FRESHWATER SCOPING ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED BOULDERS WIND FARM, VREDENBURG, WESTERN CAPE PROVINCE

Prepared for

Savannah Environmental

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a wetland scoping assessment as part of the environmental assessment and authorisation process for the proposed Boulders Wind Farm near Saldanha, Western Cape. The Wind Farm will have a contracted capacity of up to 140MW and will be developed within ten (10) different properties, hereafter referred to as the "study area" (depicted in Figure 1 below). The study area will be refined during the Environmental Impact Assessment (EIA) phase study during which the actual footprint areas as well as zone of influence of the development will be assessed in more detail.

The proposed development would entail the following activities:

- Site preparation and bush clearing;
- Earthworks (excavations, etc.);
- Construction of a turbine layout and associated infrastructure;
- Construction of gravel roads; and
- Rehabilitation of the development site after construction.

This report was compiled as part of the scoping phase for the project. Included in the scoping report is the delineation of freshwater resources within the study area, as well as the method of assessment that will be utilised as part of the environmental assessment for the development of the Environmental Impact Assessment (EIA), a preliminary literature review, and the results of the analyses of various spatial databases such as the National Freshwater Ecosystem Priority Area (NFEPA) database.

DESKTOP ASSESSMENT

The following general conclusions were drawn following the completion of the desktop study:

- The study Area falls within the Berg River Water Management Area (WMA) within quaternary catchment G10M; and
- The study area falls within the South Western Coastal Belt Eco-region.

Based on the national and provincial datasets, it is evident that there is an extensive network of wetland features scattered throughout the study area, however, these systems are considered to be in a heavily to critically modified state. Agricultural activities within the surrounding area would have resulted in a significant reduction of the ecological buffers around the wetland features, therefore impacts such as erosion, sedimentation and phosphate and nitrate inputs would have resulted in further degradation of these systems.

One unnamed ephemeral river was identified in accordance with the National Freshwater Ecosystem Priority Area (NFEPA) database. Although this river is not considered a priority area on a national scale, it is considered to be a Critical Biodiversity Area (CBA) in accordance with the provincial dataset (Western Cape Biodiversity Spatial Plan). All wetland features within the study are considered to be important from both a national and provincial scale, with most systems identified as Freshwater Ecosystem Priority Areas as well as a CBA or Ecological Support Area (ESA). It is therefore important that all freshwater features be considered no-go areas for new infrastructure development, with only existing crossings utilised as part of the Boulders Wind Farm construction and operation (cables and road crossings).

SENSITIVITY MAP

As part of the Scoping Phase a sensitivity map was developed where all freshwater features within the study area as well as within the 500m investigation zone around the study area were identified. A regulated zone is a buffer area around the delineated freshwater features that a) may be considered as

a no-go area, as deemed necessary by the specialist; or b) would require authorisation by the relevant authorities for any activities (both construction and operation) within these identified zones.

Upon review of the site conditions as well as the relevant datasets, the following sensitivity zones were identified:

- **High Sensitivity** - All freshwater features are considered to be a No-Go Area.
- **Moderate Sensitivity** -The 32m zone of regulation. This area should be avoided as far as feasibly possible for the protection of the freshwater features, but development can take place if the required authorisations in terms of NEMA and the NWA are obtained. Existing crossings must be utilised where possible.
- **Low Sensitivity-** All remaining areas. It should be noted, however, that any infrastructure within 500m of the delineated freshwater features will require authorisation in terms of the National Water Act, 1998 (Act 36 of 1998).

IMPACT ASSESSMENT

The following impacts were identified as part of the scoping phase. General management and good construction management mitigation measures have been provided in this Scoping report to guide the Boulders Wind Farm layout and planning (Section 5).

Table A: Summary of potential impacts associated with the development of the Boulders Wind Farm

Impacts	
Impacts associated with the proposed Boulders Wind Farm and associated infrastructure include potential encroachment and direct disturbance of freshwater habitats as a result of turbine locations and the creation of temporary haul roads through freshwater features, alterations to storm water run-off within the study area, altering the hydrology of the systems and increased sedimentation.	
Issue	**Nature of Issue**
Direct disturbance of freshwater habitat	Potential loss of biodiversity as a result of construction related activities within wetland zones, including construction or upgrading of roads and placement of cables within freshwater features. Decrease in the provision of wetland ecoservices due to the potential degradation of the watercourses
Decrease of freshwater habitat integrity	Encroachment of infrastructure and construction activities may result in waste materials within the freshwater features.
Alteration of runoff patterns	Potential for increased erosion as a result of earthworks in the vicinity of freshwater resources.
Altered hydrology of freshwater features	Potential inappropriate placement of infrastructure within freshwater resources or buffer zones.
Altered stream and baseflow patterns	Potential that the construction of stream crossing may impact on the hydrology and sedimentation of systems.
Ineffective rehabilitation of freshwater resources	Potential for siltation and changes in the hydrological functioning of these areas.

It is evident from the scoping phase that there are freshwater resources within the study area that are considered to be of increased ecological importance and sensitivity. It is therefore considered important that the location of these resources be considered during the planning of the layout design in order to avoid or decrease the potential impact on these resources. The presence of these resources is not considered a fatal flaw to the project, however, these freshwater features (High sensitivity) should be considered a no-go area, with no development allowed and the 32m buffer (Moderate sensitivity) should also be avoided in order to protect the freshwater features. Utilisation of existing crossings during the design phase of the project is considered necessary in order to minimise impacts on the receiving environment. Furthermore, site specific mitigation measures will be developed as part of the EIA Phase which will need to be strictly adhered to.

EIA PHASE – PLAN OF STUDY

Freshwater resources within the study area will be further assessed during the Impact Assessment study. Specific outcomes in terms of the EIA Phase report are as follows:

- Ground-truthing of delineation of the outermost edge of freshwater resources occurring within the development footprint and its associated zone of influence in accordance with "DWAF, 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness will be used to verify the delineation of the wetland temporary zone according to the guidelines;
- Define the Present Ecological State (PES) of each Hydrogeomorphic (HGM) unit within the study area according to indices such as the Wet-Health / Index of Habitat Integrity as advocated by Macfarlane *et al*., (2008) and DWA (2007), respectively as applicable;
- Determine the wetland services provided by the resources within the study area in accordance with the methodology provided by Kotze *et al.* (2009);
- Define the Ecological Importance and Sensitivity (EIS) of the freshwater resources based on the method described by Rountree & Kotze, (2013);
- Aspects regarding watercourse drivers and receptors as required by the DWS Chief Directorate Instream Water Use, as required by the Risk Assessment Matrix (GN509) will be reported on, including the following:
  - Watercourse drivers:
    - Hydrology;
    - Water quality; and
    - Sediment balance and the geomorphological regime.
  - Watercourse receptors:
    - Habitat; and
    - Biota.
- Advocate a Recommended Ecological Category (REC) for each wetland resource based on the findings of the wetland PES and wetland function assessment;
- Evaluation of environmental issues and potential impacts (direct, indirect and cumulative impacts and residual risks) identified, including:
    - The nature of the impact;
    - Extent of the impact;
    - Anticipated duration of the impact;
    - Magnitude;
    - Probability of occurrence
    - The significance of the proposed impact;
    - The status of the impact (positive, negative or neutral);
    - The degree to which the impact can be reversed/cause irreplaceable loss of resources and/or can be mitigated; and
    - Assessment of cumulative Impacts.
- Development of recommendations for mitigating impacts on the receiving environment.

DOCUMENT GUIDE

Requirements for Specialist Studies as per Appendix 6 of the EIA Regulations, as amended in 2017

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix C
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix C
b)	A declaration that the specialist is independent	Appendix C
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
cA)	An indication of the quality and age of base data used for the specialist report	Section 2
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A – Desktop assessment only
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 2 and Appendix B
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	N/A – no infrastructure layout available at this stage. To be undertaken in the EIA phase
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.2
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 5
k)	Any mitigation measures for inclusion in the EMPr	Section 5 – site specific to be provided in the EIA Phase
l)	Any conditions for inclusion in the environmental authorisation	Section 5 and Section 7
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Assessed in EIA Phase
(iA)	Regarding the acceptability of the proposed activity or activities	Assessed in EIA Phase
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 5 and 7. Details to be investigated in the EIA Phase
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CoCT	City of Cape Town
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

Scientific Aquatic Services (SAS) has been appointed to conduct a wetland scoping assessment as part of the environmental assessment and authorisation process for the proposed Boulders Wind Farm near Saldanha, Western Cape. The Wind Farm will have a contracted capacity of up to 140MW and will be developed within ten (10) different properties, hereafter referred to as the "study area" (depicted in Figure 1 below).

In order to identify all potential freshwater resources that may potentially be impacted by the proposed developments, a 500m "zone of investigation" around the study area, in accordance with Regulation 509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998) (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment. This area – i.e. the 500m zone of investigation around the study area - will henceforth be referred to as the "Investigation Area" (Figure 1 and 2). The study area will be refined during the EIA Phase Assessment during which the actual footprint areas as well as zone of influence of the development will be assessed in more detail.

The proposed development would entail the following activities:

- Site preparation and bush clearing;
- Earthworks (excavations, etc.);
- Construction of a turbine layout and associated infrastructure;
- Construction of gravel roads; and
- Rehabilitation of the development site after construction.

This report was compiled as part of the scoping phase for the project. Included in the scoping report is the delineation of freshwater resources within the study area, as well as the method of assessment that will be utilised as part of the environmental assessment for the development of the Environmental Impact Assessment (EIA), a preliminary literature review, and the results of the analyses of various spatial databases such as the National Freshwater Ecosystem Priority Area (NFEPA) database.

1.1 Scope

Specific outcomes in terms of the Scoping Phase report are as follows:

- Compile a desktop study with all relevant information as presented by the South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (GIS) website (http://bgis.sanbi.org) as well as location of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the study area;
- Compile a report presenting the results of the scoping assessment and findings, highlight key constraints and opportunities associated with the proposed development, including:
  - Identification of potential freshwater features within the study area as well as the 500m investigation zone around the study area (as per GN509); and
  - Application of a 32m zone of regulation to each of the identified freshwater features, as per the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), which is also considered a suitable buffer for the conservation of the sensitive features.
- Present the plan of study for the EIA phase of the project including the methods of assessment to be used.

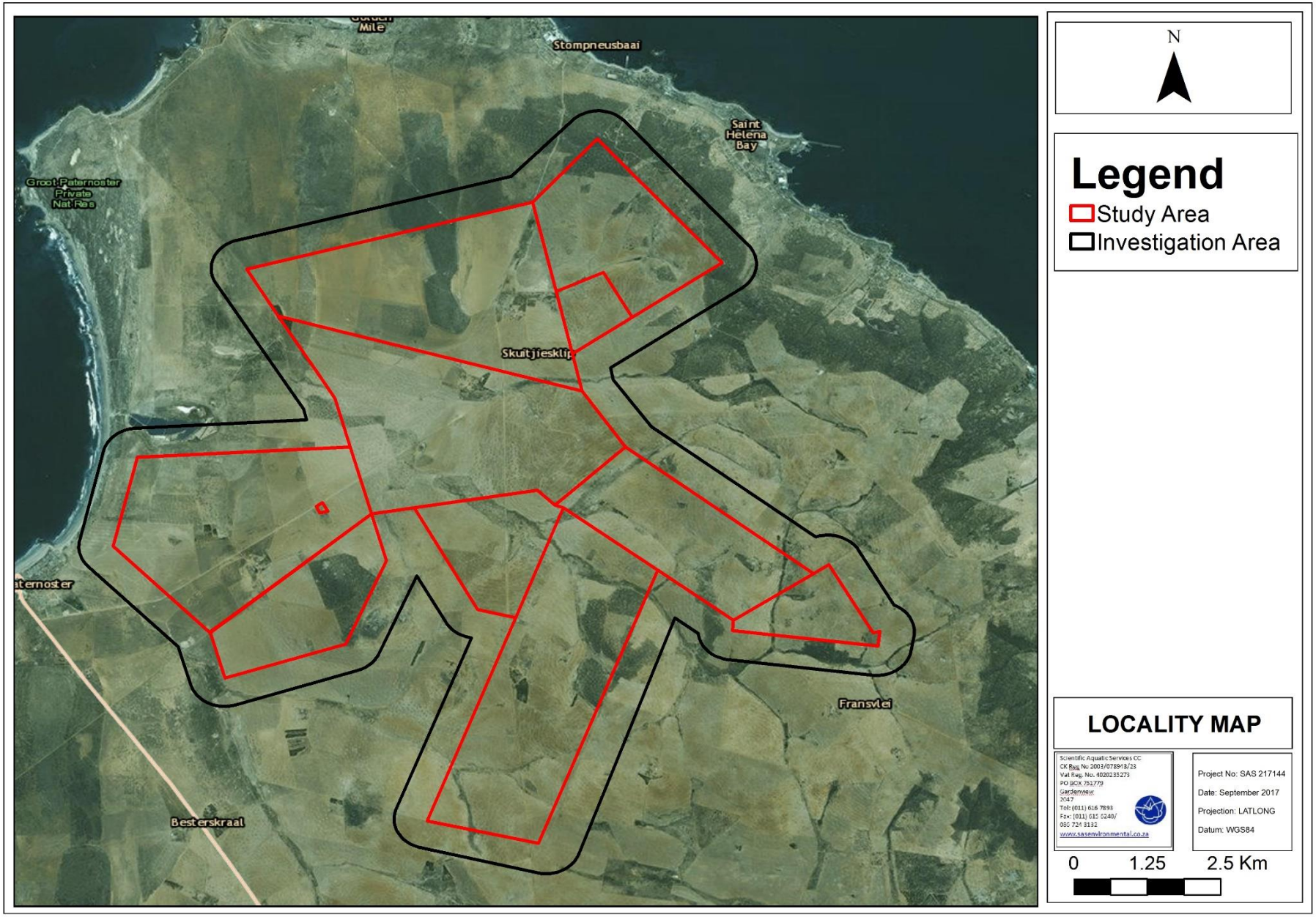

Figure 1: Digital satellite image depicting the study area and associated 500m investigation area in relation to surrounding areas.

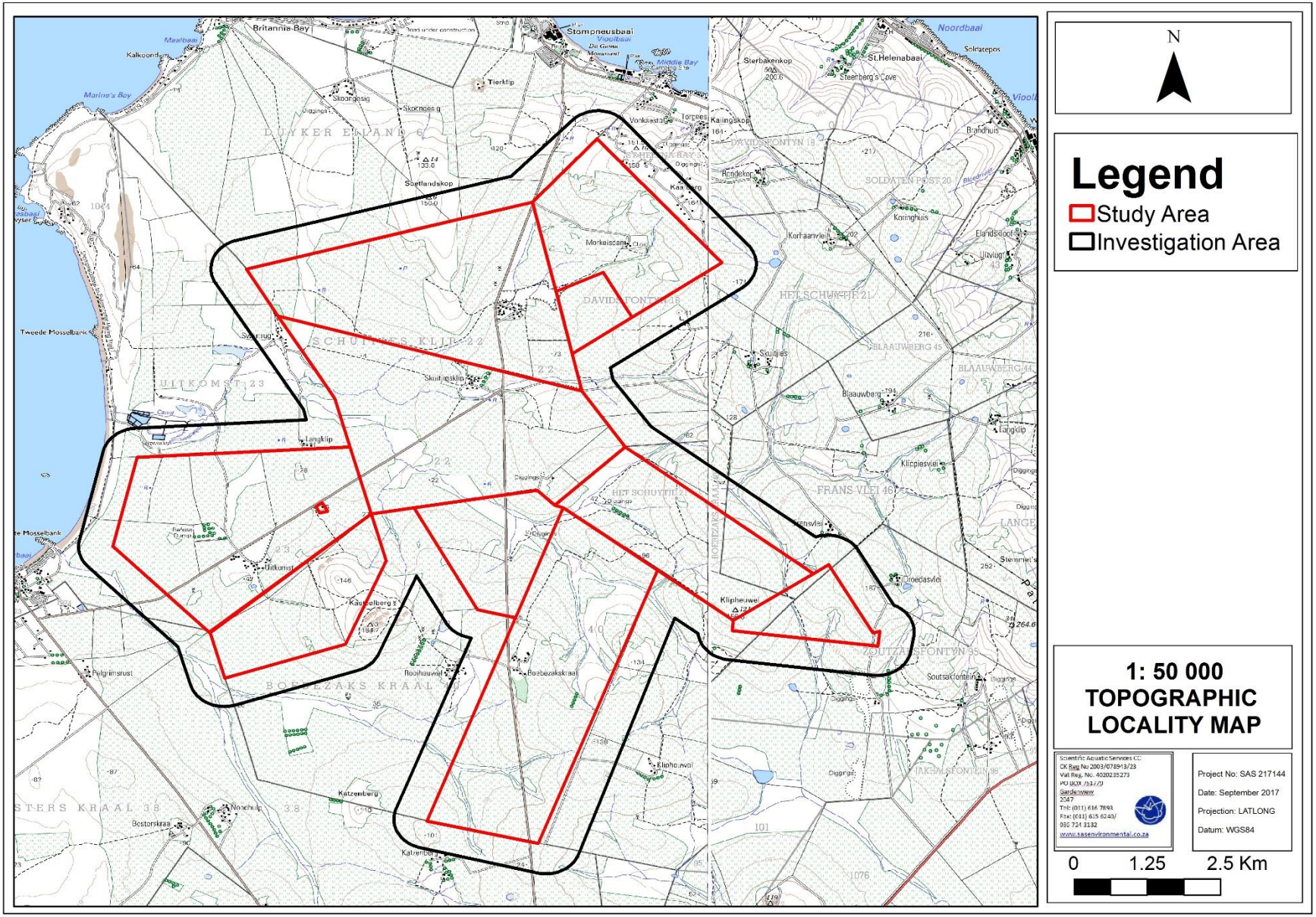

Figure 2: Location of the study area and associated 500m investigation area depicted on a 1:50 000 topographical map in relation to surrounding area.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The freshwater resource desktop assessment is confined to the study area and its associated buffer as per Figure 1 & 2 and does not include the neighbouring and adjacent properties, these were however considered as part of the desktop assessment;
- This study was undertaken as a desktop assessment only and as such, the information gathered must be considered with caution, as inaccuracies and data capturing errors are often present within these databases. Since this information forms part of the scoping phase, this desktop assessment is considered to provide adequate information for informed decision making to take place and in order to inform the Plan of Study for EIA; and
- The freshwater resource delineation will take place during the EIA Phase of the project with the aid of digital satellite imagery and historical aerial photographs. Furthermore, onsite verification was undertaken in July 2016 allowing for a more accurate delineation of the freshwater resources potentially affected by the proposed development.

1.3 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- National Water Act, 1998 (Act 36 of 1998) (NWA); and
- GN509 of 2016– requirements for Water Use License (WULA) in terms of NWA.

The details of each of the above, as they pertain to this study, are provided in **Appendix A** of this report**.**

2 SCOPING PHASE - METHOD OF ASSESSMENT

2.1 Desktop Study

A desktop study was compiled with all relevant information as presented by the SANBI's Biodiversity GIS website (http://bgis.sanbi.org). Relevant databases and documentation that were considered during the assessment of the study area included:

- National Freshwater Ecosystem Priority Areas (NFEPAs, 2011);
- Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database; and
- Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

3 SCOPING PHASE – RESULTS

3.1 Ecological importance and sensitivity of the study area based on National and Provincial datasets

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for improved assimilation of results by the reader to

take place. Where required, further discussion and interpretation is provided, and information that was considered to be of particular importance was emboldened.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area's actual site characteristics at the scale required to inform the Environmental Impact Assessment (EIA) process. However, this information is considered to be useful as background information to the study and sufficient decision making can take place with regards to Wind Farm activities based on the desktop results.

Table 1: Desktop data relating to the character of freshwater resources within the study area and surrounding region.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	South Western Coastal Belt
Catchment	Berg
Quaternary Catchment	G10M
WMA	Berg
subWMA	Lower Berg
Dominant characteristics of the South Western Coastal Belt Ecoregion (Kleynhans *et al.,* 2005)	
Dominant primary terrain morphology	Moderately Undulating Plains
Dominant primary vegetation types	West Coast Renosterveld, Dune Thicket, Strandveld Succulent Karoo
Altitude (m a.m.s.l)	0-100;
MAP (mm)	100-400
Coefficient of Variation (% of MAP)	30 to 40
Rainfall concentration index	50 to 60
Rainfall seasonality	Winter
Mean annual temp. (°C)	16 to 18
Winter temperature (July)	6 to 20
Summer temperature (Feb)	14 to 30
Median annual simulated runoff (mm)	<5 to 60
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)	
Sub-quaternary reach	G10M-08003
Proximity to study area	Traversing central area of study area from SE to NW
Assessed by expert?	Yes
PES Category Median	E
Mean Ecological Importance (EI) Class	Low
Mean Ecological Sensitivity (ES) Class	High
Stream Order	1
Default Ecological Class (based on median PES and highest EI or ES mean)	High (Class B)

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The study area is located within a subWMA n**ot considered important in terms of conservation** FEPACODE = 0
NFEPA Wetlands	The NFEPA database indicate several natural wetlands with various HGM units, situated within the study area (Figure 3). All of the wetlands are considered to be in a **heavily to critically modified ecological condition** (WETCON = Z1), with the exception of **one seep wetland** located within the southern portion of the study area, considered to be in a **moderately modified ecological condition** (WETCON = C) (Figure 4). The majority of the **wetland features are indicated to be Freshwater Ecosystem Priority Areas** (FEPA) (Figure5).
Wetland Vegetation Type	The study area is located within the Western Strandveld (Wetveg) Vegetation Type, considered to be **Endangered**.
NFEPA Rivers	According to the NFEPA database, **one unnamed, ephemeral river** system is located within the study area (Figure 4). This system is considered to be in a **modified state** (PES 1999 and RivCon = C). It is **not considered to be a FEPA river**.
Importance of the study area according to the Western Cape Biodiversity Spatial Plan (WCBSP, 2017) (Figure 7)	
CBA	Various wetland, river and terrestrial CBA 1, as well as a wetland CBA 2 are situated within the study area. A CBA is an area considered to be in a natural / near natural condition that is required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure. CBA 1 areas are considered to be in a natural condition, while CBA 2 areas are potentially degraded / represent secondary vegetation. CBAs need to be maintained in a natural / near natural state and degraded areas should be rehabilitated. All CBA areas were included in the freshwater resource sensitivity map (Figure 6) and are considered to be **no-go areas.**
ESA	Various aquatic and terrestrial ESA 1, as well various ESA 2 are situated within the study area. ESAs are areas that are not essential for meeting biodiversity targets, however they play an important role in supporting the functioning of protected areas / CBAs, and are often vital for delivering ecosystem services. ESA 2 are considered to be severely degraded or have no natural cover remaining and therefore require restoration where feasible. All ESA areas were included in the freshwater resource sensitivity map (Figure 6) and are considered to be **no-go areas.**

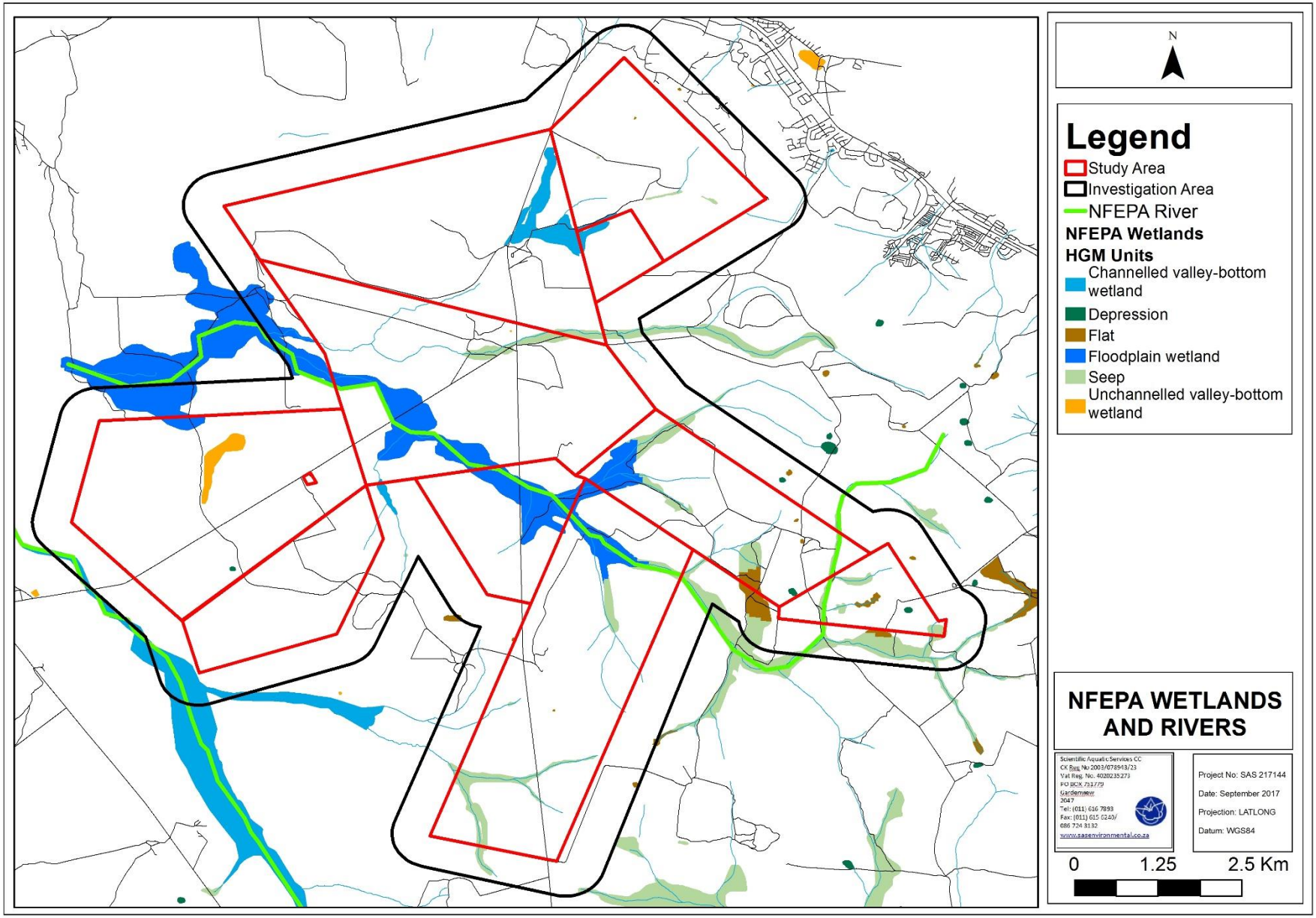

Figure 3: Wetland types and rivers associated with the study area as indicated by the NFEPA (2011) database.

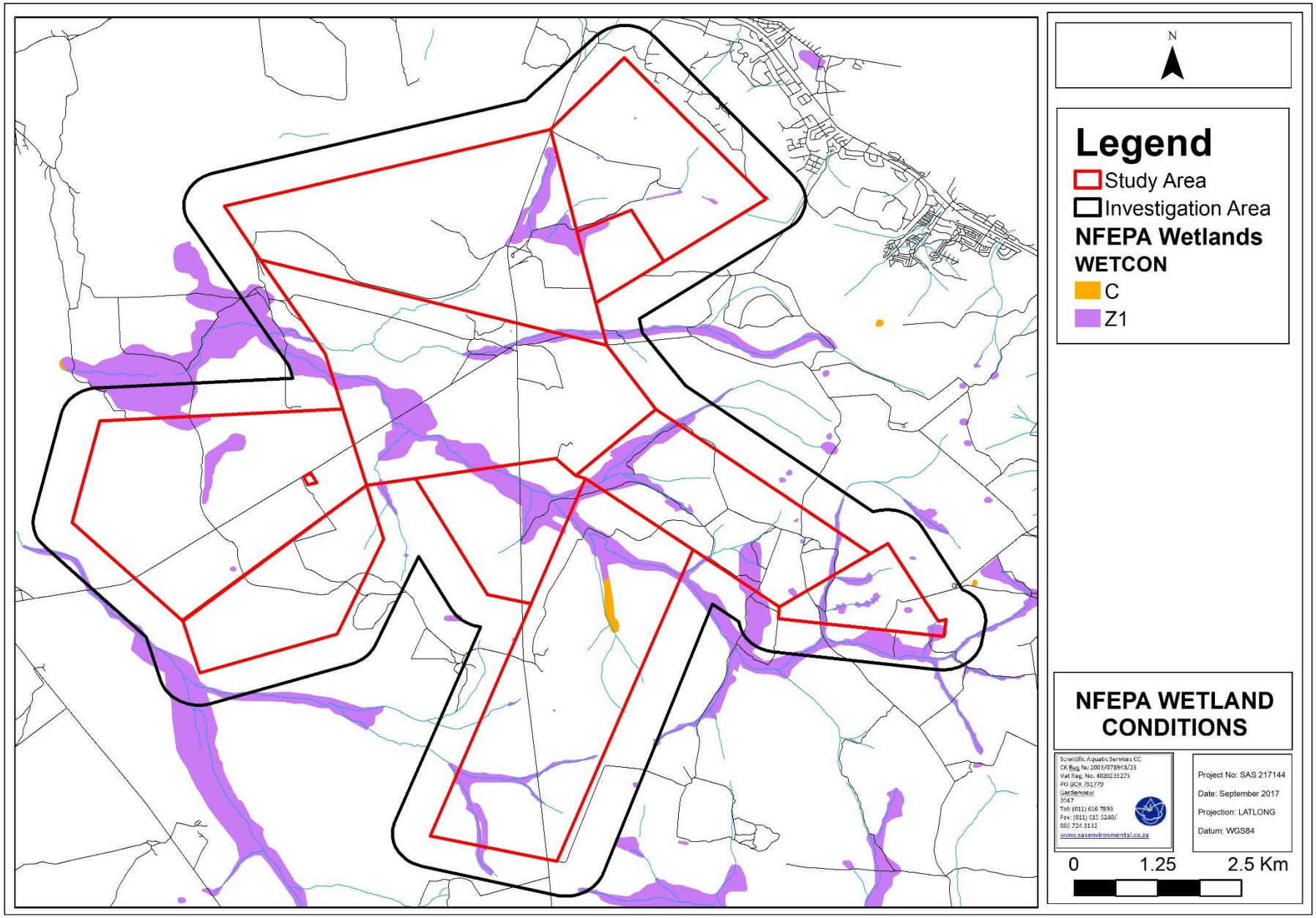

Figure 4: Condition of wetland features as indicated by the NFEPA (2011) database (C = Moderately Modified; Z1 = heavily to critically modified).

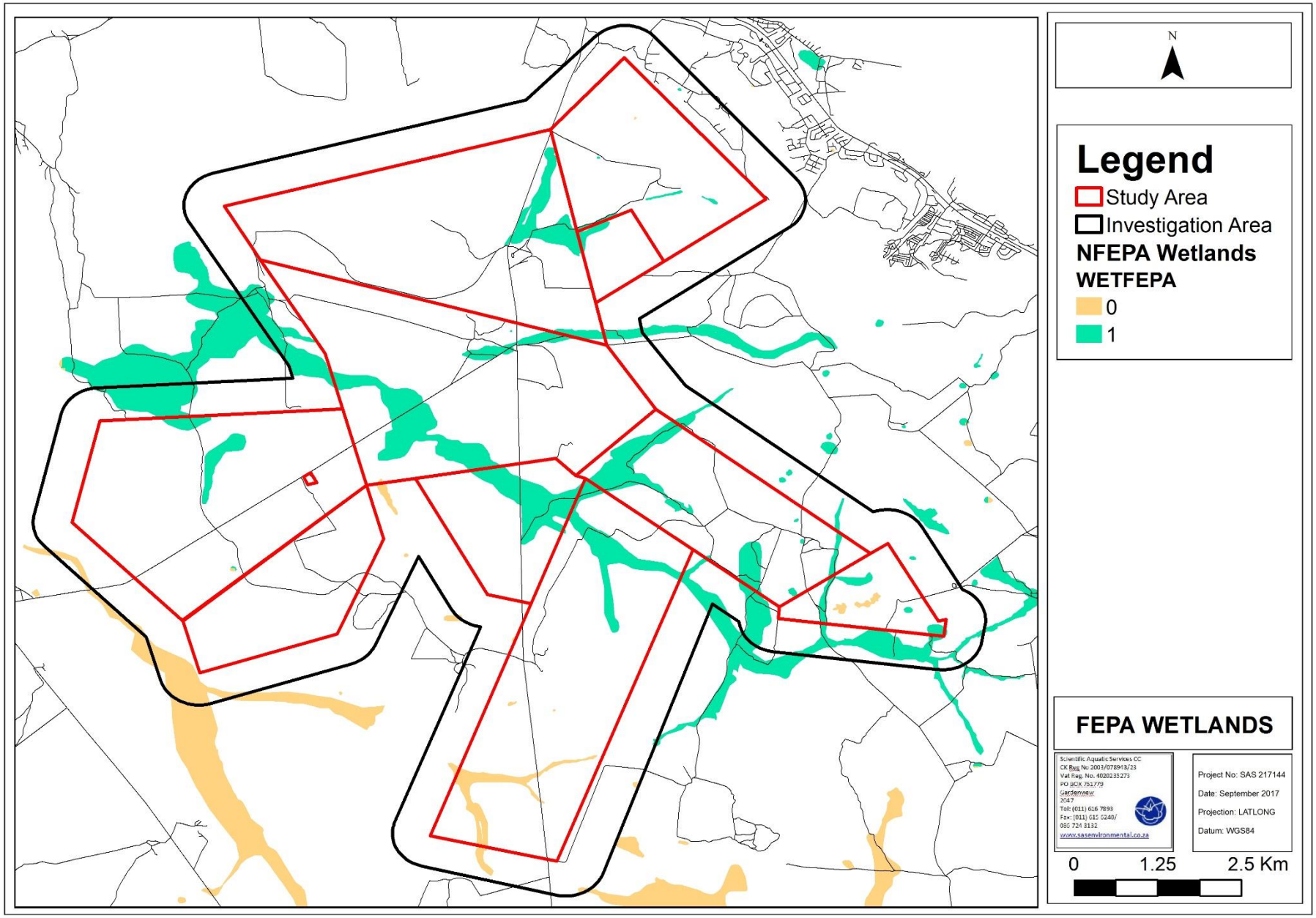

Figure 5: Wetland features are indicated by NFEPA (2011) database (0 = not considered to be a FEPA; 1 = Considered to be FEPA)

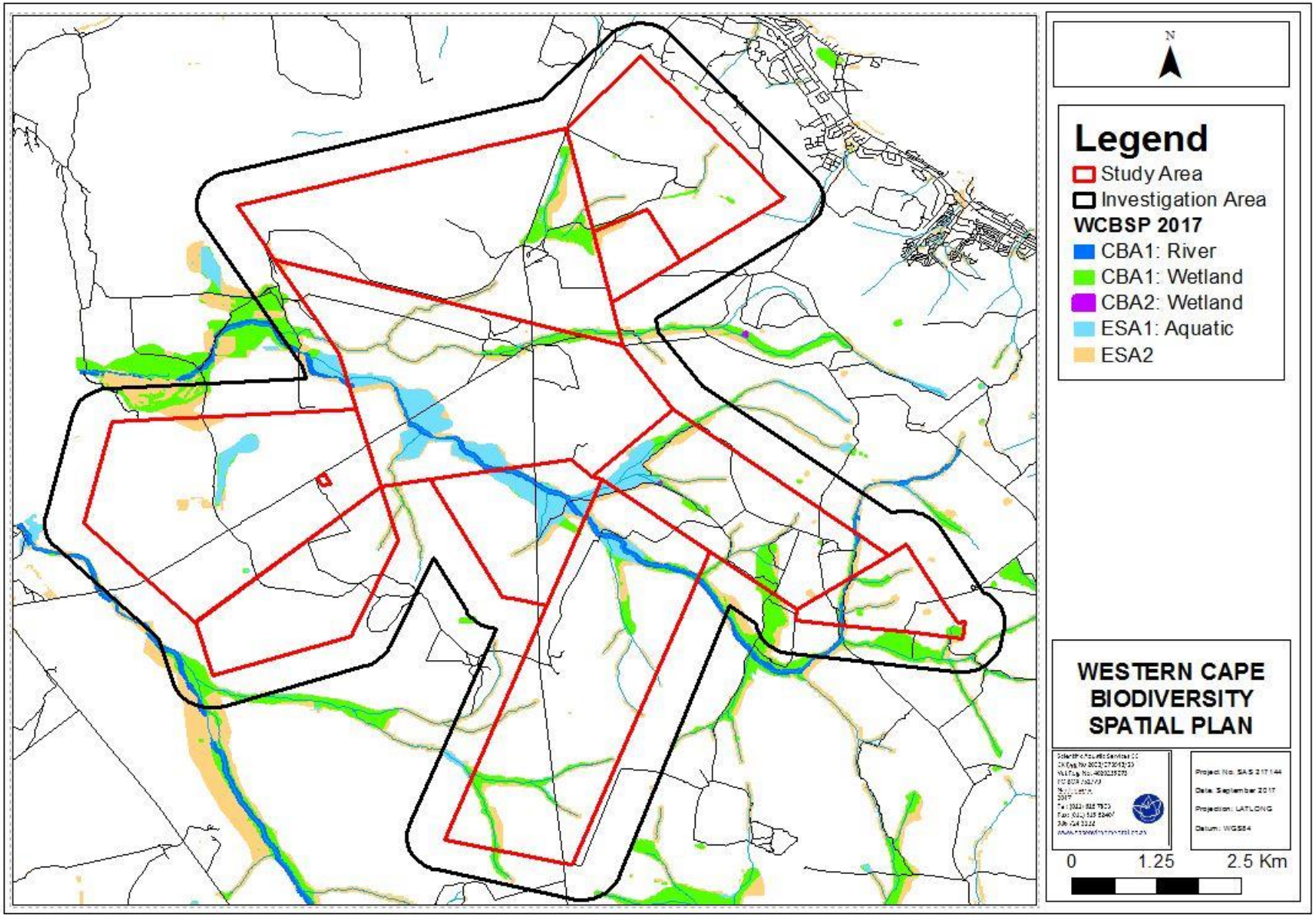

Figure 6: Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) in terms of the Western Cape Biodiversity Spatial Plan (2017) database

3.2 Background Data Summary

Based on the national and provincial datasets, it is evident that there is an extensive network of wetland features scattered throughout the study area, however, these systems are considered to be in a heavily to critically modified state (Figure 4). Agricultural activities within the surrounding area would have resulted in a significant reduction of the ecological buffers around the wetland features, therefore impacts such as erosion, sedimentation and phosphate and nitrate inputs would have resulted in further degradation of these systems. By upgrading the roads, which are currently used for farming activities, better erosion prevention and better road maintenance can be applied to prevent further degradation.

One unnamed ephemeral river was identified in accordance with the National Freshwater Ecosystem Priority Area (NFEPA) database. Although this river is not considered a priority area on a national scale, it is considered to be a Critical Biodiversity Area (CBA) in accordance with the provincial dataset (Western Cape Biodiversity Spatial Plan). All wetland features within the study are considered to be important from both a national and provincial scale, with most systems identified as Freshwater Ecosystem Priority Areas (Figure 5) as well as CBA and Ecological Support Areas (ESA) (Figure 6). It is therefore important that all freshwater features be considered no-go areas for new infrastructure development, with only existing crossings utilised and upgraded as part of the Boulders Wind Farm construction and operation (cables and road crossings).

3.3 General Wetland Assessment Results

A site assessment was undertaken in July 2016 in order to determine the extent of freshwater resources as well as the classifications (in accordance with those provided by the national and provincial datasets) within the study area. The areas in which roads and cables will cross the freshwater features were not confirmed prior to the field assessment, therefore various pre-determined wetland POIs were assessed in order to gain a general understanding of the wetland features within the study area.

An extensive floodplain wetland feature traverses the study area and numerous channelled valley bottom and hillslope seep wetlands were encountered within the study area. The majority of these features are considered to be seasonal wetlands which contain surface water for limited periods of the year (Figure 7). Wetlands assessed were largely brackish in nature and are characterised by the presence of obligate and facultative wetland species including *Phragmites australis*, *Sarcocornia* sp., *Atriplex semibaccata*, *Cyperus* sp., *Frankenia* sp., *Juncus kraussii* and *Lycium tetrandrum*.

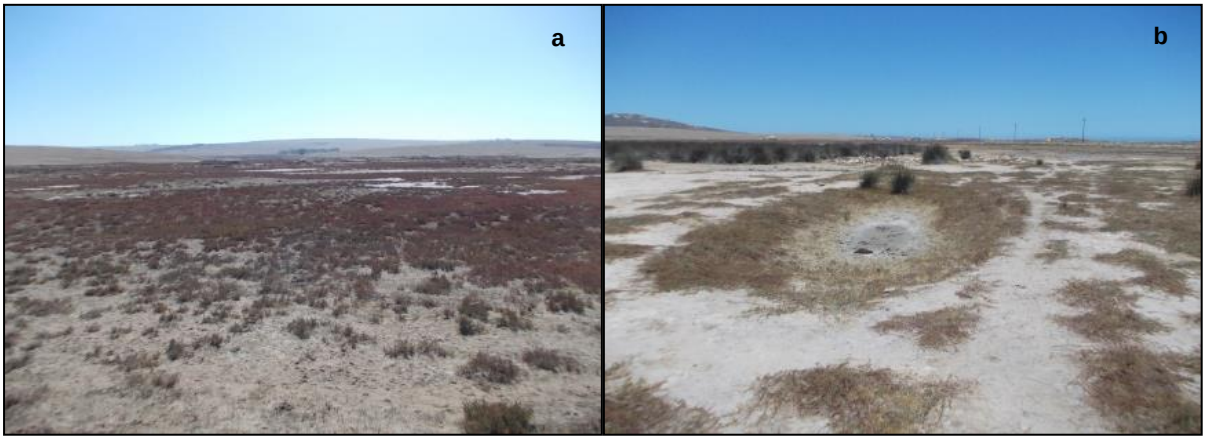

Figure 7: Floodplain wetland (a and b), channelled valley bottom wetlands (c and d) and hillslope seep wetlands (e and f)

The freshwater features associated with the study area have been impacted as a result of cultivation, earth moving activities, livestock grazing, dumping (Figure 8) and gravel road development through the features. These activities have resulted in the erosion and sedimentation of wetland areas. By upgrading the roads, which are currently used for farming activities, better erosion prevention and better road maintenance can be applied to prevent further degradation.

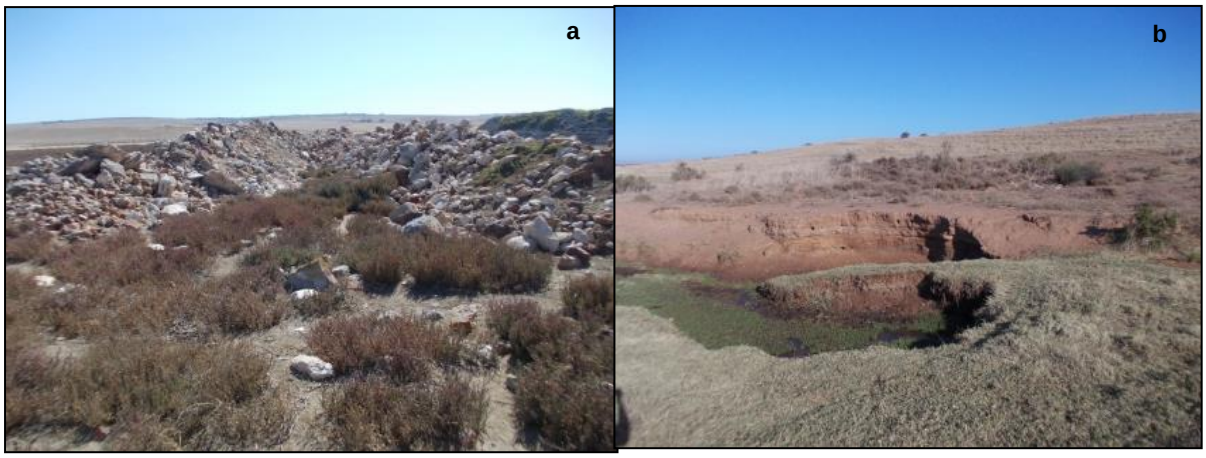

Figure 8: (a) Dumping within the freshwater features – likely from surrounding agricultural activities; (b) extensive erosion observed within the freshwater features

Although impacted, the freshwater features associated with the study area are indicated as aquatic CBAs and ESAs and are likely to play an important role in the provision of foraging and breeding habitat

for faunal species with special mention of avifauna. Furthermore, the features are likely to play an important role in the provision of faunal migratory corridors through the largely transformed agricultural areas to the coast.

Numerous depression wetlands are located within the study area (Figure 9). Depression wetlands encountered at the time of the assessment lacked surface water and were characterised by bare soil or scattered individuals of wetland species such as *Sarcocornia* sp.

Figure 9: Depression wetlands

Numerous drainage channels (Figure 10) were encountered traversing cultivated areas. The majority of these features have been significantly eroded as a result of the impact of surrounding cultivation and associated soil disturbance. Drainage channels are largely situated on hillslopes in steeper areas in which water does not accumulate for long enough for the formation of hydromorphic soils which are capable of supporting wetland floral species. Portions of channelled valley bottoms within the northern section of the study area have also been significantly modified and transformed as a result of surrounding agricultural activities and are currently considered to be more representative of drainage channels.

Figure 10: Drainage channels

Due to a lack of wetland characteristics as defined by the DWA (2005), the drainage channels cannot be considered wetland habitat. However, the features are considered important in terms of the augmentation of downstream areas and were therefore include in the EIS assessment and in the freshwater feature delineation for the study area.

It should be noted that natural drainage features are classified as watercourses by the National Water Act, 1998 (Act 36 of 1998) and any activity occurring within the natural drainage features will therefore require authorisation in terms of Section 21 c & i.

4 SENSITIVITY MAP

As part of the Scoping Phase a sensitivity map was developed where all freshwater features within the study area and the associated 500m investigation zone were delineated on a desktop level. Furthermore, all relevant legislative requirements were taken into consideration when determining the required zones of regulation for the freshwater resources. A regulated zone is a buffer area around the delineated freshwater features that a) may be considered a no-go area, as deemed necessary by the specialist; or b) would require authorisation by the relevant authorities for any activities (both construction and operation) within the identified zone. The following regulated zones were determined to be applicable to the Boulders Wind Farm:

- **Activity 12** of Listing Notice 1 (GN 327) of the NEMA (1998), as amended in April 2017 states that:
  The development of:
  (xii) Infrastructure or structures with a physical footprint of <u>100 square meters</u> or more;

  Where such development occurs—
  a) Within a watercourse;
  b) In front of a development setback; or
  c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse;

- In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 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 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
  c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

Upon review of the site conditions (Section 3.3 above) as well as the relevant datasets, the following sensitivity zones were identified (Figure 11):

- **High Sensitivity** - All freshwater features are considered to be a No-Go Area.
- **Moderate Sensitivity** -The 32m zone of regulation. This area should be avoided as far as feasibly possible for the protection of the freshwater features although development within this area can be undertaken if the required authorisation in terms of the NEMA and the NWA are obtained. Existing crossings must be utilised where possible.
- **Low Sensitivity-** All remaining areas. It should be noted, however, that any infrastructure within 500m of the delineated freshwater features will require authorisation in terms of the National Water Act, 1998 (Act 36 of 1998).

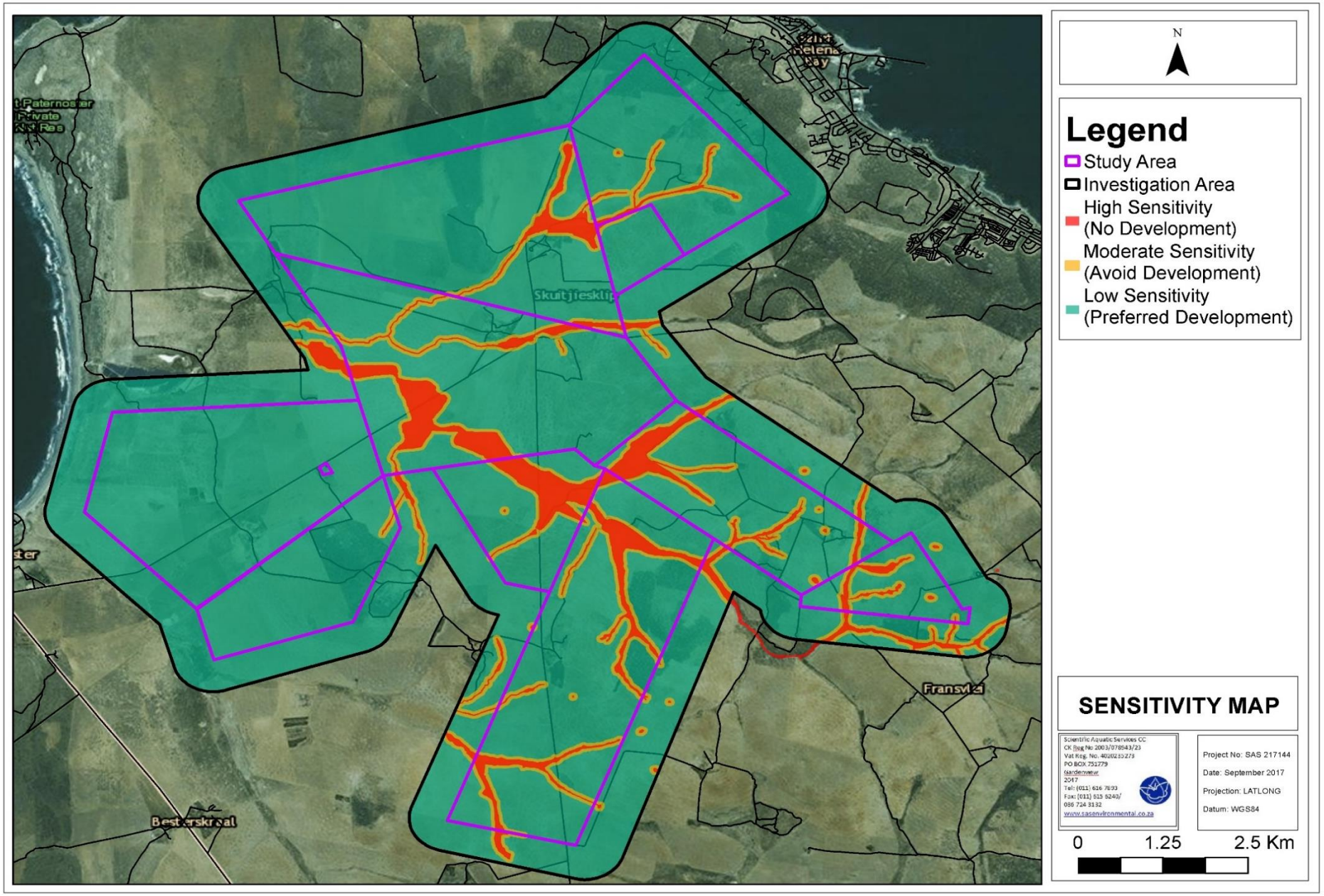

Figure 11: Sensitivity areas in accordance with the freshwater delineations (High sensitivity) and 32m zone of regulation (Moderate sensitivity).

5 POTENTIAL IMPACTS ASSOCIATED WITH THE DEVELOPMENT

This section of the scoping report aims to provide a summary of the most likely impacts that the proposed development might have on the surrounding natural area. Table 2 below provides the potential impacts a development of this nature might have on the freshwater resources within the study area, as well as the nature and extent of the impact. Desktop data was utilised to determine the preliminary impact significance of the proposed development on the freshwater resources, which will be refined during the EIA Phase of the project.

Table 2: Potential impacts and preliminary pre-mitigation and post-mitigation significance

Impacts			
Impacts associated with the Boulders Wind Farm and associated infrastructure include potential encroachment and direct disturbance of freshwater habitats as a result of turbine locations and the creation of temporary haul roads through freshwater features, alterations to storm water run-off within the study area, altering the hydrology of the systems and increased sedimentation.			
Desktop Sensitivity of the Site			
All freshwater features identified in the desktop assessment have been impacted by surrounding agricultural activities and issues. Most of the areas adjacent to the freshwater features have been ploughed, increasing the likelihood of sediment run-off and proliferation of alien and invasive species since there is a limited ecological buffer present. Based on the relevant databases, the freshwater features within the sub-quaternary catchment are likely to be in a largely to severely modified state, however, the proposed wind farm should remain outside of all delineated features and associated 32m buffer zones of regulation, which was deemed sufficient for the protection of the features.			
Issue	**Nature of Impact**	**Extent of Impact**	**No-go Areas**
Direct disturbance of freshwater habitat	Potential loss of biodiversity as a result of construction related activities within the freshwater features, including construction or upgrading of roads and placement of cables within freshwater features. Decrease in the provision of wetland ecoservices due to the potential degradation of the watercourses	Local	All delineated freshwater features should be considered a no-go area. The 32m buffer zone of regulation (considered suitable for the protection of the freshwater feature) should also be avoided. As far as possible, all linear infrastructure (roads and cables) should avoid traversing these areas or utilise existing crossings, however, if unavoidable, crossings must be planned at a 90-degree angle to the watercourse in order to reduce the extent of the impact and the relevant authorisations obtained.
Decrease of freshwater habitat integrity.	Encroachment of infrastructure and construction activities may result in the contamination of the freshwater features. This impact may be direct or indirect.	Local	
Alteration of runoff patterns	Potential for increased erosion as a result of earthworks in the vicinity of freshwater resources.	Local	
Altered hydrology of freshwater features	Potential inappropriate placement of infrastructure within freshwater resource or buffer zones.	Local	All construction footprints should remain as small as possible. Appropriately designed and well managed and monitored rehabilitation must take place in order to ensure that post construction areas are free draining while not allowing the development of concentrated flow, to ensure that the recharge of the watercourses in the area remains as natural as possible.
Altered stream and baseflow patterns	Potential that the construction of stream crossings may impact on the hydrology and sedimentation of systems.	Local	
Mismanagement and ineffective rehabilitation of freshwater resources	Potential for siltation and changes in the hydrological functioning of these areas.	Local	
Description of expected significance of impact			
When physical impact on the large intact delineated freshwater system (that have been identified as being of highe ecological importance and sensitivty) can be avoided, then this impact would be of low significance. Provided that			

pollution control measures are implemented during construction, then the impact would be of low significance. Provided that erosion control measures are implemented during construction, then the impact would be of low significance. Where linear infrastructure (roads and cables) avoid traversing these areas or utilise existing crossings, the impact would be of low significance. The significance of impact cannot be stated until the layout has been finalised, which will be done so as part of the EIA Phase.
Gaps in knowledge & recommendations for further study
The intact freshwater systems are clearly delineated and there is little uncertainty with regards to either their distribution or sensitivity. There are no significant gaps in knowledge with regards to freshwater systems within the project site. The positioning of the wind farm infrastructure must however be determined. Infrastructure located within100m from the watercourses must be considered by the developer in light of the potential requirements for water use licensing, in line with the requirements of the National Water Act.

The following general management and good construction management mitigation measures should be considered:

- All infrastructure should remain outside of the freshwater resources and their respective zone of regulation (32m buffer) as far as possible to further reduce potential impacts from occurring;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If existing roads are to be upgraded and other alternatives are unavoidable, the roads should be upgraded, as far as possible, without increasing the width of the road. Where widening of the roads is required, this must be kept to the absolute minimum within wetland and the immediately adjacent areas. Where crossings are unavoidable, the crossing should be made at a 90-degree angle to the watercourse to reduce the extent of the impact;
- Construction vehicles must use existing roads only and not be allowed to indiscriminately drive through freshwater resources;
- Edge effects of activities, particularly erosion and alien/weed control needs to be strictly managed;
- All alien and invasive vegetation should be removed. Any vegetation removed should be taken to a registered landfill site so as to prevent proliferation of alien and invasive species;
- Avoid unnecessary site clearing/vegetation clearing as far as possible;
- Concurrent rehabilitation of the freshwater areas impacted by the proposed wind farm is to take place and footprint areas should be minimised as far as possible;
- Any concrete and other foreign material used during construction must be demolished and removed from site. All rubble and waste must be disposed of at a suitably registered landfill site;
- Any soil excavated should be reinstated and re-profiled as much as possible. Any remaining soil is to be removed from the site to a registered landfill site;
- Any area where active erosion is observed in the freshwater resources, within the study area, must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible; and
- All impacted resources within the study area should be continuously monitored for any erosion and incision from construction activities.

6 EIA PHASE – PLAN OF STUDY

Specific outcomes in terms of the EIA Phase report are presented in the points below:

- Ground-truthing of delineation of the outermost edge of freshwater resources occurring within the development footprint and its associated zone of influence in accordance with “DWAF, 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones”. Aspects such as soil morphological characteristics, vegetation types and

wetness will be used to verify the delineation of the wetland temporary zone according to the guidelines;

- Define the Present Ecological State (PES) of each Hydrogeomorphic (HGM) unit within the study area according to indices such as the Wet-Health / Index of Habitat Integrity as advocated by Macfarlane *et al*., (2008) and DWA (2007), respectively as applicable;
- Determine the wetland services provided by the resources within the study area in accordance with the methodology provided by Kotze *et al.* (2009);
- Define the Ecological Importance and Sensitivity (EIS) of the freshwater resources based on the method described by Rountree & Kotze, (2013);
- Aspects regarding watercourse drivers and receptors as required by the DWS Chief Directorate Instream Water Use, as required by the Risk Assessment Matrix (GN509) will be reported on, including the following:
  - Watercourse drivers:
    - Hydrology;
    - Water quality; and
    - Sediment balance and the geomorphological regime.
  - Watercourse receptors:
    - Habitat; and
    - Biota.
- Advocate a Recommended Ecological Category (REC) for each wetland resource based on the findings of the wetland PES and wetland function assessment;
- Evaluation of environmental issues and potential impacts (direct, indirect and cumulative impacts and residual risks) identified, including:
  - The Nature of the impact;
  - Extent of the impact;
  - Anticipated duration of the impact;
  - Magnitude;
  - Probability of occurrence
  - The significance of the impact;
  - The status of the impact (positive, negative or neutral);
  - The degree to which the impact can be reversed/cause irreplaceable loss of resources and/or can be mitigated; and
  - Assessment of cumulative Impacts.
- Development of recommendations for mitigating impacts on the receiving environment.

The details of the methodology, as they pertain to this study, are provided in **Appendix B** of this report.

7 CONCLUSIONS

Scientific Aquatic Services (SAS) has been appointed to conduct the freshwater resource scoping assessment as part of the environmental assessment and authorisation process for the proposed Boulders Wind Farm. The outline of the farm boundaries identified to host the infrastructure for the wind farm was taken as the study area. The desktop study included the 500m investigation area around the study area as required in terms of Regulation GN509 of 2016. The study area will be refined during the EIA study during which the actual footprint areas of the turbines as well as all other required infrastructure and placement thereof will be identified.

It is evident from the scoping phase that there are freshwater resources within the study area that are considered to be of increased ecological importance and sensitivity. It is therefore considered important that the location of these resources be considered during the planning of the layout design in order to avoid or decrease potential impact on these resources. The presence of these resources is not

considered a fatal flaw to the project, however, all freshwater features (High sensitivity) should be considered as a no-go area and the 32m buffer (Moderate sensitivity) should also be avoided (as far as feasibly possible) in order to protect the freshwater features, however development in these areas can be undertaken if the required authorisations in terms of the NEMA and the NWA are obtained. Utilisation of existing crossings during the design phase of the project is considered necessary in order to minimise impacts on the receiving environment. Furthermore, site specific mitigation measures will be developed as part of the EIA Phase which will need to be strictly adhered to.

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APPENDIX A: LEGISLATIVE REQUIREMENTS

National Environmental Management Act (NEMA, Act 107 of 1998)

- The National Environmental Management Act (Act 107 of 1998) and the associated Environmental Impact Assessments Regulations, 2014), states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the Environmental Impact Assessment (EIA) process depending on the nature of the activity and scale of the impact.

National Water Act, 1998 (NWA, Act 36 of 1998)

- The NWA (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved;
- No activity may therefore take place within a watercourse unless it is authorised by DWS or registered;
- A watercourse is defined by the NWA as:
  - A river or spring;
  - A natural channel in which water flows regularly or intermittently;
  - A wetland, lake or dam into which, or from which, water flows; and
  - Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.
- Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWA in terms of Section 21.

General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)

In accordance with GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as:

- *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;*
- *in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or*
- *a 500 m radius from the delineated boundary (extent) of any wetland or pan*.

This notice replaces GN1199 and may be exercised as follows:

i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in Table B1 below, subject to the conditions of this authorisation;

ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix;

iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix;

iv) Conduct river and stormwater management activities as contained in a river management plan;

v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and

vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol.

APPENDIX B: FRESHWATER RESOURCE ASSESSMENT APPROACH

Wetland and Riparian Delineation

For the purposes of this investigation, a wetland and a riparian habitat are defined in the National Water Act (NWA) (1998) as stated below:

- A wetland is a 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.
- Riparian habitat is defined as including the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

The wetland and riparian zone delineations took place according to the method presented in the "The practical field procedure for identification and delineation of wetlands and riparian areas" published by DWAF in 2005. The foundation of the method is based on the fact that wetlands have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The objective of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland or riparian area.

Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

The river encountered during site assessment was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis *et. al*., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
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)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[1] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;

[1] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** 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;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland 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
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008) and WET-EcoServices (Kotze *et. al*., 2009).

Index of Habitat integrity

To assess the PES of the river identified, the IHI for South African floodplain and channelled valley bottom wetland types (Department of Water Affairs and Forestry Resource Quality Services, 2007) was used.

The WETLAND-IHI is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP). The WETLAND-IHI has been developed to allow the NAEHMP to include floodplain and channelled valley bottom wetland types to be assessed. The output scores from the WETLAND-IHI model are presented in A-F ecological categories (table below), and provide a score of the PES of the habitat integrity of the wetland or riparian system being examined.

Table C3: Descriptions of the A-F ecological categories (after Kleynhans, 1996, 1999).

Ecological Category	PES (% Score)	Description
A	90-100%	Unmodified, natural.
B	80-90%	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	60-80%	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	40-60%	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. 20-40% Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
E	20-40%	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0-20%	Critically/Extremely modified. Modifications have reached a critical level and the 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.

WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores, and Present State categories are provided in the table below.

Table C4: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

Impact category	Description	Impact score range	Present State category
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 recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole need to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

Wet-Ecoservices (2009)

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;

- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C6: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C7) of the wetland system being assessed.

Table C7: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

Recommended Ecological Category (REC)

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure" (DWA, 1999).

The REC (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above), and is followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same class for the PES as the REC if the wetland is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the wetland feature.

Table C8: Description of REC classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

Freshwater Resource Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act (1998) as "land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

The wetland zone delineation took place according to the method presented in the DWAF (2005) document "A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoxymorphic soil feature, which are morphological signatures that appear in soils with prolonged periods of saturation.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant periods of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

Scoping Report Requirements

The purpose of the Scoping Report is to identify and evaluate the main issues and potential impacts of the proposed project at a desktop level based on existing information. The scoping report must be updated in terms of the EIA Regulations of 2014, as amended on 07 April 2017 and as per Savannah Environmental's requirements and should:

- Identify potential sensitive environments and receptors that may be impacted on by the proposed facility and the types of impacts (i.e. direct, indirect and cumulative) that are most likely to occur;
- Provide an evaluation of the expected significance of identified impacts (including nature, extent, significance, consequence, duration and probability of the impacts including the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated);
- Identify sensitive and 'No-Go' areas, where applicable; and
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.

The scoping report must include:

- a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including direct, indirect, cumulative impacts and residual risks) that have been identified;
- Direct, indirect, cumulative impacts and residual risks of the identified issues must be evaluated within the Scoping Report 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, for each impact anticipated;
- the extent, wherein it will be indicated whether the impact will be local (limited to the immediate
- area or site of development), regional, national or international. See Table on the next page.
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- a comparative evaluation of the identified feasible alternatives, and nomination of a preferred alternative for consideration in the EIA phase; and

- Identification of potentially significant impacts to be assessed within the EIA phase and details of the methodology to be adopted in assessing these impacts. This should be detailed enough to include within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impacts associated with the project. This must also include any gaps in knowledge at this point of the study and further recommendations for the EIA Phase. Consideration of areas that would constitute "acceptable and defendable loss" should be included in this discussion.

Scoping of impacts must be summarised in the following table format. The rating values as per the above criteria must also be included. Complete a table and associated ratings for each impact identified during the scoping study.

***Example of Impact table summarising the evaluation of Potential Impacts Associated with the Construction of the Facility at the Scoping Phase* Impact.**

Impacts			
Description of the expected impacts. Areas anticipated to be affected.			
Desktop Sensitivity of the Site			
Sensitivity analysis in terms of the impacts expected. Discuss areas of high concern.			
Issue	**Nature of Impact**	**Extent of Impact**	**No-go Areas**
I.e. disturbance to and loss of indigenous natural vegetation	Discussion of the consequences of the construction of the facility to the issue/impact considered in column 1.	I.e. local/ Regional/ National	No-Go areas would include the larger drainage lines and Duneveld.
Description of expected significance of impact			
Description of expected significance of impact Describe expected significance, consequence, duration and probability of the impacts as well as degree to which these impacts— (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated			
Gaps in knowledge & recommendations for further study			

APPENDIX C: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1.(a)(i) Details of the specialist who prepared the report

Stephen van Staden	MSc (Environmental Management) (University of Johannesburg)
Kim Dalhuijsen	Bsc Hons (Zoology) (University of the Witwatersrand)
Sanja Erwee	Bsc (Zoology)

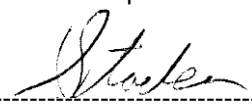
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Johannesburg, 2007		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1.(b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, 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 relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, 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



SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO)
Member of the Gauteng Wetland Forum

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2002
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2000
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	1999

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe
Eastern Africa – Tanzania
West Africa – Ghana, Liberia, Angola, Guinea Bissau
Central Africa – Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Development compliance studies

- Project co-leader for the development of the EMP for the use of the Wanderers stadium for the Ubuntu village for the World Summit on Sustainable Development (WSSD).
- Environmental Control Officer for Eskom for the construction of an 86Km 400KV power line in the Rustenburg Region.
- Numerous Environmental Impact Assessment (EIA) and EIA exemption applications for township developments and as part of the Development Facilitation Act requirements.
- EIA for the extension of mining rights for a Platinum mine in the Rustenburg area by Lonmin Platinum.
- EIA Exemption application for a proposed biodiesel refinery in Chamdor.
- Compilation of an EIA as part of the Bankable Feasibility Study process for proposed mining of a gold deposit in the Lofa province, Liberia.
- EIA for the development of a Chrome Recovery Plant at the Two Rivers Platinum Mine in the Limpopo province, South Africa.
- Compilation of an EIA as part of the Bankable Feasibility Study process for the Mooihoek Chrome Mine in the Limpopo province, South Africa.
- Mine Closure Plan for the Vlakfontein Nickel Mine in the North West Province.

Specialist studies and project management

- Development of a zero discharge strategy and associated risk, gap and cost benefit analyses for the Lonmin Platinum group.
- Development of a computerised water balance monitoring and management tool for the management of Lonmin Platinum process and purchased water.
- The compilation of the annual water monitoring and management program for the Lonmin Platinum group of mines.
- Analyses of ground water for potable use on a small diamond mine in the North West Province.
- Project management and overview of various soil and land capability studies for residential, industrial and mining developments.
- The design of a stream diversion of a tributary of the Olifants River for a proposed opencast coal mine.
- Waste rock dump design for a gold mine in the North West province.
- Numerous wetland delineation and function studies in the North West, Gauteng and Mpumalanga Kwa-Zulu Natal provinces, South Africa.
- Hartebeespoort Dam Littoral and Shoreline PES and rehabilitation plan.
- Development of rehabilitation principles and guidelines for the Crocodile West Marico Catchment, DWAF North West.

Aquatic and water quality monitoring and compliance reporting

- Development of the Resource Quality Objectives for the Local Authorities in the Upper Crocodile West Marico Water management Area.
- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Lonmin Platinum groups water monitoring program.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Initiation and management of a physical, chemical and biological monitoring program, President Steyn Gold Mine Welkom.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for African Rainbow Minerals Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several Gold mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for the Valpre bottled water plant (Coca Cola South Africa).
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane for all their Waste Water Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in southern, central and west Africa.
- Lalini Dam assessment with focus on aquatic fish community analysis.
- Musami Dam assessment with focus on the FRAI and MIRAI aquatic community assessment indices.

Wetland delineation and wetland function assessment

- Wetland biodiversity studies for three copper mines on the copper belt in the Democratic Republic of the Congo.
- Wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Terrestrial and wetland biodiversity studies for developments in the mining industry.
- Terrestrial and wetland biodiversity studies for developments in the residential commercial and industrial sectors.
- Development of wetland riparian resource protection measures for the Hartbeespoort Dam as part of the Harties Metsi A Me integrated biological remediation program.
- Priority wetland mammal species studies for numerous residential, commercial, industrial and mining developments throughout South Africa.

Terrestrial ecological studies and biodiversity studies

- Biodiversity Action plans for numerous mining operations of Assmang Chrome throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Xstrata Alloys and Mining throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plan for the Nkomati Nickel and Chrome Mine Joint Venture.
- Terrestrial and wetland biodiversity studies for three copper mines on the copperbelt in the Democratic Republic of the Congo.
- Terrestrial and wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Numerous terrestrial ecological assessments for proposed platinum and coal mining projects.
- Numerous terrestrial ecological assessments for proposed residential and commercial property developments throughout most of South Africa.
- Specialist Giant bullfrog (*Pyxicephalus adspersus*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist Marsh sylph (*Metisella meninx*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Project management of several Red Data Listed (RDL) bird studies with special mention of African grass owl (*Tyto capensis*).
- Project management of several studies for RDL Scorpions, spiders and beetles for proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist assessments of terrestrial ecosystems for the potential occurrence of RDL spiders and owls.
- Project management and site specific assessment on numerous terrestrial ecological surveys including numerous studies in the Johannesburg-Pretoria area, Witbank area, and the Vredefort dome complex.
- Biodiversity assessments of estuarine areas in the Kwa-Zulu Natal and Eastern Cape provinces.
- Impact assessment of a spill event on a commercial maize farm including soil impact assessments.

Fisheries management studies

- Tamryn Manor (Pty.) Ltd. still water fishery initiation, enhancement and management.
- Verlorenkloof Estate fishery management strategising, fishery enhancement, financial planning and stocking strategy.
- Mooifontein fishery management strategising, fishery enhancement and stocking programs.
- Wickams retreat management strategising.
- Gregg Brackenridge management strategising and stream recalibration design and stocking strategy.
- Eljira Farm baseline fishery study compared against DWAF 1996 aquaculture and aquatic ecosystem guidelines.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM DALHUIJSEN

PERSONAL DETAILS

Position in Company	Consultant
Date of Birth	28 February 1989
Nationality	The Netherlands
Languages	English, Afrikaans
Joined SAS	2015 - Present

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered SACNASP Professional (Registration number 117137)
Member of the Wetlands Society of South Africa

EDUCATION

Qualifications

Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013
BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)	2012
BSc (Zoology and Environment, Ecology and Conservation) (University of Witwatersrand)	2011

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
West Africa – Uganda

PREVIOUS EMPLOYMENT

Position	Junior Environmental Scientist
Company	ILISO Consulting (Pty) Ltd
Employment	2013 - 2015

SELECTED PROJECT EXAMPLES

Wetland delineation and wetland function assessment

- Wetlands Assessment for the proposed Vergenoegd Wine Farm Sewage Treatment Plant, Cryodon, Western Cape.
- Wetland Assessment for the Sewage Bulk Service System for the Val de Vie development, Paarl, Western Cape.
- Wetland Assessment for the proposed Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- Wetland Assessment for the Riverfarm Development for the Val de Vie development, Paarl, Western Cape.
- Freshwater Assessment for the proposed Riverclub Estate as part of the Val de Vie Development, Paarl, Western Cape.
- Wetland Assessment for the development of three agricultural dams for irrigation of crops, Cape Farms, Western Cape.
- Wetland Assessment for the Willow Wood Estate Sewage pipeline upgrade, D'Urbanvale, Western Cape
- Wetland Assessment for the rectification of infilling of a freshwater feature, D'Urbanvale, Western Cape.
- Freshwater Assessment for the stabilisation of the Franschhoek River embankment, Leeu Estates, Franschhoek, Western Cape.

- Freshwater Assessment for the proposed De Hoop Residential Development, southern Paarl, Western Cape.
- Freshwater verification for the proposed Vendome/Boplaas residential development, southern Paarl, Western Cape.

Faunal Assessments

- Faunal Screening for the proposed Brand se Baai Abalone Farm, Tronox Namakwa Sand's Mine, Western Cape.
- Faunal Assessment for the proposed Vergenoegd Village residential development near Crydon, Western Cape.
- Faunal Baseline Study for the proposed wetland offset Study at Denel Swartklip, Cape Town international Airport, Western Cape.

Water Use Authorisations

- WUA for the SANRAL N3 De Beers Pass Section within the Free State and KwaZulu-Natal.
- Assistance with the WULA for the Mzimvubu Water Project, Eastern Cape.
- WUA for the Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- WUA for the Golden Valley Phase II Wind Energy Facility, Eastern Cape.
- WUA for the Sewage Bulk Service system for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Riverfarm Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Pearl Valley II Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Levendal Village for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for a residential Development, Klapmuts, Western Cape.
- WUA for the Riverclub Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the proposed Copperton Wind Energy Facility, Northern Cape.
- WUA for the proposed bulk water pipeline crossing over the Kuils River, Bellville, Western Cape.
- WUA for the proposed Vergenoegd Village residential development near Crydon, Western Cape.
- WUA for the proposed De Hoop Residential Development, Paarl, Western Cape
- WUA for the proposed Platrug Dam and abstraction from the Diep Rver, Durbanville, Western Cape.
- Validation and Verification process of three farms in Franschhoek, Western Cape.
- Validation and Verification process for Farm 1165 in Durbanville, Western Cape.

Public Participation and Environmental Impact Assessments

- Public Participation for the Environmental Impact Assessment for the Eskom Photovoltaic Plant at Arnot and Duvha Power Station.
- Eskom Hendrina to Gumeni sub-stations 400 kV Powerline. Co-ordination of Heritage and Ecological Assessment and updating the Construction and Operation Environmental Management Plan.
- Public Participation Team Leader for the Mzimvubu Dam Environmental Impact Assessment.
- Public Participation Process for Eskom Exemption from and Postponement of Air Emission Licence Applications.
- EIA for Eskom Vierfontien to Wawielpark 22 kV Transmission line refurbishing.
- Junior Environmental Scientist for the Hartbeespoort Waste Charge Discharge System.
- Public Participation Process for City of Tshwane's Bus Rapid Transit from Pretoria Station to Rainbow Junction.
- EIA for the Rwengaaju Model Village Irrigation Scheme in Kabarole District, Uganda.
- EIA for tte Water supply and Sanitation system in Moroto, Bugaddem Kacheri-Lokona, Nakapelimoru and Kotido, Uganda.
- EIA for the Farm Income Enhancement and Forestry Conservation Project: Irrigation Scheme for Katete, Kibimba and Mubuku II, Uganda.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SANJA ERWEE

PERSONAL DETAILS

Position in Company	Ecologist, GIS Technician, Faunal Specialist
Date of Birth	8 April 1991
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2014

EDUCATION

Qualifications	
BSc Zoology	2013
Short Courses	
Global Mapper	2015
SANBI BGIS Course	2017

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, KwaZulu-Natal

SELECTED PROJECT EXAMPLES

GIS Assessments

- Completed GIS mapping and GIS analysis for a significant number of ecological projects
- Desktop assessment of 45 wetland and river crossings identified along the proposed Fibreco Fibre Optic Cable Route changes between Cape Town to George, George to Port Elizabeth and from Port Elizabeth to Durban
- High level desktop ecological study and site sensitivity report as part of the site selection process for the possible Rapid Rail Extension to the Gauteng Rapid Rail Network
- Ecological scan and site sensitivity report as part of the environmental authorisation process prior to prospecting activities for two prospecting areas in Newcastle, Kwazulu-Natal
- High level desktop study and site sensitivity report as part of the environmental authorisation process prior to prospecting activities on Portion 4 of the Farm Kapstewel no 436, Administrative District of Hay, Northern Cape
- Cumulative Sensitivity Analyses using GIS Techniques for the Fuleni Anthracite Project, KwaZulu Natal.
- High level desktop study and site sensitivity report for mining activities on the farm Wessel 227 and Dibiaghomo, North of Black Rock, Northern Cape Province
- High level desktop study and site sensitivity report prior to prospecting activities for the Minerano Gold Fields Project, near Viljoenskroon, Free State Province

Wetland Assessments

- Wetland and aquatic ecological assessment for the proposed N3 De Beers Pass Route.
- Wetland assessment as part of the environmental authorisation process for the proposed Sappi Enstra Mill Wastewater Pipeline in Springs
- Wetland Verification and Rehabilitation Criteria for Aspen Hills Estate
- Wetland Ecological Assessment for development in Shoshanguve, adjacent to Tshwane University of Technology
- Wetland assessment as part of the environmental authorisation process for the proposed Braakfontein Coal Mine near Newcastle, Kwazulu-Natal Province
- Wetland assessment as part of the water use license application for the proposed extension of a flood protection wall within the Sorex Estate, Centurion, Gauteng

Faunal Assessments

- Faunal assessment as part of the environmental authorisation process for the proposed New Belfast Mine Railway Siding, Mpumalanga

• Terrestrial ecological scan as part of the environmental authorisation process for the proposed construction of a sewer system in the Ekangala Township, Gauteng Province • Faunal assessment as part of the environmental authorisation process for the Ledig Water Project near Pilanesberg National Park, North West Province • Faunal assessment as part of the ecological assessment for the Op Goedenhoop Section 102 Coal Project, Mpumalanga Province • Terrestrial faunal, floral and wetland ecological assessment update for the proposed water supply pipeline upgrade at the Duvha Power Station, Mpumalanga
Rehabilitation Plan • Wetland rehabilitation plan for Dorothy Road, Midrand, Gauteng Province • Rehabilitation and Management Plan for the Freshwater Resources within the Proposed Rivierplaas Farm No 1486 Residential Development, Western Cape Province • Wetland Rehabilitation and Management Plan for proposed mixed land use development (Kosmosdal extension 92) on the remainder of portion 2 of the farm Olievenhoutbosch 389 jr, Gauteng • Wetland rehabilitation and management plan, including input into the stormwater management, landscaping and Red Data Listed species conservation for the Olifantsvlei Cemetery, Gauteng
Risk Assessment • Motivation for General Authorisation for the development of a pipeline at Sappi in Springs, Gauteng Province **Water Use Licence Application** • Assisting in the public participation for an Integrated Water Use Licence for the proposed sewer pipeline and upgrade of the Refengkgotso Waste Water Treatment Works (WWTW); • Writing an emergency response plan for the proposed sewer pipeline and Refengkgotso WWTW