptile species which may frequent the freshwater resources of the study area including drainage lines. These species are not considered unique species for the region.
3. Species/taxon Richness	1	4	Species and taxon richness are relatively low in terms of hydrophytic floral and faunal species as indicated above.
4. Diversity of Habitat Types or Features	1	4	The broader area is considered to be relatively homogenous in terms of habitat types. The freshwater resources however can be said to represent a different habitat type. However, within the ephemeral wetland, the habitat can be considered homogenous in its own right, and the diversity is considered to be relatively low.
5. Migration route/breeding and feeding site for wetland species	2	3	The ephemeral wetland is likely to be an important migration route/breeding and feeding sites for reptiles, invertebrates and waterfowl but this is only limited to following infrequent and intermittent rainfall events, and only for relatively very short periods thereafter. However, it must be considered that some species have adapted to this very brief period of water availability which elevates the importance of the feature. This determinant was scored moderate as a result considering the present ecological state of the wetland.
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3	The ephemeral nature of the wetland means that the wetland will be fairly sensitive to further reductions and changes in the natural hydrological regime. The floral species that make up the vegetation component is likely to transition to more terrestrial and drought resistant species with over grazing and reduction of water supply.
7. Sensitivity to Water Quality Changes	1	3	The wetland currently acts as sediments sink and therefore is typically associated with relatively high sediment loads given the minimal vegetation cover and harsh dry climate. This was apparent in the alluvial deposits observed in the wetland. The wetland is considered to be sodic and will have a good chemical buffer capacity.
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	One of the main potential functions of the wetlands is the ability to perform a functional role in terms of sediment trapping, erosion control, flood attenuation and maintenance of biodiversity. In this regard, the wetland is significant in terms of

			the role the wetland performs in the greater landscape.
Modifying Determinants			
9. Protected Status	2	4	The wetland is considered to be an Ecological Support Area (ESA) according to the Northern Cape Conservation Plan 2017. However, the wetland vegetation type is considered to be Least Threatened. Based on this information, the wetland is considered to be moderately protected.
10. Ecological Integrity	2	4	The overall PES of the wetland was assessed to be a Class C (moderately modified) system. The ecological integrity is therefore considered to be moderate.
TOTAL	17	34	
MEDIAN	1,7	3,4	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**		**The wetland is considered to be ecologically important and sensitive on a provincial or local scale**

Considering the above, the most important determinants that the wetland scored relatively high in was in terms of being ecological sensitive as a result of any change in the natural regime of the hydrological component, and important from a migration route/breeding and feeding site for invertebrates, amphibians and waterfowl aspect, despite being ephemeral in nature. In addition to this, the wetland was identified to serve an important role in performing sediment trapping, erosion control and flood attenuation function for the local catchment as identified in **Section 5.3** above. Lastly, the wetland scored moderately due to the wetland being classed as an ESA and was assessed to be a Class C moderately modified system in terms of the present ecological state (see **Section 5.2**). Overall, the EIS of the wetland was classed a **Class C system** which is considered to be moderately ecologically important and sensitive, on a provincial or local scale.

5.5. Riparian Habitat Vegetation Response Assessment Index (VEGRAI)

5.5.1. Reference Condition

In order to apply the VEGRAI index, it is essential to qualify the reference conditions (Kleynhans *et al*., 2007). The reference conditions are a determination of the state of the riparian habitat that is completely natural and unmodified / affected by existing impacts. When assessing the state of the riparian habitat, the habitat can be broken down into two components including, the marginal zone and non-marginal zone. The marginal zone includes the area from the water level at low flow, if present, to those features that are hydrologically activated for the greater part of the year (Kleynhans *et al*., 2007). The non-marginal zone collectively includes the lower and upper zone. The lower zone extends from the marginal zone and usually ends where a marked increase occurs in lateral elevation, whilst the upper zone extends from the end of the lower zone to the end of the riparian corridor which is usually characterised by steeper slopes and the presence of both riparian and terrestrial vegetation species (Kleynhans et al., 2007). It must be noted that not all zones are necessarily present in all watercourses.

The reference state of the vegetation within the identified minor drainage lines would be confined to the marginal zone as no non-marginal zone could be defined given the characteristics of the watercourses and connectivity in terms of vegetation composition with the surrounding landscape. The minor drainage lines

are also head water streams and as such, have poorly defined channel structure. The marginal zone of the minor drainage lines therefore would typically include the active channel as well as fringing riparian habitat. The vegetation cover could be considered to be dense along the channel fringes with little to no vegetation present in the active channel (with the possible exception of some graminoid species such as *Stipagrostis*) Cover constituting shrubland vegetation would be moderate along the channel fringes, given the very dry climate and free draining alluvial soils. Water flow would be intermittent only after rainfall events and for short lived periods.

For the major drainage lines, the marginal and non-marginal zone are expected to be present under reference conditions. The marginal zone would typically consist of a mix of graminoid (Stipagrostis) and shrub species consisting of a mix of Rhigozum and Stipagrostis dominated channel banks. Cover would also remain fairly low. However, from the edge of the active and braided channels to the outer edge of the riparian habitat, the non-marginal zone is expected to be present under reference conditions.

5.5.2. Present Condition

For the minor drainage lines, the present state of vegetation within the marginal zone is fairly close to the reference conditions referred to above. With the exception of the present cover of vegetation in the riparian habitat which is somewhat scattered and low, as opposed to being relatively moderately dense. The other characteristics in terms of water quality and quantity were assessed to be affected to a very minor level in terms catchment level impacts due to farming activities in linear infrastructure in the broader landscape.

For the major drainage lines, the present state of the vegetation pattern within marginal zone of the watercourses comprise of loosely patterned dense thickets in some areas, whereas in others, the channel bed is devoid of vegetation cover. The composition of the vegetation is relatively similar to that under reference conditions, although some alien invasive species have colonised the watercourses to a limited extent, which indicate signs of vegetation disturbance. The other characteristics in terms of water quality and quantity were also found to be affected to a very minor level as per the minor drainage lines referred to above.

In consideration of the non-marginal zone, vegetation cover was also found to be affected by the identified existing disturbance impacts including vehicle tracks and overgrazing by sheep. This included the relatively limited extent that vegetation cover and abundance were affected by loss of some species, and also in the limited extent that species composition was altered with some *P. glandulosa* species invading the larger watercourses. Likewise, the other characteristics in terms of water quality and quantity were also found to be affected to a very minor level as per the minor drainage lines referred to above.

Taking the above into consideration, the results shown in **Table 5.2** and **Table 5.3** below were obtained for the VEGRAI assessment of the minor and major drainage lines.

Table 5.2: Result of the Minor Drainage Lines VEGRAI assessment.

LEVEL 3 ASSESSMENT						
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**	**NOTES: (give reasons for each assessment)**
MARGINAL	90,0	90,0	5,0	1,0	100,0	Full proportion of the vegetation component and channel structure.
NON-MARGINAL	100,0	0,0	4,2	2,0	0,0	No non-marginal zone.

	2,0				100,0	
LEVEL 3 VEGRAI (%)				90,0		
VEGRAI EC				**A/B**		
AVERAGE CONFIDENCE				4,6		

Table 5.3: Result of the Major Drainage Lines VEGRAI assessment.

LEVEL 3 ASSESSMENT						
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**	**NOTES: (give reasons for each assessment)**
MARGINAL	87,0	62,1	5,0	1,0	100,0	Larger proportion of the vegetation component and channel structure.
NON-MARGINAL	90,9	26,0	4,2	2,0	40,0	Smaller proportion of the vegetation component and channel structure but which includes for the floodplain area.
	2,0				140,0	
LEVEL 3 VEGRAI (%)				88,1		
VEGRAI EC				**A/B**		
AVERAGE CONFIDENCE				4,6		

Based on the result above, the Ecological Condition (EC) of the riparian habitat of the minor drainage lines were assessed to be 90% unmodified and therefore, a **Class A unmodified system**. The EC of the riparian habitat of the major drainage lines were assessed to be 88% unmodified and therefore, a **Class B largely natural with few modifications system,** with a relatively high confidence level for both.

5.6. Riparian Habitat Ecosystem Services Results

The primary potential ecosystem services that could be expected to be provided by the minor and major drainage lines include **sediment trapping, bank stabilisation and maintenance, flood attenuation, maintenance of biotic diversity, erosion control and as an ecological corridor for migration of species**. The majority of the minor drainage lines are first order streams which drain into lower order tributaries in a south west direction, eventually meeting up with either the Klein Rooiberg or Raskraal rivers downstream. This is with the exception of minor drainage line 8 which drains into Brakpan, a large depression wetland located approximately 3.5km away to the north east. As many of the minor drainage lines constitute higher order streams, their role is fairly limited when compared to the lower order streams which are more developed downstream. The minor drainage lines are therefore expected to have a lower significance in terms of the potential services provided in terms of the geomorphological, hydrological and general ecological functionality referred to above, than when compared with the major drainage lines.

5.7. Riparian Habitat Ecological Importance and Sensitivity (EIS) Results

The ecological importance and sensitivity (EIS) were assessed for all watercourses. The determinants assessed and results obtained are provided in **Table 5.4** below.

Table 5.4: Watercourses Ecological Importance and Sensitivity Results

Wetland Name	**Watercourses**		**Reason**
Determinant	**Score**	**Confidence**	
Primary Determinants			
1. Rare & Endangered Species	1	3	No rare or endangered species are expected to occur in the watercourses. Nor were any rare or endangered species identified at the time when the field investigation was undertaken. It is therefore generally anticipated that there is a very low potential for any rare or endangered species to be present in the watercourses.
2. Populations of Unique Species	1	3	There are no populations of unique species that were identified during the field visit, and are expected to occur generally. From a faunal perspective, Todd (2018) identifies a number of mammal and reptile species which may frequent the freshwater resources of the study area including drainage lines. These species are not considered unique species for the region.
3. Species/taxon Richness	1	4	Species and taxon richness are relatively low in terms of hydrophytic floral and faunal species as indicated above.
4. Diversity of Habitat Types or Features	1	4	The broader area is considered to be relatively homogenous in terms of habitat types. The freshwater resources however can be said to represent a different habitat type in the context of the landscape. However, within watercourses, the habitat can be considered slightly divers in its own right, although the diversity is considered to be relatively low.
5. Migration route/breeding and feeding site for wetland species	3	3	The watercourses are likely to be an important migration route/breeding and feeding sites for reptiles, invertebrates and waterfowl during the dry season and more significantly following infrequent and intermittent rainfall events, and only for relatively very short periods thereafter. However, it must be considered that some species have adapted to this very brief period of water availability which elevates the importance of the feature. This determinant was scored moderately high, considering the present ecological state.

6. Sensitivity to Changes in the Natural Hydrological Regime	3	3	The intermittent nature of the flows means that the watercourses will be fairly sensitive to any reductions and / or changes in the natural hydrological regime. The floral species that make up the vegetation component is likely to transition to more terrestrial and drought resistant species with over grazing and reduction of water supply. Additionally, with catchment level impacts and decrease in surface roughness, with increased flood peaks, this could contribute to disturbance of the watercourse thereby making the watercourses vulnerable to alien invasive vegetation, as the *P. glandulosa* species observed in some of the watercourses.
7. Sensitivity to Water Quality Changes	1	3	The watercourses are typically associated with relatively high sediment loads given the minimal vegetation cover and harsh dry climate. This was apparent in the alluvial deposits observed in the various watercourses.
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3	One of the main potential ecosystem functions of the watercourses that were identified included the ability to perform a functional role in terms of sediment trapping, erosion control and flood attenuation. In this regard, the watercourses are significant in terms of the role performed in the greater landscape.
Modifying Determinants			
9. Protected Status	0	4	The watercourses are all considered to be in an Other Natural Area according to the Northern Cape Conservation Plan 2017, which is not considered to be specifically projected. The vegetation type for the drainage lines area also considered Least Threatened. Based on this information, the watercourses are considered not to be protected.
10. Ecological Integrity	4	4	The overall PES of the wetland was assessed to be a Class A for both the minor and major drainage lines. The ecological integrity is therefore considered to be high.
TOTAL	18	34	
MEDIAN	1,8	3,4	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**		**The wetland is considered to be ecologically important and sensitive on a provincial or local scale**

Considering the above, the most important determinants that the watercourse scored relatively high in was in terms of being important from a migration route/breeding and feeding site for reptiles, invertebrates and waterfowl despite being intermittent in nature. In addition to this, the watercourse was identified to serve an important role in performing sediment trapping, attenuation of storm water and energy dissipation for the local catchment as identified in **Section 5.6** above. The watercourses were also identified to be sensitive to changes in the natural hydrological regime in respect of water supply reductions or alteration of flood

peaks thereby causing desiccation and disturbance, respectively. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring high due to the fact that the watercourses were assessed to be Class A/B systems in terms of the vegetation ecological condition. Despite these relatively high scores, **the watercourses were classed as Class C systems** due to the low scores for the remaining determinants which averaged out the final score. Class C systems are considered to be moderately ecologically important and sensitive on a local scale.

6. IMPACT ASSESSMENT

The potential impacts to freshwater resources that are anticipated to be associated with the proposed development, are identified and assessed in this section.

6.1. Potential Impacts

The assessment of the potential impacts was undertaken using the Savannah impact assessment methodology (see **Section 3.10**), which includes the stipulation of appropriate mitigation measures for the relevant phases of the proposed development. The anticipated impacts are provided below.

6.1.1. Potential Impacts to the In-stream and Riparian Habitat of the Watercourses (Construction Phase)

Potential impacts to the in-stream and riparian habitat of the watercourses is likely to take place with vegetation clearance through the watercourses. Vegetation will need to be removed within the riparian zone and in the in-stream habitat when preparing the gravel road through the watercourses. With disturbance of the vegetation within and adjacent to the watercourses, it is also likely that the watercourses will be vulnerable to encroachment of pioneer and alien invasive species, thereby having a potential impact on the species composition of the watercourses.

The impact rating and significance of the impacts related to vegetation clearance is shown in **Table 6.1** below.

Table 6.1: Potential impacts associated with vegetation clearance in the watercourse.

Nature: Vegetation clearance in the riparian habitat and in-stream habitat of the watercourses for the proposed access road. Potential for pioneer and alien invasive species to encroach on watercourses during and after disturbance caused during vegetation clearance.		
	Without mitigation	**With mitigation**
Extent	Immediate area (1)	Immediate area (1)
Duration	Medium-term (3)	Short-term (2)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**35 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
» Mitigation: » Vegetation clearance must be limited as far as possible and only within the servitude and course of the proposed access road. No unnecessary clearance is to be undertaken.		

- » Cleared vegetation stockpiles are to be removed as soon as possible to limit disturbance.
- » No cleared vegetation stockpiles are to be placed in any of the watercourses.
- » Movement of workers within the watercourse must be limited to the servitude of the road. Workers are not allowed to wonder freely in the watercourse. This will cause unnecessary degradation of the watercourse.
- » Construction of the access road in the watercourse is to take place preferably in the summer and spring months (September to March) as these are the drier months in which rainfall is likely to be limited. Construction in the autumn and winter months (April to August) is to be avoided as far as possible, as this is when rainfall can be expected and the watercourses are likely to be in flow after rainfall events.
- » An alien invasive monitoring and control management programme must be compiled to manage encroachment of alien species within the watercourses and along the entire course of the road. Control along the entire route of the access road is required is to ensure that vegetation disturbance is managed and alien vegetation establishment does not take place high or lower along the road route which could result in encroachment on the watercourses at a later stage. Control along the entire access route is also important since catchment level drainage may also result in the dispersion of seeds from alien species into the watercourses should alien establish along the route of the access road outside of the watercourses. Importantly, the alien invasive monitoring and control management programme is also to be implemented post-construction for approximately two (2) years to ensure alien invasives do not encroach following construction.

Cumulative impacts:

No cumulative impacts.

Residual Impacts:

Possible residual Impacts after implementation of mitigation measures can include alien vegetation species colonisation following construction. It has been included in the mitigation measures above to implement the alien invasive monitoring and control management programme post-construction to prevent subsequent alien vegetation encroachment.

6.1.2. Potential Impacts to the Geomorphology and Hydrology of the Watercourses (Construction Phase)

Potential impacts to the geomorphology of the freshwater resources are expected to result with construction of the gravel roads through the watercourses. The construction of the proposed access road is likely to include clearance of the topsoil in the riparian habitat, clearance of substrate in the watercourses and possibly infill of materials in the watercourses for the purposes of levelling the proposed gravel road.

During vegetation clearance and infill, vehicle movement through the watercourses resulting compaction impacts on the geomorphology of the watercourses can also be expected. Associated with vehicle movement, possible soil contamination impacts in the watercourse can result from oils and fuels leaking from vehicles when crossing through the watercourses.

Indirect potential impacts to the geomorphology of the watercourses are also anticipated by means of erosion impacts. Following rainfall events, the cleared watercourses will be vulnerable to erosion where sediment is either infilled or removed from the bed of the watercourses. No indirect impacts are anticipated for the ephemeral wetland however, given the distance (200m) from the proposed Alternative Access Road 1.

The rating and significance related to the identified geomorphological impacts is shown in **Table 6.2** below.

Table 6.2: Potential impacts associated with excavation impacts in the watercourse.

Nature: Clearance of substrate and infill of materials during road construction. Vehicle movement and compaction in the watercourses. Possible soil contamination from vehicle oils and fuels. General erosion impacts to the watercourses.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Immediate site (1)
Duration	Short-term (2)	Very short-term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**50 (Medium)**	**30 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Crossing points must be perpendicular to the watercourses, as far as possible, to prevent the onset of erosion along the length of the watercourse. Aligning the road in parallel will induce a preferential flow path altering the hydrology, which can erode away the substrate along the length of the watercourse, thereby threatening the structural integrity of the geomorphology of the watercourse. Erosion will also cause additional sedimentation impacts. » Ideally, ford crossings are to be implemented through the watercourses for the width and length of the proposed road through the watercourse. The ford crossing should either be concrete based or comprise of geotextile topped with course aggregate. Care must be taken when pouring concrete into the watercourses during the construction of the fords, so that no cement is spilt outside of the designated construction area within the watercourse. The ford crossings will have a relatively minimal impact on the hydrology of the watercourses. However, if ford crossings cannot be implemented, any other suitable crossing can be implemented following approval from the Department of Water and Sanitation. » Vehicle movement must be limited as far as possible through watercourses to minimise compaction impacts. » All vehicles and machinery to be used within the watercourses during construction must be checked for oil and fuel leaks before being allowed to cross or work in the watercourses. Should a leak be detected, the vehicle is to		

be prohibited from working within or crossing through the watercourses until repaired. » Soil stockpiles are to be removed as soon as possible to limit disturbance. » No soil stockpiles are to be placed within 50m of any watercourse. Soil stockpiles within 100m of a watercourse must be bunded with suitable materials (such as bricks or planks), to prevent sedimentation. » During construction, silt netting must be erected on the downstream side, along the length of the road crossing, through the watercourse and riparian habitat (as delineated) during the dry season to contain sediment as far as possible. However, the silt nets are to be removed during the autumn and winter months (April to August) should construction need to take place at this time, as the silt nets will act as physical barriers to the watercourses altering the hydrology somewhat, and are likely to be washed away during or after rainfall events. » An appointed environmental control officer (ECO) must monitor the structural integrity of the watercourses when undertaking inspections. Should any erosion be detected, mitigation measures are to be implemented to repair erosion as advised. The environmental control officer must have some experience in erosion rehabilitation to proposed adequate measures, should this be required.
Cumulative impacts: No cumulative impacts.
Residual Impacts: No residual Impacts after implementation of mitigation measures.

6.1.3. Potential Impacts to the Water Quality of the Watercourses (Construction Phase)

The potential for impacts on the water quality of the watercourses include the possible contamination of water quality as a result of leaks and spillages of oils and fuels directly from vehicles working in or crossing the watercourses. There is also the possibility of chemical contamination from any temporary chemical toilets that are placed within or close to the watercourses during construction. General sedimentation impacts can also be expected following clearance of vegetation in the watercourses.

The rating and significance related to possible water quality impacts is shown in **Table 6.3** below.

Table 6.3: Potential impacts to the water quality of the watercourses.

Nature: Water contamination due to vehicle oil and fuel leakages temporary chemical toilets. General sedimentation impacts are anticipated following clearance of vegetation in the watercourses.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Low (1)
Duration	Medium-term (3)	Very short-term (1)
Magnitude	Moderate (6)	Low (2)
Probability	Probable (3)	Improbable (2)
Significance	**33 (Medium)**	**8 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » No fuels, oils or any other hazardous materials are to be brought into the watercourse or stored within 100m from the edge of the watercourses. » During the construction phase, no vehicles are to cross through the watercourses when the watercourses are in flow. Additionally, no work is to take place in the watercourses when in flow. » Temporary chemical sanitation facilities must be not be placed in the watercourses. Rather these will need to be placed at least 100m away from the watercourses. Temporary chemical sanitation facilities must also be checked regularly for maintenance purposes and cleaned often to prevent spills. » Sedimentation mitigation measures have been included in **Section 6.1.2** above.		
Cumulative impacts: No cumulative impacts.		
Residual Impacts: No residual Impacts after implementation of mitigation measures.		

6.2. Cumulative Impacts

The assessment of cumulative impacts was undertaken with consideration of the type of developments which require the need for access roads, and for which cumulative impacts can be identified that are anticipated to affect freshwater resources in the region. This mainly relates to the trend of renewable energy projects arsing in the region around Helios Substation. Known developments include the Khobab and Loeriesfontein 2 Wind Farms north of Helios Substation. Impacts to watercourses as a result of access roads were observed to be limited, as sensitive features are assumed to have been avoided as far as possible during the environmental authorisation process. With further renewable projects proposed for the region, it can be expected that freshwater resources will come under increasing threat from a cumulative impact perspective in that the resources will be physically altered and degraded with direct development, as well as indirectly from a catchment level through a change in surface roughness and consequent hydrological alterations in catchment drainage. Given the relative density of watercourses and depression wetlands, the cumulative impact was assessed to be of medium significance.

The rating and significance related to possible cumulative impacts is shown in **Table 6.4** below.

Table 6.4: Potential cumulative impacts to the freshwater resources.

Nature: Indirect impacts due to catchment level changes to surface roughness and drainage hydrology, as well as direct impacts related to physical alteration and degradation of freshwater resources in general.		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**39 (Medium)**	**33 (Medium)**

Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Freshwater resources are to be completely avoided as far as possible when planning renewable energy developments. This includes all components, not only access roads.		
Cumulative impacts: Described above.		
Residual Impacts: No residual Impacts after implementation of mitigation measures.		

7. ALTERNATIVE COMPARATIVE ASSESSMENT

Two alternatives have been proposed including Alternative Access Road 1 and Alternative Access Road 2. A comparative assessment of each alternative is provided in **Table 7.1** below, providing reasons for the selection of the preferred.

Table 7.1: Comparative Alternatives Assessment

Preferred Alternatives from an Environmental Perspective	
Alternative Access Road 1	**Alternative Access Road 2**
The construction of the proposed access road will require eight[2] (8) crossings through watercourses. There is already an existing impact for a section of the proposed access road which traverses the north western boundary of the farm Narosies 228, whereby an existing farm road is present. In addition, only minor drainage lines will be affected which will confine the footprint of the impact caused by watercourse crossings. The impact will therefore be less than the other alternative, and is therefore preferred.	The construction of the proposed access road will require nine (9) crossings through watercourses. There are no existing roads along this proposed route so the impact will be greater to the environment. The watercourse crossings required will also affect major drainage lines, thereby increasing the footprint of the crossings required for the access road in comparison to Alternative Access Road 1. The impact will therefore be greater for this alternative and is therefore less preferred.

Based on the information in the comparative assessment above, **Alternative Access Road 1 is preferred** given the expected reduced impact to freshwater resources.

[2] One watercourse was crossed twice, which has resulted in seventeen watercourse 'crossings' identified in total for all watercourses. Note however, that only sixteen watercourse reaches were delineated in total.

8. RECOMMENDATIONS

With consideration of the condition and functionality of the watercourses identified, and the potential impacts anticipated to affect the watercourses in terms of the proposed access road, the following recommendations are made from a freshwater perspective:

- Construction stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off issues;
- Alien invasive control and management plan is to be compiled for the construction and post-construction phases by a suitably qualified ecological specialist;
- Alternative Access Road 1 should be authorised given the expected reduced impact to freshwater resources;
- Prior to construction, a risk assessment is to be undertaken on the proposed access road. This is to be undertaken to determine the need for appropriate water use authorisation with the Department of Water and Sanitation, should a preferred alternative be authorised by the Northern Cape Department of Environment and Nature Conservation.

9. CONCLUSION

This freshwater delineation and impact assessment report focused on providing an assessment of the affected freshwater resources along the proposed access road alternatives for the Dwarsrug Wind Energy Facility (WEF) near Loeriesfontein, Northern Cape Province.

From a desktop perspective, it was observed from Google Earth™ satellite imagery that numerous drainage lines could be observed intersecting with the proposed alternative access roads. In addition, two wetlands were identified in nearby proximity (within 500m) of the proposed alternative access roads. These freshwater resources were further investigated by means of field verification and delineation. The in-field investigation and assessment confirmed the presence of the drainage lines, of which **sixteen (16) watercourses** in total were delineated. The watercourses were sub-divided into **thirteen minor drainage lines and three major drainage lines**. The in-field investigation also confirmed the presence of **one nearby ephemeral depression wetland**. These freshwater resources were delineated using the indicators as stipulated in the national guidelines, and were assessed further accordingly.

The present ecological state of the ephemeral depression wetland was assessed to gain an understanding of the condition of the wetland. This was assessed using the WET-Health methodology. The results showed that the wetland was assessed to be a **Class C (moderately modified) ephemeral depression wetland system**.

The potential wetland ecosystem services of the wetland were assessed to determine the functionality of the wetland. This was undertaken using the WET-Ecoservices methodology. The **ecosystem services which scored highest included sediment trapping and erosion control**. These are typical functions which the depression wetland was assessed to potentially provide society. Although, the wetland was assessed to have a relatively low significance in this regard overall.

The ecological condition of the riparian habitat for the drainage lines were assessed to gain an understanding of the condition of the habitat. This was assessed using the VEGRAI methodology. The results showed that the Ecological Condition (EC) of the riparian habitat of the minor drainage lines were assessed to be 90% unmodified and therefore, a **Class A unmodified system**. The EC of the riparian habitat of the major drainage lines were assessed to be 88% unmodified and therefore, a **Class B largely natural systems with few modifications**.

A qualitative assessment of the potential ecosystem services that could be provided by the drainage lines followed the ecological condition assessment. It was found that the primary potential ecosystem services assessed included **sediment trapping, bank stabilisation and maintenance, flood attenuation, maintenance of biotic diversity, erosion control and as an ecological corridor for migration of species**. The drainage lines were to be deemed relatively significant in providing these ecosystem services to society.

The ecological importance and sensitivity (EIS) of the wetland and watercourses were assessed taking into account the various determinants of each freshwater resource. The most important determinants of the wetland, which scored relatively high, were in terms of being ecologically sensitive as a result of any change in the natural regime of the hydrological component, and important from a migration route/breeding and feeding site for invertebrates, amphibians and waterfowl despite being ephemeral in nature. In addition, the wetland was identified to serve an important role in performing sediment trapping, erosion control and

flood attenuation function for the local catchment. The wetland was classified as an ESA (in terms of the Northern Cape Conservation Plan, 2016) and was assessed to be a Class C moderately modified system in terms of the present ecological state, which also raised the ecological important score. Overall however, many of the other determinants scored fairly low, and the end result was that the EIS of **the wetland was assessed to be a Class C system** which is considered to be moderately ecologically important and sensitive on a provincial or local scale. For the watercourse, the most important determinants of the wetland which scored relatively high were in terms of being important as a migration route/breeding and feeding site for reptiles, invertebrates and waterfowl, despite being intermittent in nature. In addition to this, the watercourses were identified to serve an important role in performing sediment trapping, attenuation of storm water and energy dissipation for the local catchment. The watercourses were also identified to be sensitive to changes in the natural hydrological regime in respect of water supply reductions or alteration of flood peaks thereby causing desiccation and disturbance, respectively. Lastly, the results of the desktop assessment and VEGRAI assessment informed the ecological integrity component of the EIS assessment, also scoring high due to the fact that the watercourses were assessed to be Class A/B systems in terms of the vegetation ecological condition. Despite these relatively high scores, **the watercourses were classed as Class C systems** due to the low scores for the remaining determinants which averaged out the final score.

As the proposed development is to include the construction of linear feature through a watercourse, a buffer zone was deemed to be impractical and ineffective, as the proposed road would need to cross the relevant watercourses regardless. **A buffer zone was therefore not recommended for the watercourses**.

The impact assessment identified potential impacts during the construction phase only. These included **potential impacts to the in-stream and riparian habitat (post-mitigation rating – medium), to the geomorphology and hydrology (post-mitigation rating – medium), and water quality (post-mitigation rating – low) of the watercourses**. Suitable **mitigation measures were proposed to minimise potential impacts** as far as possible.

A comparative assessment of the proposed alternatives for the access road was undertaken. The results showed that **Alternative Access Road 1 was preferred** given the expected reduced impact to freshwater resources.

With consideration of the condition and functionality of the watercourses identified, and the potential impacts anticipated to affect the watercourses in terms of the proposed access road, the following recommendations are made from a freshwater perspective:

- Construction stormwater management plan must be compiled by a suitable engineer to address general drainage and run-off issues;
- Alien invasive control and management plan is to be compiled for the construction and post-construction phases by a suitably qualified ecological specialist;
- Alternative Access Road 1 should be authorised given the expected reduced impact to freshwater resources;
- Prior to construction, a risk assessment is to be undertaken on the proposed access road. This is to be undertaken to determine the need for appropriate water use authorisation with the Department of Water and Sanitation, should a preferred alternative be authorised by the Northern Cape Department of Environment and Nature Conservation.

Ultimately, the proposed access road was assessed to have a moderate to low negative potential impact significance on the watercourses to be affected, and with the implementation of the mitigation measures and recommendations stipulated. **The proposed construction of the access road is therefore supported, and should be allowed to proceed on condition that the mitigation measures proposed are implemented, in addition to obtaining the necessary water use authorisation from the Department of Water and Sanitation prior to construction.**

10. REFERENCES

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APPENDIX A:
SPECIALIST CVS

1st Floor, Block 2, 5 Woodlands Drive Office Park
Woodlands Drive, Woodmead
Johannesburg, South Africa

Email: shaun@savannahsa.com
Tel: +27 (11) 656 3237

CURRICULUM VITAE OF SHAUN TAYLOR

Profession : Environmental and Permitting Lead Consultant

Specialisation: Environmental Impact Assessments; Strategic Environmental Assessments; Environmental permitting compliance, advice & assurance; Water Use Licenses; Project Management; Wetland Assessments.

Work Experience: Eleven (11) years' experience in the environmental field

OCATIONAL EXPERIENCE

Shaun's highest qualification is a Master of Science Degree in Aquatic Health. Shaun has an in-depth understanding of environmental and water related South African legislation. Applicable legislation includes the National Environmental Management Act, 1998 (Act No. 107 of 1998), the Environmental Impact Assessment (EIA) Regulations (2006, 2010 and 2014, as amended) and the National Water Act, 1998 (Act No. 36 of 1998). Over and above a number of other projects, Shaun has successfully conducted and obtained environmental approvals for numerous renewable energy (wind and solar) developments as well as for infrastructure (roads, water pipeline and power line) related projects. Shaun has excellent experience in dealing with the entire environmental authorization (EA) process from beginning to end i.e. submission of applications, undertaking Environmental Impact Assessments and Basic Assessments (BAs), conducting EA amendments, extension applications and compiling Draft and Final Environmental Management Programmes (EMPrs). Shaun is well acquainted and experienced in dealing with the key provincial and national environmental authorities, other organs of state as well as any other key stakeholders.

Within the water field, Shaun has completed numerous water use license applications (WULAs), General Authorisations (GAs), Risk Assessments and WULA compliance monitoring for various developments. Shaun is also specialised in wetland ecology and operates as a wetland specialist. Shaun has undertaken and completed numerous wetland and riparian assessments for renewable energy, linear projects as well as site specific projects. Shaun has also undertaken a wetland offset plan and several wetland rehabilitation plans for various developments.

SKILLS BASE AND CORE COMPETENCIES

- Environmental Project Management
- Environmental Impact Assessments and Basic Assessments
- Environmental Management Programmes
- Environmental Compliance Monitoring
- Environmental Amendments
- Strategic Environmental Assessments
- Environmental Management
- Public and Stakeholder Engagement
- Water Use License Applications
- General Authorisations

- Risk Assessment Matrix
- Wetland Delineation, Functional and Impact Assessments
- Geographic Information Systems (GIS)

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- M.Sc. Aquatic Health, University of Johannesburg, Johannesburg (2011)
- B.Sc (Hons) Geography and Environmental Studies, University of Witwatersrand, Johannesburg (2010)
- B.A Geography and Environmental Science, Monash University, Johannesburg (2008)

Short Courses:

- National Training and Development Buffer Zone Workshop, Eco-pulse (2015)
- Integrated Water Resources Management (IWRM), the National Water Act (NWA), and Water Use Authorisations, focusing on Water Use License Applications – Procedures, Guidelines, Integrated Water and Waste Management Plan (IWWMP), Carin Bosman Sustainable Solutions (2014)
- Grass identification short course, Bushveld Eco Services (2010)
- Wildflower identification short course, Bushveld Eco Services (2010)
- Veld management short course, Bushveld Eco Services (2010)
- Short course and certification in Wetland Delineation and Rehabilitation Training Course from the School of Continuing Education, University of Pretoria (2008)

Professional Society Affiliations:

- Member of the South African Wetland Society (SAWS) (Current)
- Registration pending with the South African Council for Natural Scientific Professions as a Professional Natural Scientist: Environmental Scientist (Current)

Other Relevant Skills:

- Project Management Course, SiVEST (2017)

EMPLOYMENT

Date	Company	Roles and Responsibilities
June 2018 – Current:	Savannah Environmental (Pty) Ltd	Environmental and Permitting Lead Consultant *Tasks include: undertaking strategic environmental assessments, environmental impact assessments, basic assessments, environmental management programmes (EMPrs), environmental amendments, environmental screening and due diligence assessments, water use license applications, wetland assessments and rehabilitation plans. Ensuring environmental compliance on permitting processes. Client liaison and relationship management.*
November 2010 – May 2018	SiVEST South Africa (Pty) Ltd	Environmental Scientist *Tasks included: conducting environmental impact assessments, basic assessments and water use license application processes, undertaking amendment and exemption*

Date	Company	Roles and Responsibilities
		applications, general project management, report writing, marketing and proposal writing, client liaison and relationship management, invoicing, conducting specialist riparian/wetland delineation and functional assessments, environmental and water related compliance monitoring and auditing.
October 2009 – March 2010	Envirokey cc	Junior Environmental Consultant and GIS support *Tasks included: being responsible for managing basic assessments, report writing, conducting specialist wetland assessments, auditing procedures and GIS mapping.*
August 2007 – September 2009	Holgate Meyer and Associates Environmental Management Services	Junior Environmental Consultant *Tasks included: being responsible for managing basic assessments, report writing, conducting specialist wetland assessments, environmental auditing procedures and GIS mapping.*

PROJECT EXPERIENCE

Project experience includes environmental approvals for numerous renewable energy (wind and solar) developments as well as for infrastructure (roads, water pipeline and power line) related projects. Within the water field, project experience includes numerous water use license applications, general authorisations, risk assessments and compliance monitoring for various developments. In terms of wetland assessments, project experience includes numerous wetland and riparian delineation, functional and impact assessments for renewable energy, linear projects and site-specific projects. The wetland experience also includes a wetland offset plan and several wetland rehabilitation plans (various types of developments).

RENEWABLE POWER GENERATION PROJECTS: SOLAR ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Hyperion 1, 2, 3 and 4 – 75MW Photovoltaic (PV) Plants near Kathu, Northern Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant, public participation*
Loeriesfontein PV Plant, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Renosterberg PV Plant near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Environmental consultant, public participation, wetland specialist*
Droogfontein II - 70MW Solar Photovoltaic Power Plant near Kimberley, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Construction of a Concentrated PV/ PV Plant in De Aar, Northern Cape	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Sirius Solar 3 and 4 100MW PV Plants near Upington, Northern Cape Province	*SOLA Future Energy*	*Project leader, environmental consultant, public participation*
Aggeneys 2 X 100MW PV Plants, Northern Cape Province	*Atlantic Energy Partners & ABO Wind*	*Project leader, environmental consultant, public participation*
Proposed development of a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, public participation, wetland specialist*
Proposed development of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, public participation, wetland specialist*
Loeriesfontein 70MW PV Plant, Northern Cape Province	*Biotherm Energy*	*Environmental consultant*
Droogfontein II - 70MW Solar Photovoltaic Power Plant near Kimberley, Northern Cape Province	*SunEdison*	*Project leader, environmental consultant*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Sol Invictus 3 & 4 PV Part 2 Amendment Application, Northern Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant*
Aries PV Part 1 Amendment Application, Northern Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Konkoonsies PV Part 1 Amendment Application, Northern Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Steynsrus PV 1 & PV 2 Financial Close, Free State Province	*Cronimet*	*Project leader, environmental consultant*
Heuningspruit PV 1 Financial Close, Free State Province	*Cronimet*	*Project leader, environmental consultant*
Integrated Water Use License Application for the Construction of a Concentrated PV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Proposed Construction of the De Wildt Solar Photovoltaic Power Plant, General Authorisation and Risk Assessment, Gauteng Province	*SunEdison*	*Project leader, environmental consultant, wetland specialist*
Loeriesfontein Photovoltaic (PV) Plant Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*
Droogfontein II 70MW Solar Photovoltaic Power Plant near Kimberley Vegetation Permits, Northern Cape Province	*SunEdison*	*Environmental consultant*

RENEWABLE POWER GENERATION PROJECTS: WIND ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Noupoort Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant & public participation*

Loeriesfontein Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Khobab Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Renosterberg Wind Farm near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Environmental consultant, public participation, wetland specialist*
Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*
Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, public participation, wetland specialist*

Screening Studies

Project Name & Location	***Client Name***	***Role***
Environmental Constraints Analysis Report for the establishment of four Wind Farms in the Northern and Eastern Cape Provinces	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*

Compliance Advice and ESAP reporting

Project Name & Location	***Client Name***	***Role***
Noupoort Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental advisor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Perdekraal West Wind Farm Part 2 Amendment Application, Western Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Witberg Wind Farm Part 2 Amendment Application, Western Cape Province	*Building Energy South Africa*	*Project leader, environmental consultant*
Karreebosch Wind Farm Part 2 Amendment Application, Northern & Western Cape Provinces	*G7 Renewable Energies*	*Project leader, environmental consultant*
Dassiesklip Wind Farm Part 1 Amendment Application, Western Cape Province	*Biotherm Energy (Pty) Ltd*	*Project leader, environmental consultant*
Water Use License for the Dwarsrug Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Water Use License for the Victoria West Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Khobab Wind Farm Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*

Loeriesfontein Wind Farm Vegetation Permits, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Environmental consultant*

RENEWABLE POWER GENERATION PROJECTS: CONCENTRATED SOLAR FACILITIES (CSP)

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Integrated Water Use License Application for the Construction of a CPV/ PV Plant in De Aar, Northern Cape Province of South Africa	*Mainstream Renewable Power South Africa*	*Environmental consultant, wetland specialist*
Water Use License for the Rooipunt Concentrated Solar Power Project, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Water Use License for the Limestone Concentrated Solar Power Project, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*

RENEWABLE POWER GENERATION PROJECTS: GAS POWER FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Richards Bay Combined Cycle Gas Turbine Power Plant near Richards Bay, KwaZulu Natal Province	*Eskom*	*Environmental consultant & public participation*

CONVENTIONAL POWER GENERATION PROJECTS (COAL)

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Proposed Installation of a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station, Mpumalanga Province	*Eskom Generation*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Water Use License Compliance Auditing for Grootvlei Power Station, Mpumalanga Province, South Africa	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Armcor Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Ash Dump Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Pollution Dams Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Stream Diversion and Water Pipeline Crossings Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*
Kusile Power Station Geotechnical Water Use License Compliance Audit, Mpumalanga Province	*Eskom Generation*	*Project leader, environmental auditor, wetland specialist*

GRID INFRASTRUCTURE PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Mookodi Integration Project Environmental Impact Assessment, North West Province	*Eskom Distribution*	*Environmental consultant, wetland specialist*
Eskom Thyspunt Nuclear Integration Project – Transmission and Substation Infrastructure (Northern and Southern Corridor), Eastern Cape Province	*Eskom Transmission*	*Environmental consultant, wetland specialist*

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Wilger 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Limestone 1 – 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Limestone 2 – 132kV Overhead Distribution Power Line, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Environmental consultant, wetland specialist*
Proposed Tweespruit to Welroux Power Line and Substations, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the proposed 200MW Concentrated Solar Power (CSP) Plant on the Farm Rooipunt Number 617 near Upington, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Loeriesfontein 132kV Power Line, Northern Cape Province	*Biotherm Energy*	*Project leader, environmental consultant, wetland specialist*
Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the Kalkaar Concentrating Solar Thermal Power Project on the Remainder of Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State and Northern Cape Provinces	*SolarReserve South Africa (Pty) Ltd*	*Project leader, environmental consultant, wetland specialist*
Droogfontein II – 132kV power line and substation near Kimberley, Northern Cape Province	*SunEdison*	*Project leader, environmental consultant*
Mookodi Integration Project II – 132kV Power Line, Havelock Loop-in/Loop-out, Ganyesa Substation, North West Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Environmental Compliance Auditing for the Nigel Substation to Jameson Park (Inland Terminal 2) 88kV power lines	*Eskom Distribution*	*Environmental auditor*

Ga-rankuwa 11kV Underground Power Cable Water Use License Compliance Audit, Gauteng Province	*Eskom Distribution*	*Project leader, environmental auditor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use License / General Authorisation for Ga-rankuwa Substation, Gauteng Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License / General Authorisation for Klevebank to Dalkieth 88kV Power Line, Gauteng Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License Application for the Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*
Water Use License / General Authorisation Proposed Tweespruit to Welroux Power Line and Substations, Free State Province	*Eskom Distribution*	*Project leader, environmental consultant, wetland specialist*

MINING SECTOR PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Karowe Diamond Mine Environmental Management Plan Review and Update, Boteti District, Botswana	*Karowe Diamond Mine*	*Environmental consultant*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Post-rehabilitation Assessment of Three Wetland Crossing Sites for the Re-working of a Tailings Dam Project near Stilfontein, North West Province	*Chemwes (Pty) Ltd*	*Environmental auditor*

TRANSPORT SECTOR PROJECTS

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Polokwane Integrated Rapid Public Transport Network, Limpopo Province	*City of Polokwane*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Transnet Rail Water Use License Compliance Audit, Northern Cape Province	*Hatch-Goba / Transnet*	*Environmental auditor*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use Licensing for the Polokwane Integrated Rapid Public Transport Network, Limpopo Province	*City of Polokwane*	*Environmental consultant, wetland specialist*
General Authorisation for the proposed eThekwini Integrated Rapid Public Transport Network (IRPTN) -	*Nako Iliso*	*Environmental consultant, wetland specialist*

BRT Phase 1: Route C1A, General Authorisation and Risk Assessment, Kwa-Zulu Natal Province		

INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Sir Lowry's Pass River Flood Alleviation Project, Western Cape Province	*City of Cape Town*	*Environmental consultant*

Screening Studies

Project Name & Location	***Client Name***	***Role***
Environmental Screening Assessment for a vegetable oil pipeline in Richards Bay Industrial Development Zone, KwaZulu Natal	*Wilmar Processing (Pty) Ltd*	*Environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Wetland Post-rehabilitation Assessment of the Inland New Multi-Purpose Pipeline in the Mpumalanga and Gauteng Provinces	*Transnet SOC Ltd*	*Wetland specialist*

HOUSING AND URBAN PROJECTS

Screening Studies

Project Name & Location	***Client Name***	***Role***
Social Housing Projects in Sasolburg and Secunda, Gauteng Province	*Provincial Department of Human Settlements*	*Environmental consultant, wetland specialist*

INDUSTRIAL PROJECTS

Basic Assessments

Project Name & Location	***Client Name***	***Role***
PPC Slurry Plant decommissioning of Kilns 5 & 6, North West Province	*PPC Limited*	*Project leader, environmental consultant*
SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Project leader, environmental consultant, wetland specialist*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Environmental Compliance Auditing for the Meadow Feeds Standerton Broiler Feed Mill, Mpumalanga Province	*Meadow Feeds*	*Environmental consultant, wetland specialist*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Water Use License for the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Project leader, environmental consultant, wetland specialist*

Water Use License for the Proposed Tissue Manufacturing Capacity at the Kliprivier Operations Base, General Authorisation and Risk Assessment, Gauteng Province	*Twinsaver Group*	*Project leader, environmental consultant, wetland specialist*

ENVIRONMENTAL MANAGEMENT TOOLS

Strategic Environmental Assessments

Project Name & Location	***Client Name***	***Role***
Molemole Local Municipality Strategic Environmental Assessment, Limpopo Province	*Capricorn District Municipality*	*Environmental consultant, wetland specialist*
Blouberg Local Municipality Strategic Environmental Assessment, Limpopo Province	*Capricorn District Municipality*	*Environmental consultant, wetland specialist*

SPECIALIST STUDIES

Wetland and Riparian Delineation, Functional and Impact Assessments

Project Name & Location	***Client Name***	***Role***
Wetland delineation assessment for a vegetable oil pipeline in Richards Bay, KwaZulu Natal Province	*Wilmar Processing (Pty) Ltd*	*Wetland specialist*
Surface water assessment for the Dwarsrug Wind Farm Access Road near Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a Wind Farm in Prieska, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a Wind Farm in Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a 132KV Distribution Line from the Kudu Substation to Dorstfontein Substation in Mpumalanga Province	*Eskom Distribution*	*Wetland specialist*
EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Northern Corridor: Eastern Cape Province	*Eskom Transmission*	*Wetland specialist*
EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Southern Corridor: Eastern Cape Province	*Eskom Transmission*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Environmental Management Framework for the Mogale City Local Municipality Surface Water Report – Desired State Report: Gauteng Province	*Mogale City*	*Wetland specialist*
Surface Water Assessment for the Proposed Township Development on the Remainder of Portion 27 of the Farm Middelburg and Townsland 287 JS, Mpumalanga Province	*Steve Tshwete Local Municipality*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Construction of a CSP and a CPV/ PV Plant in Kimberley, Northern Cape Province, South Africa	*Mainstream Renewable Power South Africa*	*Wetland specialist*

Surface Water Assessment for the Westrand Strengthening Project from Westgate Substation to Hera Substation and Westgate Substation Extension, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Mookodi Integration Project 2 Basic Assessment Surface Water Impact Assessment, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Construction of a Gabion Structure at Waterval Substation in the Midrand Area, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Single 400kV Power Line from Borutho to Nzhlele, North West Province	*Eskom Transmission*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 88kv Power Line at Palmridge in the Ekurhuleni Metropolitan Municipality, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province	*SolarReserve South Africa (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Rebuilding of an 88kV Power Line from Henneman Substation to Serfontein Substation near Kroonstad, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Deconstruction and Construction of an 11kV Power Line near Delmas, Mpumalanga Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Solar Photovoltaic Power Plant near De Aar, Northern Cape Province, South Africa	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Wind Farm near De Aar, Northern Cape Province	*Renosterberg Wind Energy Corporation (RWEC) & Industrial Development Corporation (IDC) of South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Low-Cost Housing Development in the Soutpan area of Tshwane, Gauteng Province	*Makole Property Development*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 132kV Power Line near Kimberley, Northern Cape Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Extension of Delmas Substation and Associated Power Lines, Mpumalanga Province, South Africa	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Substation in the Midrand area of Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Construction of an 88kV Power Line at Lochvaal Kudu in the Emfuleni Municipality, Gauteng Province	*Eskom Distribution*	*Wetland specialist*

Surface Water Assessment for the Proposed construction of an 88kV Power Line from Klevebank Substation to Dalkeith Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 88kV Power Line from Heilbron Substation to Villiers Substation, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 132kV Power Line, Substation and the Extension of Homestead Substation Associated with the 75MW Concentrating Photovoltaic (CPV) / Photovoltaic (PV) Plant (PV 3) on the Farm Droogfontein in Kimberley, Northern Cape Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Moddershaft Underground to Overhead Cable Replacement of an 11kV Power Line from Moddershaft Substation to a Minisub near Anzac, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 11kV Underground Power Cable from Civic Centre to Zola Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Substation on Portion 265 Randjesfontein 405-JR, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Mathibestad Danhauser 33kV Power Line Network, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mathibestad-Danhauser Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mothutlung North Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Mothutlung South Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Nonyane Madidi North Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Nonyane Swartdam Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Rebuild of a Section of the Existing 33kV Pelly Klipdrift Network, Gauteng and North West Provinces	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Zonderwater Kraal Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Hammanskraal Lusthof Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*

Surface Water Assessment for the Proposed Re-build of a Section of the Existing 33kV Klipgat Circle Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Re-build of Sections of the Existing 33kV Erasmus Aviva Power Line Network, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of an 11kV Underground Power Cable at the Ga-Rankuwa Substation, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Mamatwan Manganese Mine, Northern Cape Province	*Groundwater Consulting Services (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Dwarsrug Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Manzimtoti Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Compensation Flats Development, Kwa-Zulu Natal Province	*Tongaat Hulett*	*Wetland specialist*
Surface Water Assessment for the Tinley Manor South Road Development, Kwa-Zulu Natal Province	*Tongaat Hulett*	*Wetland specialist*
Surface Water Assessment for the Ntuzuma Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Esphiva Sewer Line Project, Kwa-Zulu Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Frankfort 132kV Power Line Wetland Walk-down Assessment, Free State Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Esphiva Water Pipeline near Ulundi, KwaZulu-Natal Province	*Environmental Planning and Design cc*	*Wetland specialist*
Surface Water Assessment for the Grootvlei Power Station, Mpumalanga Province	*Eskom Generation*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Embangweni and Bhekabantu Irrigation Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Nondabuya and Khwehle Primary Agriculture Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Expansion of the Makhathini Irrigation Scheme, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Mbaliyezwe Irrigation Schemes, KwaZulu-Natal Province	*Nzingwe Consultancy*	*Wetland specialist*
Surface Water Assessment for the Proposed Mixed Use Development on the Remainder of Portion 27 of the Farm Middelburg Town and Townlands 287 JS, Steve Tshwete Local Municipality in the Mpumalanga Province	*Steve Tshwete Local Municipality*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of Two Power Lines and Two	*Mainstream Renewable Power South Africa*	*Wetland specialist*

Substations for the Mainstream Wind Facilities near Beaufort West, Western Cape Province		
Surface Water Assessment for the Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province	*Nako Iliso*	*Wetland specialist*
Surface Water Assessment for the Proposed Coal Railway Siding at the Welbedacht Marshalling Yard and associated Milder Road Upgrade near Springs, Gauteng Province	*Canyon Coal*	*Wetland specialist*
Surface Water Assessment for the Proposed Development of a 22kV Medium Voltage Power Line in Mofofutso, North West Province	*Eskom Distribution*	*Wetland specialist*
Wetland Walk-down Assessment for the Mookodi Integration Power Line Project, North West Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Coal Loading Facility within the existing Bronkhorstspruit Railway Siding near Bronkhorstspruit, Gauteng Province	*Canyon Coal*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Two 75MW Tlisitseng Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Two 75MW Sendawo Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Sendawo Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Helena 1, 2 & 3 Photovoltaic Energy Facilities near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 70MW Photovoltaic Facility and 132kV Power Line near Loeriesfontein, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Expansion of the Tissue Manufacturing Capacity at the Kliprivier Operations Base, Gauteng Province	*Twinsaver Group*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka West 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka East 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Eureka 132kV Power Line near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*

Surface Water Assessment for the Proposed Construction of the Aletta 140MW Wind Farm near Copperton, Northern Cape Province	*Biotherm Energy*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Expansion of the Mountain Valley "A" Grade Chicken Abattoir on the Remainder of Subdivision of Portion 17 (of 16) of the Farm Leeuw Poort 1120 FT, KwaZulu-Natal Province	*Shangoni Management Services (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a Linking Station, Power Lines and Substations for the Mainstream Wind Energy Facilities near Beaufort West, Western Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction 132kV Power Lines and a Substation for Tsakane Ext 10 and 22, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Harte Beeste Leegte Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Ithemba Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Gras Koppies Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Xha! Boom Wind Farm, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 140MW Wind Farm and Associated Infrastructure near Hutchison, Northern Cape Province	*Mainstream Renewable Power South Africa*	*Wetland specialist*
Surface Water Assessment for the Proposed Maintenance of the Water Pipeline in Parys, Ngwathe Local Municipality, Free State Province	*Gedezar Consulting*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the Rietkuil Coal Railway Siding near Bronkhorstspruit, Gauteng Province	*Canyon Coal*	*Wetland specialist*

Surface Water Assessment for the Proposed Construction of a 75MW Solar Photovoltaic Power Plant near Dennilton, Limpopo Province	*Nokukhanya Energy (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of a 9.9 MW Solar Photovoltaic (PV) Energy Facility on the Farm Wildebeestkuil near Leeudoringstad, North West Province	*Leeudoringstad Solar Plant (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of up to a 5MW Solar Photovoltaic (PV) Energy Facility on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad, North West Province	*Leeudoringstad Solar Plant (Pty) Ltd*	*Wetland specialist*
Surface Water Assessment for the Proposed Construction of the De Wildt Solar Photovoltaic Power Plant, Gauteng Province	*SunEdison*	*Wetland specialist*

Wetland and Riparian Rehabilitation Plans

Project Name & Location	***Client Name***	***Role***
Wetland and River Rehabilitation Plan for the Fourways 22kV Feeder Cable, Gauteng Province	*Eskom Distribution*	*Wetland specialist*
Wetland and Riparian Rehabilitation Plan for the Proposed eThekwini Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province	*eThekwini Metropolitan Municipality*	*Wetland specialist*
Wetland Rehabilitation Plan for the Delmas Pedestrian Bridge, Mpumalanga Province	*Canyon Coal*	*Wetland specialist*
Wetland Remediation Plan for the Graspan Colliery Extension on the Remaining Extent of Portion 31 on the Farm Elandspruit 291 JS, Mpumalanga Province	*GiBB*	*Wetland specialist*

Wetland Offset Plans

Project Name & Location	***Client Name***	***Role***
Wetland Offset Plan for the Proposed Construction of the SPAR Distribution Centre, Port Elizabeth, Eastern Cape Province	*SPAR Group Ltd*	*Wetland specialist*