



**SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS PTY (LTD)**

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**Proposed Construction of the  
Graskoppies Wind Farm near  
Loeriesfontein, Northern Cape  
Province**

**Surface Water Impact Assessment  
Report**

**Issue Date:** 9<sup>th</sup> October 2017

**Revision No.:** 3

**Project No.:** 13622

<b>Date:</b>	9 <sup>th</sup> October 2017
<b>Document Title:</b>	Proposed Construction of the Graskoppies Wind Farm near Loeriesfontein, Northern Cape Province – Surface Water Impact Assessment Report
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<b>Revision Number:</b>	3
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## environmental affairs

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA


### DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

### PROJECT TITLE

Proposed Construction of the Graskoppies Wind Farm near Loeriesfontein, Northern Cape Province –  
Surface Water Impact Assessment Report

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Graskoppies Wind Farm  
Surface Water Impact Assessment Report  
Revision No.: 3  
9<sup>th</sup> October 2017

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The specialist appointed in terms of the Regulations

I, **Shaun Taylor**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



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**Signature of the specialist**

**SiVEST Environmental**

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**Name of company (if applicable)**

**9<sup>th</sup> October 2017**

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**Date**

**National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations (2017) Requirements for Specialist Reports (Appendix 6)**

<b>Section in EIA Regulations (2017)</b>	<b>Clause</b>	<b>Page in Report</b>
Appendix 6 – Section 1	(1) A specialist report prepared in terms of these Regulations must contain —	N/a
	(a) details of –	N/a
	(i) the specialist who prepared the report; and	Page 7, Appendix A
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Page 7, Appendix A
	(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Page ii-iii
	(c) An indication of the scope of, and the purpose for which, the report was prepared;	Page 1
	(cA) An indication of the quality and age of base data used for the specialist report;	Page 16 & 25
	(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Page 26-61
	(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Page 6 & 26
	(e) A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Page 16-21
	(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;	Page 26-40
	(g) An indication of any areas to be avoided, including buffers;	Page 26-40
	(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Page 26-40
	(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Page 6-7
	(j) A description of the findings and potential implications of such findings on the impact of the	Page 40-63

		proposed activity, including identified alternatives on the environment or activities;	
	(k)	Any mitigation measures for inclusion in the EMPr;	Page 40-61
	(l)	Any conditions for inclusion in the environmental authorization;	Page 63-64
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Page 40-64
	(n)	A reasoned opinion –	N/a
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Page 63-64
		(iA) regarding the acceptability of the proposed activity or activities; and	Page 63-64
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Page 63-64
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Included in Environmental Impact Report
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Included in Environmental Impact Report
	(q)	Any other information requested by the authority.	Included in Environmental Impact Report
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/a

**SOUTH AFRICA MAINSTREAM RENEWABLE POWER  
DEVELOPMENTS (PTY) LTD**

**PROPOSED CONSTRUCTION OF THE GRASKOPPIES WIND FARM  
NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE**

**SURFACE WATER IMPACT ASSESSMENT REPORT**

<b>Contents</b>	<b>Page</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Legislative Context .....	2
1.2 Definition of Surface Water Resources as Assessed in this Study .....	4
1.3 Assumptions and Limitations .....	6
1.4 Specialist Credentials .....	7
<b>2 Project Need and Desirability .....</b>	<b>7</b>
<b>3 Project Technical description .....</b>	<b>8</b>
3.1 Project Location .....	8
3.2 Wind Farm Technical Details.....	12
3.3 Alternatives .....	16
<b>4 Methodology.....</b>	<b>16</b>
4.1 Revisit Database Identification and Desktop Delineations of Surface Water Resources .....	16
4.2 Field-based Surface Water Resources Delineation Techniques .....	17
4.3 Surface Water Buffer Zones .....	20
4.4 Impact Assessment Method .....	21
<b>5 General Study Area.....</b>	<b>21</b>
5.1 Bushmanland Basin Shrubland Vegetation Unit.....	22
<b>6 Findings of assessment .....</b>	<b>25</b>
6.1 Surface Water Database Information .....	25
6.2 Surface Water Fieldwork Delineation Information.....	26
6.3 Surface Water Buffer Zones.....	39
<b>7 Nature of the Potential Impacts Associated with the Proposed Graskoppies Wind Farm .....</b>	<b>40</b>
7.1 Construction Phase Potential Impacts .....	41



7.2	Operation Phase Potential Impacts .....	53
7.3	Decommissioning Phase Potential Impacts .....	56
7.4	Potential Cumulative Impacts .....	57
<b>8</b>	<b>Legislative Implications.....</b>	<b>61</b>
8.1	National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2017) .....	61
8.2	National Water Act, 1998 (Act No. 36 of 1998) .....	62
<b>9</b>	<b>Specialist Recommendations .....</b>	<b>63</b>
<b>10</b>	<b>Conclusion.....</b>	<b>64</b>
<b>11</b>	<b>References .....</b>	<b>67</b>

## LIST OF TABLES

<b>Table 1.</b>	<b>Rating for Potential Construction Impacts to Surface Water Resources Habitat.....</b>	<b>42</b>
<b>Table 2.</b>	<b>Rating for Potential Construction Impacts to the Geomorphology of the Surface Water Resources .....</b>	<b>47</b>
<b>Table 3.</b>	<b>Rating for Potential Construction Impacts to the Soil and Water Contamination Impacts to Surface Water Resources .....</b>	<b>50</b>
<b>Table 4.</b>	<b>Rating for Potential Construction Impacts to the Fauna associated with Surface Water Resources .....</b>	<b>52</b>
<b>Table 5.</b>	<b>Impacts to the Geomorphology of Surface Water Resources .....</b>	<b>54</b>
<b>Table 6.</b>	<b>Renewable energy developments proposed within a 55km radius of the Graskoppies Wind Farm application site.....</b>	<b>57</b>
<b>Table 7.</b>	<b>Example of the significance impact rating table.....</b>	<b>70</b>

## LIST OF FIGURES

<b>Figure 1:</b>	<b>Regional Context Map.....</b>	<b>10</b>
<b>Figure 2:</b>	<b>Locality Map .....</b>	<b>11</b>
<b>Figure 3:</b>	<b>Typical Components of a Wind Turbine.....</b>	<b>13</b>
<b>Figure 4:</b>	<b>Conceptual Wind Farm Electricity Generation Process.....</b>	<b>14</b>
<b>Figure 5:</b>	<b>Land Cover Map .....</b>	<b>23</b>
<b>Figure 6:</b>	<b>Vegetation Unit Map.....</b>	<b>24</b>
<b>Figure 7:</b>	<b>Database Surface Water Occurrence Map.....</b>	<b>27</b>
<b>Figure 8:</b>	<b>Surface Water Delineation Map .....</b>	<b>28</b>
<b>Figure 9:</b>	<b>Drainage Line Channel in North Eastern (left) and Western (right) Areas of the Study Site ...</b>	<b>29</b>
<b>Figure 10:</b>	<b>Example of a Drainage Line lined by Herbaceous Vegetation .....</b>	<b>29</b>

Figure 11: Example of Deposited Sand within a Drainage Line .....	30
Figure 12: Example of a Drainage Line with a Mixture of Graminoid and Herbaceous Vegetation .....	31
Figure 13: Image of a Pan Wetland inside the Major Drainage Line .....	32
Figure 14: Transition from Terrestrial Vegetation into the Major Drainage Line Containing a Pan Wetland .....	33
Figure 15: Example of a Pan Wetland found in the Middle of the Study Site with no Salt Precipitation .....	35
Figure 16: Soil Sample Drawn from a Pan Wetland in the Northern Region of the Study Site Showing Hydric Conditions.....	36
Figure 17: Example of a Saline Pan Wetland in the Eastern Area of the Study Site Wedged on the Eastern Side of the Ridgeline .....	36
Figure 18: Salt Precipitation at the Surface (left) and Red Iron and Black Manganese Accumulations observed in the Sub-soils of a Saline Wetland .....	37
Figure 19: Example of a Pan Wetland colonised by <i>Athanasia minuta</i> in the Northern Area of the Study Site.....	38
Figure 20: Heritage Resource found in Wetland 14.....	39
Figure 21. Renewable Energy Facilities Proposed within a 55km Radius of the Graskoppies Wind Farm Application Site.....	60

# **SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD**

## **PROPOSED CONSTRUCTION OF THE GRASKOPPIES WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE**

### **SURFACE WATER IMPACT ASSESSMENT REPORT**

#### **1 INTRODUCTION**

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as “Mainstream”) are proposing to construct a wind farm near Loeriesfontein in the Northern Cape Province. The proposed development will consist of up to a 235MW export capacity wind farm referred to as Graskoppies Wind Farm (hereafter referred to the, “the proposed development”).

The Graskoppies Wind Farm will have an associated and a 132kV Power Line, which will evacuate the electricity generated by the wind farm. The power line component will however form part of a separate Basic Assessment (BA) process. Additionally, it must be noted that the proposed development however forms part of the greater Leeuwberg Wind Farms project which comprises four separate, but adjacent 140MW wind farms in total (including Graskoppies Wind Farm). The other three remaining wind farm developments include Ithemba Wind Farm, Hartebeest Leegte Wind Farm and Xha! Boom Wind Farm. Each of these three proposed wind farms will be undertaken as separate EIA processes, and are therefore not included in this assessment.

In terms of the Environmental Impact Assessment (EIA) Regulations (8<sup>th</sup> December 2014) promulgated under Sections 24 and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), various aspects of the proposed development are considered to fall within the ambit of listed activities which may have an impact on the environment, and therefore require environmental authorization (EA) from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities. It has therefore been identified that an EIA process is to be followed which will require scoping and impact phase assessments for the proposed Graskoppies Wind Farm.

SiVEST Environmental Division have subsequently been appointed as the independent surface water specialist consultant to undertake the surface water impact assessment for the proposed development. The impact phase surface water report will provide refined information obtained at a desktop level (where applicable) as well as findings from the infield groundtruthing, verification and delineation exercise. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), the anticipated legislative implications and requirements, identification of the potential environmental impacts that could be associated with the proposed development, potential cumulative

impacts of other surrounding proposed developments, proposed mitigation measures to minimize any potential impacts and finally, specialist recommendations based on the proposed wind farm layouts.

## 1.1 Legislative Context

### 1.1.1 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on watercourses and wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- A river or spring;
- A natural channel in which water flows regularly or intermittently; and
- A wetland, lake or dam into which, or from which, water flows.

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quantity of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- Rehabilitation of the water resource.

In the context of the proposed development and implications towards surface water resources potentially occurring on the study site, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- Less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- Harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body (for example, the excavation of a wetland or changes to the morphology of a water body) can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of **Section 19** of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

#### 1.1.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management, 1998 (Act No. 107 of 1998) (NEMA) was created essentially to establish:

- Principles for decision-making on matters affecting the environment;
- Institutions that will promote co-operative governance; and
- Procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in **Chapter 1 Section 2**, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
  - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
  - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.

- That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the EIA Regulations (2006, 2010 and 2014 as amended) were promulgated in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for Environmental Authorisation subject to a Basic Assessment (BA) or EIA process is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, potential impacts / issues as a result of the proposed development on surface water resources are addressed later in this report (**Section 7 & 8**).

## **1.2 Definition of Surface Water Resources as Assessed in this Study**

Using the definition of a surface water resource under the NWA, this study will include a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows.

### *1.2.1 Wetlands*

The lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland as, "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydrogeomorphic units (HGM units). **Ollis et al. (2013)** have described a number of different wetland hydrogeomorphic forms which include the following:

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

### 1.2.2 Riparian Habitat

Riparian habitats may potentially occur in the study area. Riparian habitats (also known as riparian areas or zones) include plant communities usually adjacent to or along natural channels that are affected by surface and subsurface flows (**DWAF, 2005**). Riparian habitats can be found on the edges of lakes, or drainage lines but are more commonly associated with channelled flowing systems like streams and rivers. Riparian habitats can also be associated with wetlands that are similarly associated with streams and rivers. These are defined as riparian wetlands.

### 1.2.3 Watercourses

According to the NWA, a watercourse falls within the ambit of a 'water resource'. For watercourses however, the following is relevant:

- A river or spring; and
- A natural channel in which water flows regularly or intermittently.

Watercourses may be perennial or non-perennial in nature. Moreover, non-perennial watercourses can encompass seasonal or ephemeral watercourses (including drainage lines) depending on the climate and other environmental constraints.

Any of the above mentioned wetland forms, riparian habitats or watercourses may occur within the study area. The types of surface water resources identified are addressed later in the report (**Section 6**).

## 1.3 Assumptions and Limitations

This short term once-off surface water assessment has only focused on the identification and delineation of surface water resources within the proposed development area. Identification and delineation of surface water resources in the wider area outside of the proposed development area have not been undertaken.

Given the short term once-off nature of the assessment, the assessment should not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence within the surface water resources.

Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas (**NFEPA, 2011**) database. This database is a national level database and some smaller surface water resources may not be identified if the database. Additionally, mainly wetlands with permanent inundation are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles may not be included. The fieldwork component was included in the assessment to verify the desktop database information in order to address these shortcomings.

Surface water resources were initially identified and delineated at a desktop level. These were then groundtruthed and verified in the field work phase. The initial delineations undertaken at a desktop level were refined following findings made in the field work phase.

A Global Positioning System (GPS) device was used to groundtruth surface water resources as well as for delineation purposes. The GPS is expected to be accurate from 5m up to 15m depending on meteorological conditions.



Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor have water quality, hydrological or groundwater studies been included.

Wetland or river health, present ecological status (PES), ecosystem services and the ecological importance (EI)/ecological sensitivity (ES) categories have not been assessed for identified surface water resources. Only desktop information in terms of PES/EI/ES (where available) from the databases were provided as per the scoping assessment information.

Application of the **DWAF (2005 & 2008)** delineation guidelines are limited for the delineation of drainage lines and pan wetlands in arid and semi-arid regions due to the intermittent nature of flow which is poorly accommodated in the methodology, and application thereof.

Avi-fauna in general are known to frequent surface water resources regularly, or in some cases can live in these habitats on a longer more permanent basis. Impacts to avi-fauna therefore may fall within the scope of a surface water assessment from an ecological perspective. However, as a separate independent avifaunal assessment has been undertaken for the proposed development, the assessment of potential impacts as related to avi-fauna have not been included in this assessment. It is therefore assumed that all avi-faunal impacts (including that related to waterfowl associated with wetlands and other surface water resources) will have been adequately covered in the avi-faunal impact assessment.

## 1.4 Specialist Credentials

This surface water assessment has been undertaken by Shaun Taylor from SiVEST. Shaun Taylor has a Master's (MSc) Qualification in Aquatic Health. Shaun has undertaken numerous surface water (wetland) delineations, present ecological state determinations, wetland ecosystem service assessment as well as ecological importance and sensitivity classifications for projects countrywide as well as a number of short training courses. Shaun has certification in the wetland training course on delineation, legislation and rehabilitation of wetlands and riparian habitats from the University of Pretoria. A full CV and delineation certificate is attached as **Appendix A**. In addition, following best practice, an external peer review will be undertaken by Mr. Michiel Jonker (*Pr. Sci. Nat.* Registration Number: 400275/12) of Ecotone Freshwater Consultants (CV also attached – **Appendix A**).

## 2 PROJECT NEED AND DESIRABILITY

The negative environmental impacts of using fossil fuels are well documented. In addition to depleting fossil fuels, the processes often result in large pollution risks. The Government of South Africa has committed to contributing to the global effort to mitigate greenhouse emissions.

According to the White Paper on the Promotion of Renewable Energy and Clean Energy Development (2002), the Government has committed to develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

In response to this goal, Mainstream are proposing to establish Wind Farms near Loeriesfontein in the Northern Cape Province.

The overall objective of the project is to generate electricity to feed into Eskom's national electricity grid by means of renewable energy technologies.

### **3 PROJECT TECHNICAL DESCRIPTION**

Mainstream are proposing to construct a wind farm and associated infrastructure near Loeriesfontein in the Northern Cape Province of South Africa. The proposed development will consist of a 235MW maximum export capacity wind farm referred to as Graskoppies Wind Farm. In addition, the overall objective of the project is to generate electricity to feed into the National Grid.

The proposed development will encompass the installation of wind turbines and associated infrastructure, in order to generate electricity that is to be fed into the Eskom grid. The facility will have a maximum export capacity of up to 235MW and will be referred to as the Graskoppies Wind Farm. The wind farm will consist of up to 70 turbines, each with a generation capacity between 3 and 5MW. The generated electricity will be fed into the national grid at the Helios Substation via a 132kV power line. It should however be noted that this 132kV power line will require a separate Environmental Authorisation and is being conducted as a part of a separate Basic Assessment (BA) process. The total area of the project infrastructure has not been determined and will be determined during the EIA phase, however the total extent of the development area is approximately 5088 hectares. The total buildable area for the proposed Wind Farm is 2468.27 hectares.

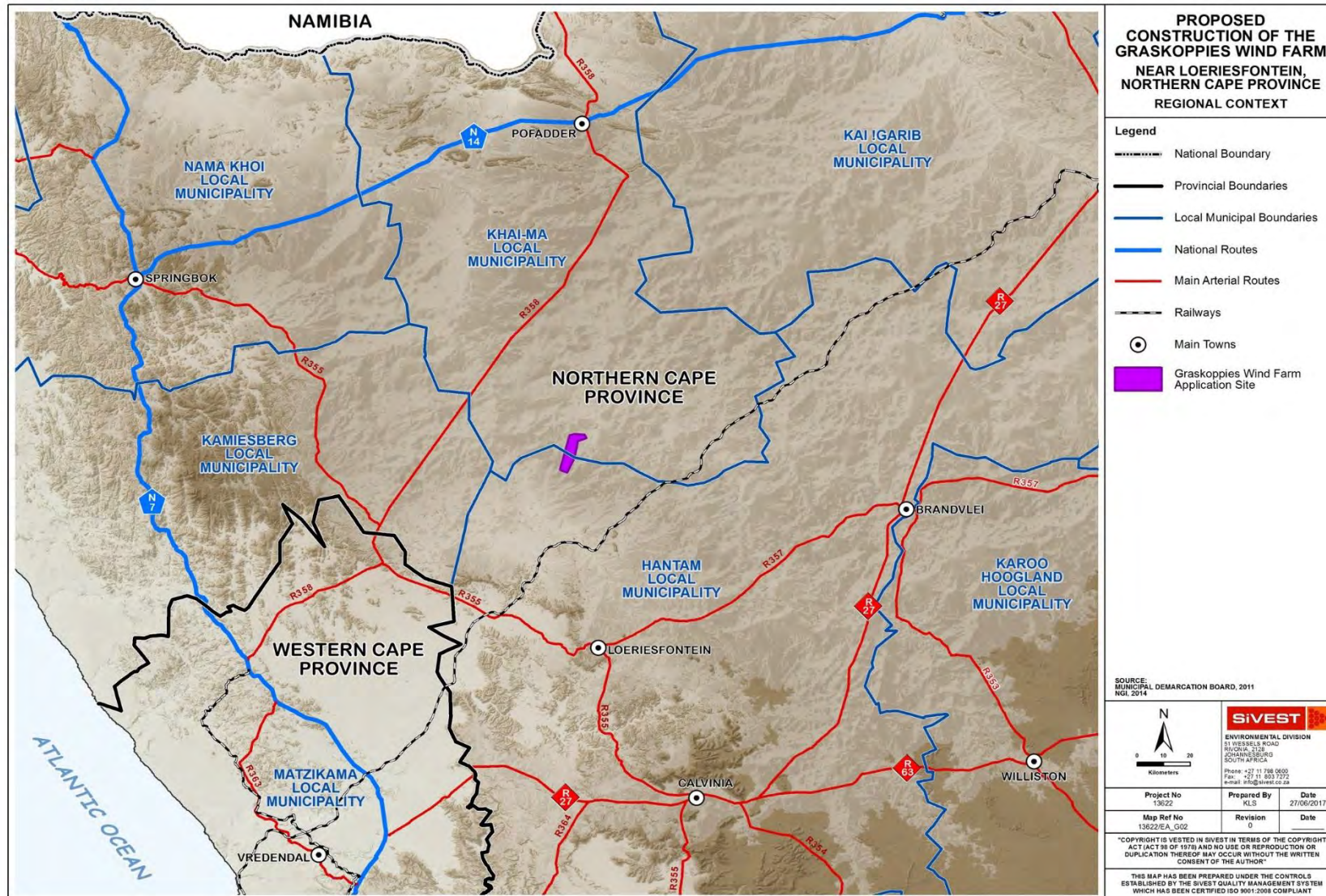
#### **3.1 Project Location**

The proposed wind farm is located approximately 70km north of Loeriesfontein in the Northern Cape Province and straddles the boundary between the Hantam and Khai-Ma Local Municipalities (**Figure 1**). The application site as shown on the locality map below (**Figure 2**). The study area is on the following properties:

- Eastern portion of Portion 2 of the Farm Graskoppies No. 176; and
- Eastern portion of Portion 1 of the Farm Hartebeest Leegte No. 216.

The project site has been identified by Mainstream based on wind resource, grid connection suitability, competition, flat topography, land availability and site access. The buildable area of the site will however be determined by sensitive areas identified in the EIA.

The key components of the project are detailed below.



**Figure 1: Regional Context Map**

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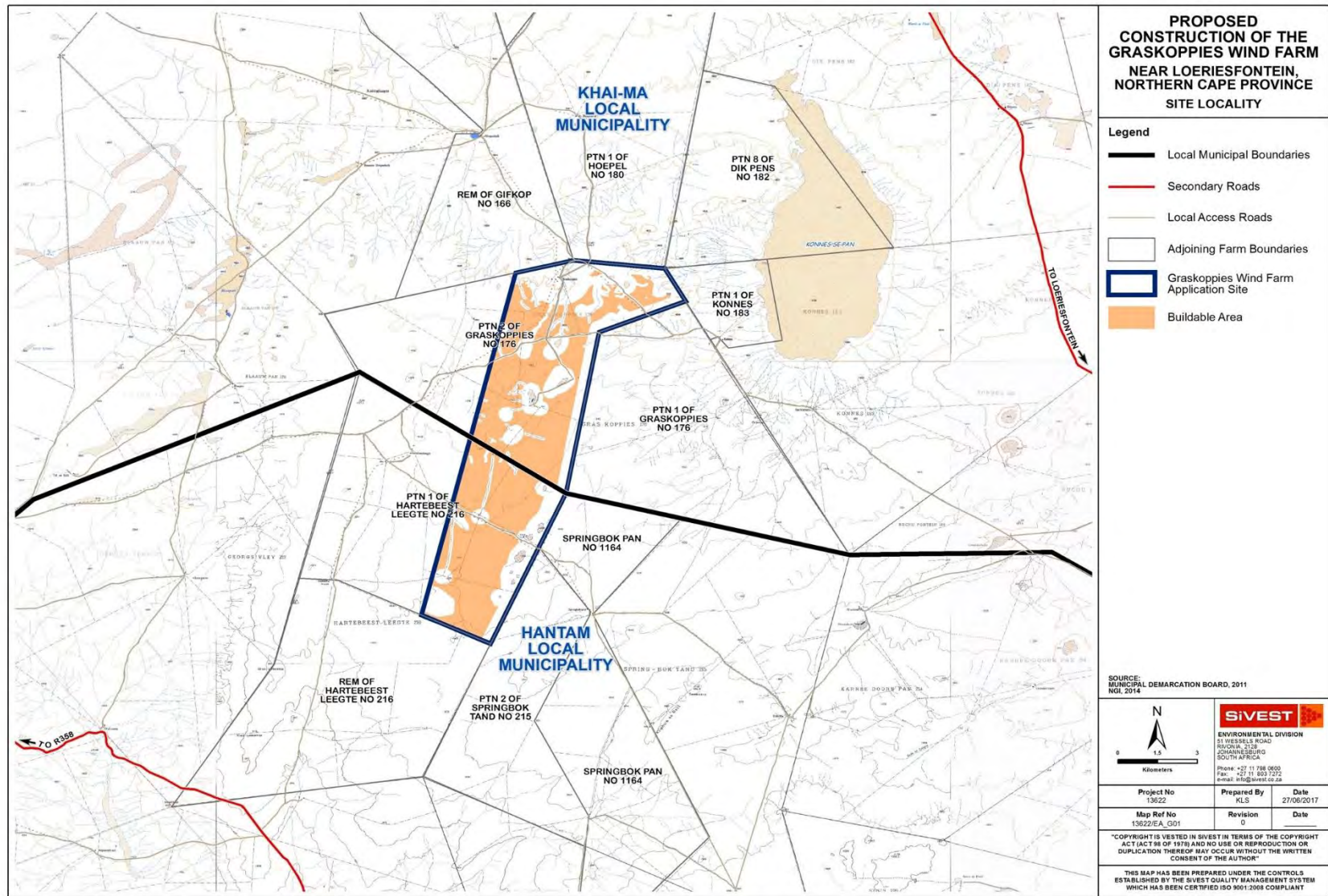
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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017



**Figure 2: Locality Map**

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Surface Water Impact Assessment Report

Revision No.: 3

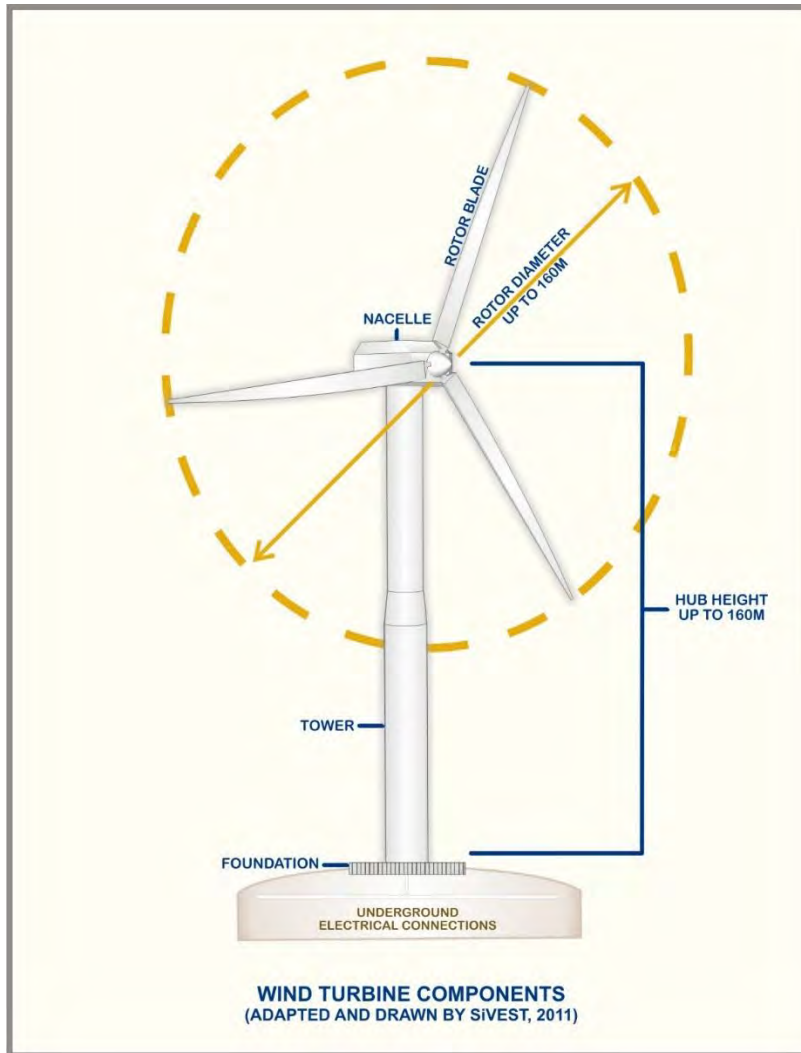
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## 3.2 Wind Farm Technical Details

At this stage it is proposed that the wind farm, comprising wind turbines and associated infrastructure will have a total generation capacity of 235MW. The generated electricity will be fed into the national grid at the Helios Substation via a 132kV power line. The key components of the project are detailed below.

### 3.2.1 Turbines

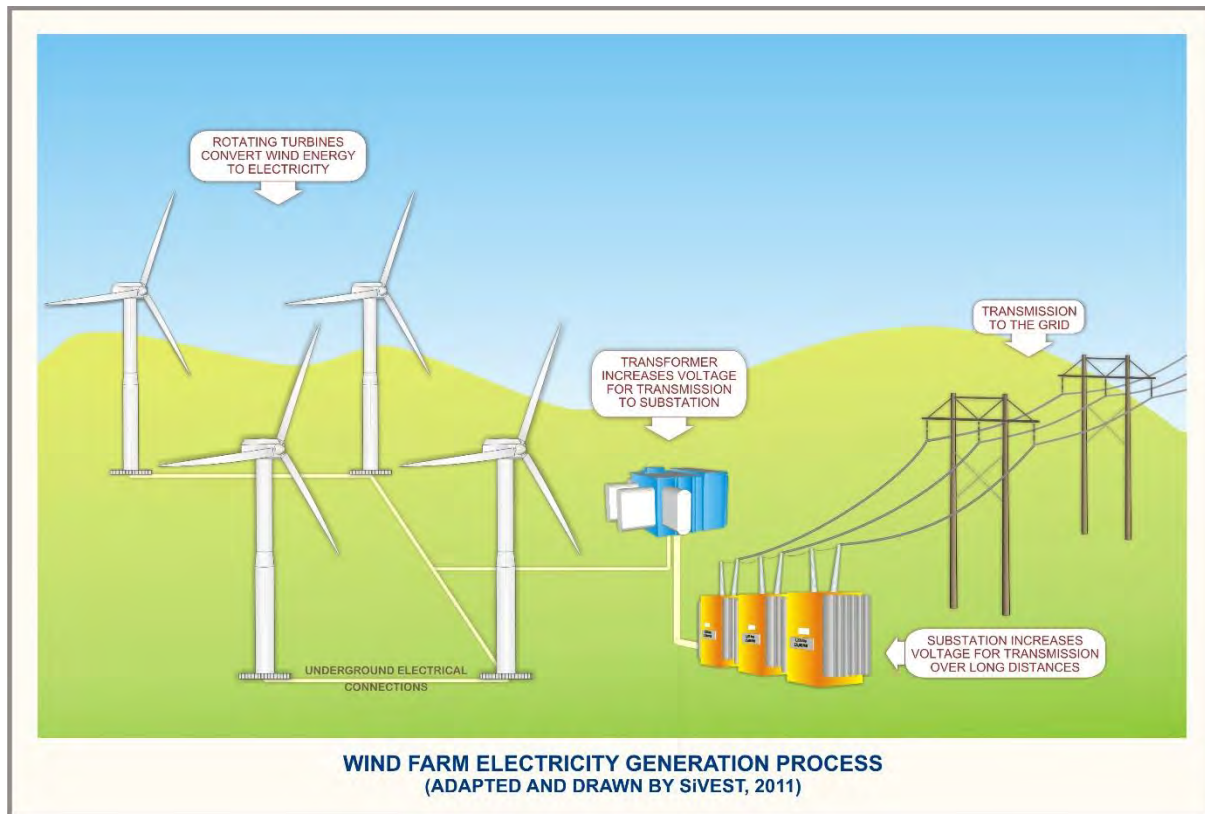
The total amount of developable area is approximately 5088 hectares. The total buildable area for the proposed Wind Farm is 2468.27 hectares. The wind turbines and all other project infrastructure will be placed strategically within the development area based on environmental constraints. The size of the wind turbines will depend on the developable area and the total generation capacity that can be produced as a result. The wind turbines will therefore have a hub height of up to 160m and a rotor diameter of up to 160m (**Figure 3**). Each wind turbine will have a foundation diameter of up to 25m and will be approximately 3m deep, however, these dimensions may be larger if geotechnical conditions dictate as such. The hardstand area occupied by each wind turbine will be up to 0.5 hectares (85m x 60m). The excavation area will be approximately 1 000m<sup>2</sup> in sandy soils due to access requirements and safe slope stability requirements. A hard standing area / platform of approximately 2 400m<sup>2</sup> (60m x 40m) per turbine will be required for turbine crane usage. There will be up to 70 wind turbines constructed with a capacity up to 235MW. The electrical generation capacity for each turbine will range between 3MW and 5MW, depending on the final wind turbine selected for the proposed development. It must be noted that the final selection for the turbine type will be conducted after the project has been selected as a Preferred Bidder project under the DoE REIPPPP. This is as a result of technology constantly changing as time progresses.



**Figure 3: Typical Components of a Wind Turbine**

### 3.2.2 Wind Farm Electrical Infrastructure

The wind turbines will be connected to the proposed 132kV on-site Graskoppies substation using buried (up to a depth of 1,5m) medium voltage cables (**Figure 4**) except where a technical assessment of the proposed design suggests that overhead lines are more appropriate such as over rivers, gullies and long runs. Where overhead power lines are to be constructed, self-supported or H-pole tower types will be used. The height will vary based on the terrain, but will ensure minimum Overhead Line (OHL) clearances with buildings, roads and surrounding infrastructure will be maintained. The dimensions of the specific OHL structure types will depend on electricity safety requirements. The exact location of the towers, the selection of the final OHL structure types and the final designs will comply with the best practise and SANS requirements.



**Figure 4: Conceptual Wind Farm Electricity Generation Process**

### 3.2.3 Roads

Internal access roads with a maximum width of 20m are initially being proposed for the construction phase. This is however only temporary as the width of proposed internal access roads will be reduced to approximately 6 – 8m for maintenance purposes during the operational phase. The proposed internal access roads will include the net load carrying surface excluding any V drains that might be required.

### 3.2.4 Temporary Construction Lay Down Area

The temporary construction lay down area will be approximately 10 000m<sup>2</sup> (100m x 100m) and will include an access road and contractor's site office area of up to 5 000m<sup>2</sup>. A hard standing area / platform of approximately 2 400m<sup>2</sup> (60m x 40m) per turbine will be required for turbine crane usage.



### 3.2.5 Operations and Maintenance Buildings

The operation and maintenance buildings will include an on-site spares storage building, a workshop and operations building with a total combined footprint that will not exceed 5 000m<sup>2</sup>. The operation and maintenance buildings will be situated in proximity to the wind farm substation due to requirements for power, water and access.

### 3.2.6 Other Associated Infrastructure

Other infrastructure includes the following:

- Fencing (if required) will be up to 5m where required and will be either mesh or palisade.

The key technical details and infrastructure required is presented in the table below.

**Table i: Summary of technical details**

<b>Project Name</b>	<b>DEA Reference</b>	<b>Farm name and area</b>	<b>Technical details and infrastructure necessary for the proposed project</b>
Graskoppies Wind Farm	To be announced	<ul style="list-style-type: none"> <li>▪ Eastern portion of Portion 2 of the Farm Graskoppies No.176; and</li> <li>▪ Eastern portion of Portion 1 of the Farm Hartebeest Leegte No.216</li> </ul> <p>Development Area: 5088 ha</p>	<ul style="list-style-type: none"> <li>▪ Up to <b>70 wind turbines</b>, between 3 and 5MW, with a maximum export capacity up to 235MW.</li> <li>▪ Wind turbines will have a hub height of up to 160m and a rotor diameter of up to 160m.</li> <li>▪ <b>132kV on-site Graskoppies IPP Substation</b></li> <li>▪ The turbines will be connected via <b>medium voltage cables</b> to the proposed 132kV on-site Graskoppies IPP Substation.</li> <li>▪ Internal <b>access roads</b> are proposed to be up to 20 m wide. This would however only be for the construction phase as the width of the internal access roads will be reduced to 6 - 8m during the operational phase.</li> <li>▪ A temporary construction <b>lay down area</b>.</li> <li>▪ A <b>hard standing area / platform</b> per turbine.</li> <li>▪ The <b>operations and maintenance buildings</b>, including an on-site spares</li> </ul>

			<p>storage building, a workshop and an operations building.</p> <ul style="list-style-type: none"> <li>▪ <b>Fencing</b> (if required) will be up to 5m where required and will be either mesh or palisade.</li> </ul>
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### 3.3 Alternatives

In terms of the NEMA and the EIA Regulations, feasible alternatives are required to be considered during the EIA Process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The following alternatives will be considered and investigated as part of this Impact Phase Report:

- The “No-go” Alternative.

#### 3.3.1 No-go Alternative

The ‘no-go’ alternative is the option of not establishing the proposed wind energy facility. South Africa is currently under immense pressure to generate electricity to accommodate for the additional demand which has been identified. With the current global focus on climate change, the government is exploring alternative energy sources in addition to coal fired power stations. Although wind power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind energy facility would be detrimental to the mandate that the government has set to promote the implementation of renewable power. It is a suitable sustainable solution to the energy crisis and this project would contribute to this solution. This project will aid in achieving South Africa’s goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

## 4 METHODOLOGY

### 4.1 Revisit Database Identification and Desktop Delineations of Surface Water Resources

The first step in the impact level surface water assessment was to revisit the initial scoping level desktop findings of the surface water features. This was undertaken using Geographic Information System (GIS) software. The software ArcView developed by ESRI was used. The collection of data source information encompassed (but is not limited to) 1:50 000 topographical maps (digital), the National Freshwater Ecosystem Priority Areas (**NFEPA, 2011**) database, the Northern Cape and National Environmental Potential Atlas (**ENPAT, 2000**) database, the South African National Biodiversity Institute (SANBI): C.A.P.E. Fine-Scale Biodiversity Plan (**SANBI, 2007**) database and the SANBI Vegetation Map (**SANBI, 2006**).

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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017

Utilising these resources, wetlands and any other surface water resources identified were then scrutinized against surface water resources identified and delineated at a desktop level from satellite imagery (**Google Earth™**). The verified and desktop delineated surface water resources were then highlighted for the in-field impact phase of the assessment. The supplementary use of satellite imagery allowed for other potentially overlooked surface water resources, not contained within the above mentioned databases, to be identified and earmarked for ground-truthing in the field work component in the EIA phase.

## 4.2 Field-based Surface Water Resources Delineation Techniques

### 4.2.1 Wetlands

Wetland delineations are based primarily on soil wetness indicators. For an area to be considered a wetland, redoximorphic features must be present within the top 50cm of the soil profile (**Collins, 2005**). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen depleted) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered 'hydric soils'. Redoximorphic features typically occur in three types (**Collins, 2005**):

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe<sup>3+</sup> ions which are characterised by "grey" colours of the soil matrix;
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles).

These can occur as:

- Concretions - harder, regular shaped bodies;
- Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
- Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site were assessed according to the **DWAF (2005; 2008)** guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". According to the **DWAF (2005 & 2008)** guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features

within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) (**Collins, 2005**). Three other indicators (vegetation, soil form and terrain unit) are typically used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

Importantly, it must be recognised that there can be up to three saturation zones to every wetland including a permanent zone, seasonal zone and the temporary zone. Each zone is differentiated based on the degree and duration of soil saturation. The permanent zone usually reflects soils that indicate saturation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate saturation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of saturation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (**DWAF, 2005**). It must be noted that not all wetlands will have all three saturation zones. In arid and semi-arid regions, wetlands are often only associated with temporary saturation zones or temporary and seasonal saturation zones, thereby lacking the permanent zone.

Vegetation identification was based on identifying general plant species within the wetland boundaries focusing on the occurrence of hydrophytic (water loving) wetland vegetation. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are (**DWAF, 2005**):

- Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
- Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
- Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
- Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

The actual delineation process essentially entailed drawing soil samples, at depths between 0-50 cm in the soil profile, using a soil augur. This is done in order to determine the location of the outer edge of the temporary zone for wetlands. The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. Where the appropriate wetland soil form is of interest, soil samples are drawn up to a depth of 1.2 metres (where possible).

Where a wetland was identified, a conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system for mapping purposes. A GIS shapefile was created to represent the boundaries of the delineated wetlands or other surface water resources.

#### 4.2.2 Riparian Habitat

In terms of watercourses and riparian habitats, the **DWAF (2005)**, the assessment for riparian habitats requires the following aspects to be taken into account:

- Topography associated with the watercourse;
- Vegetation; and
- Alluvial soils and deposited material.

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

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

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

Where riparian habitats occur, the above mentioned indicators were used to identify the outer edge. A GPS was used to record the points taken in the field.

#### 4.2.3 Drainage Lines

In terms of drainage lines or pathways, there are no official methodologies or guidelines for delineating drainage lines in the country. As such, the environmental indicators used to identify riparian habitats (such as topography associated with a watercourse, alluvial soils and deposited materials, and vegetation), which also form integral biophysical components of drainage lines were used to identify these temporary conduits for run-off.

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

- Perennial – flows continuously throughout the year in most years;
- Non-perennial – does not flow continuously throughout the year, although pools may persist. Can be subdivided as follows:
  - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;

- Intermittent – water flows for a relatively short time of less than one season’s duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;
- Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.
- Unknown – for rivers where the flow type is not known.

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

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

### 4.3 Surface Water Buffer Zones

A wetland buffer zone is typically an area of vegetated, un-developed land surrounding a wetland that is maintained to protect, support and screen wetland flora and fauna from the disturbances associated with neighbouring land uses. As wetlands and aquatic habitats are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of this habitat unit that could potentially emanate from terrestrial-based activities. Ultimately, buffer zones are typically required to protect and minimise the edge impacts to wetlands.

Although buffers are considered vitally important to the functioning of wetland systems through the provision of the abovementioned services, the determination of the minimum buffer widths to effectively protect and sustain different wetland processes and functions has proven difficult. The minimum wetland buffer width required to maintain the integrity of a wetland is the product of a number of factors:

- The sensitivity of the wetland flora and fauna to edge effects (noise, light, alien plants and direct human disturbances), sediment pollution, water pollution and/or increased surface water inputs;
- The specific lifecycle and habitat requirements of the wetland flora and fauna present within the wetland;
- The disturbance intensity of the proposed neighbouring land use in terms of noise, light, alien plants and/or direct human disturbances;

- The disturbance intensity and risk of sediment and/or water pollution associated with the proposed neighbouring/adjacent land use;
- The ability of the proposed buffer to capture sediment and/or remove and filter pollutants before reaching the wetland; and
- The ability of the proposed buffer to dissipate and infiltrate the surface runoff before reaching the wetland.

Depending on the type of land use or development proposed, an appropriate buffer zone to protect wetlands (**DWAF, 2005**) and other surface water resources should be applied to delineations. As such, consideration of the above factors (including the flow drivers, water quality, geomorphology, habitat and biota of the surface water resources) in relation to potential impacts as a result from the proposed development were taken into account in determination of an appropriate buffer zone.

#### 4.4 Impact Assessment Method

Current and potential impacts will be identified based on the proposed development and potential impacts that may result for the construction, operation and decommissioning of the proposed development. The identified potential impacts will be evaluated using an impact rating method (**Appendix A**). This is addressed in **Section 9**.

## 5 GENERAL STUDY AREA

The Graskoppies Wind Farm is accessible via farm dirt roads off Granaatboskolk, which can be taken via the R357 which leads to Loeriesfontein. Land cover in the area is mainly vacant land used for grazing purposes but also includes salt mining, railways and various renewable energy developments (both solar and wind). A map indicating the land cover classes of the general area for the proposed development are provided in **Figure 5** below.

According to **Mucina and Rutherford (2006)**, the proposed development site falls within the Nama-Karoo Biome. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas. The development site can be found within the Bushmanland bioregion. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed development can therefore be found within the Bushmanland Basin Shrubland vegetation unit (**Figure 6**). The description of Vegetation and Landscape Features, Geology and Soils, Climate and Conservation as contained in **Mucina and Rutherford (2006)** are provided below for this vegetation unit.

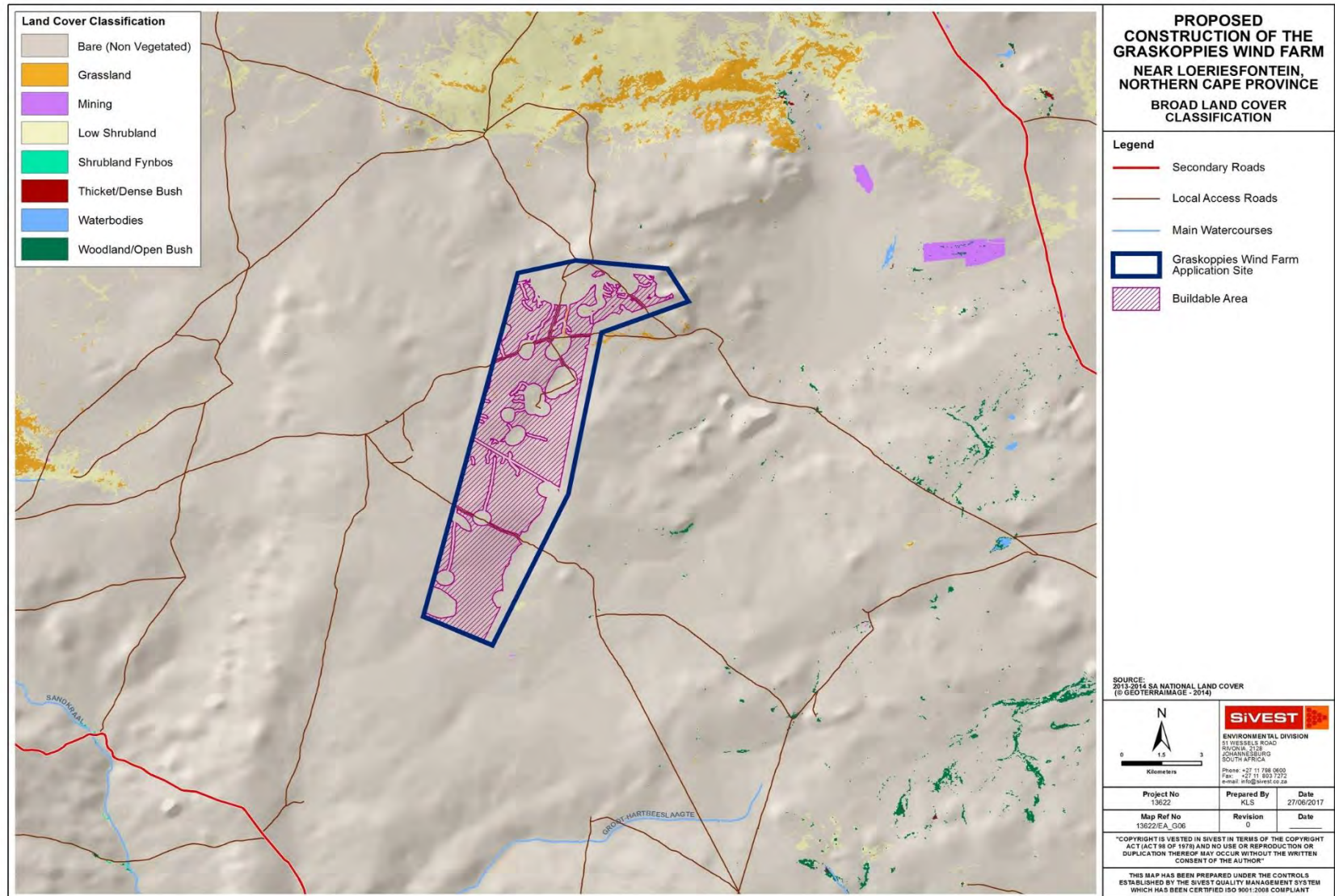
## 5.1 Bushmanland Basin Shrubland Vegetation Unit

The vegetation and landscape features of the Bushmanland Basin Shrubland are characterised by slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum*, *Salsola*, *Pentzia*, *Erioccephalus*), "white" grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*.

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

Rainfall occurs in late summer and early autumn. Mean Annual Precipitation (MAP) ranges from about 100-200mm. Mean maximum and minimum monthly temperatures in Brandvlei are 39.6°C and -2.2°C for January and July, respectively. Corresponding values for Van Wyksvlei are 39.5°C and -4.6°C.





**Figure 5: Land Cover Map**

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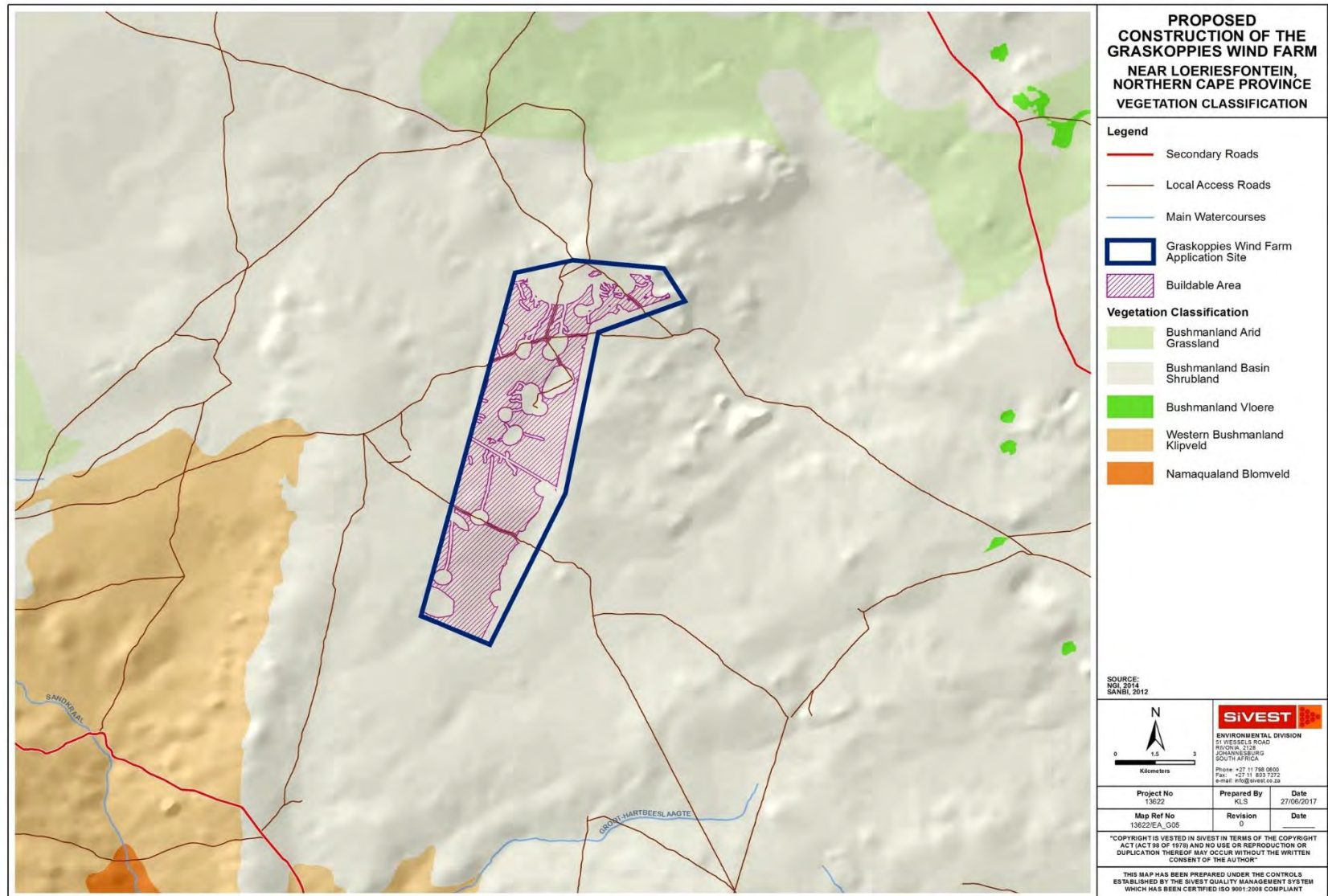
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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017



**Figure 6: Vegetation Unit Map**

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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017

The conservation status of the vegetation unit is described as least threatened (Target 21%). None of the unit is conserved in statutory conservation areas. No signs of serious transformation is present, but scattered individuals of *Prosopis* sp. occur in some areas (e.g. in the vicinity of the Sak River drainage system), and some localised dense infestation form closed “woodlands” along the eastern border of the unit with Northern Upper Karoo (east of Van Wyksvlei). Erosion is moderate (56%) and low (34%).

## 6 FINDINGS OF ASSESSMENT

### 6.1 Surface Water Database Information

In terms of the **National ENPAT (2002)** database, the proposed wind farm study site is within two water management areas (WMAs) including the Lower Orange WMA and the Olifants / Doorn WMA (**Figure 7**). Moreover, the proposed development is therefore also within two primary catchments including the Orange Primary Catchment (Lower Orange WMA) and the Olifants – Cape Primary Catchment (Olifants / Doorn WMA). At a finer level of detail, the Graskoppies Wind Farm site traverses two (2) quaternary catchments including D53F and E31C.

In terms of the **NFEPA (2011)** database, there are fourteen (14) natural depression wetlands and one (1) artificial depression wetland. None of these wetlands are considered to be WETFEPAs. WETFEPAs or Wetland Freshwater Ecosystem Priority Areas are wetlands that are earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy.

No rivers were identified in both the **Northern Cape ENPAT (2000)** and **NFEPA (2011)** databases. Drainage lines were identified on the 1:50 000 topographical maps however.

No new database information was identified that could be of relevance to the proposed development. Previous scoping level findings were therefore unchanged and used for the in-field assessment.

## 6.2 Surface Water Fieldwork Delineation Information

The in-field wetland delineation assessment took place from the 6<sup>th</sup> to the 8<sup>th</sup> of December 2016. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the proposed development area. The refined results for the Graskoppies Wind Farm study site are as follows:

- Twenty (20) Depression Wetlands;
- One (1) Major Drainage Line (drainage lines with channel width >5m);
- Seventy five (75) Drainage Lines (drainage lines with a channel width <5m).

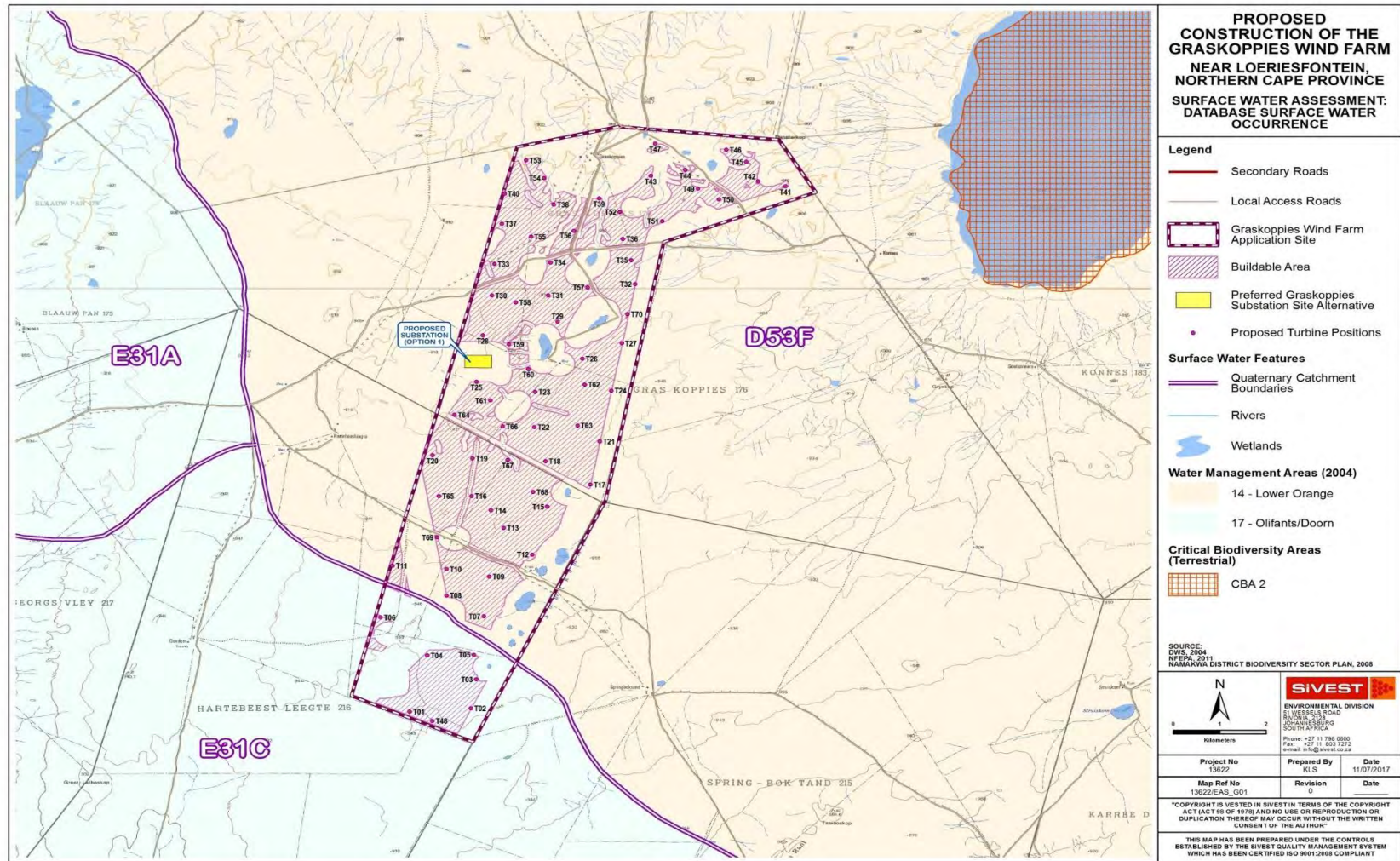
The refinement of the surface water resources as stated above are presented in **Figure 8** below. A more detailed description of the environmental attributes (indicators) of the surface water resources characteristics is provided in the sub-sections below.

### 6.2.1 Channels (Minor Drainage Lines)

#### 6.2.1.1 Topography Associated with the Watercourses

The proposed development area is relatively flat, sloping gently in a northerly direction. The open plain areas undulate gently. In the northern boundary of the study site, isolated rocky hills protrude from the landscape. A small ridgeline also rises in the south eastern area of the study site containing a series of depression wetlands wedged along the ridgeline boundary. Another smaller ridgeline runs diagonally bisecting the study site approximately midway along the length of the study site. Small drainage lines emanate either side from this ridgeline. The majority of drainage lines however, can be observed in the northern area of the study site. Here, the topography is slightly more irregular (particularly along the northern boundary of the study site). Serving as tributaries, many of the drainage lines are first, second and third order streams or A section reaches. These drainage lines are considered A-section reaches due to the lack of a saturation zone. The drainage lines can however flow briefly following rainfall events. Hence, all drainage lines were identified as ephemeral watercourses.

The drainage lines can be grouped as ultimately forming part of a greater drainage network which flows north east wards into a large pan wetland (Konnes se Pan). Konnes se Pan is located approximately 2.3km from the study site boundary measured from the north eastern most corner. The minor drainage lines in the northern area of the study site have more defined channels than those found along the diagonal ridgeline midway on the study site **Figure 9**. The drainage line channels have variable lengths, but are no more than 5m wide.



**Figure 7: Database Surface Water Occurrence Map**

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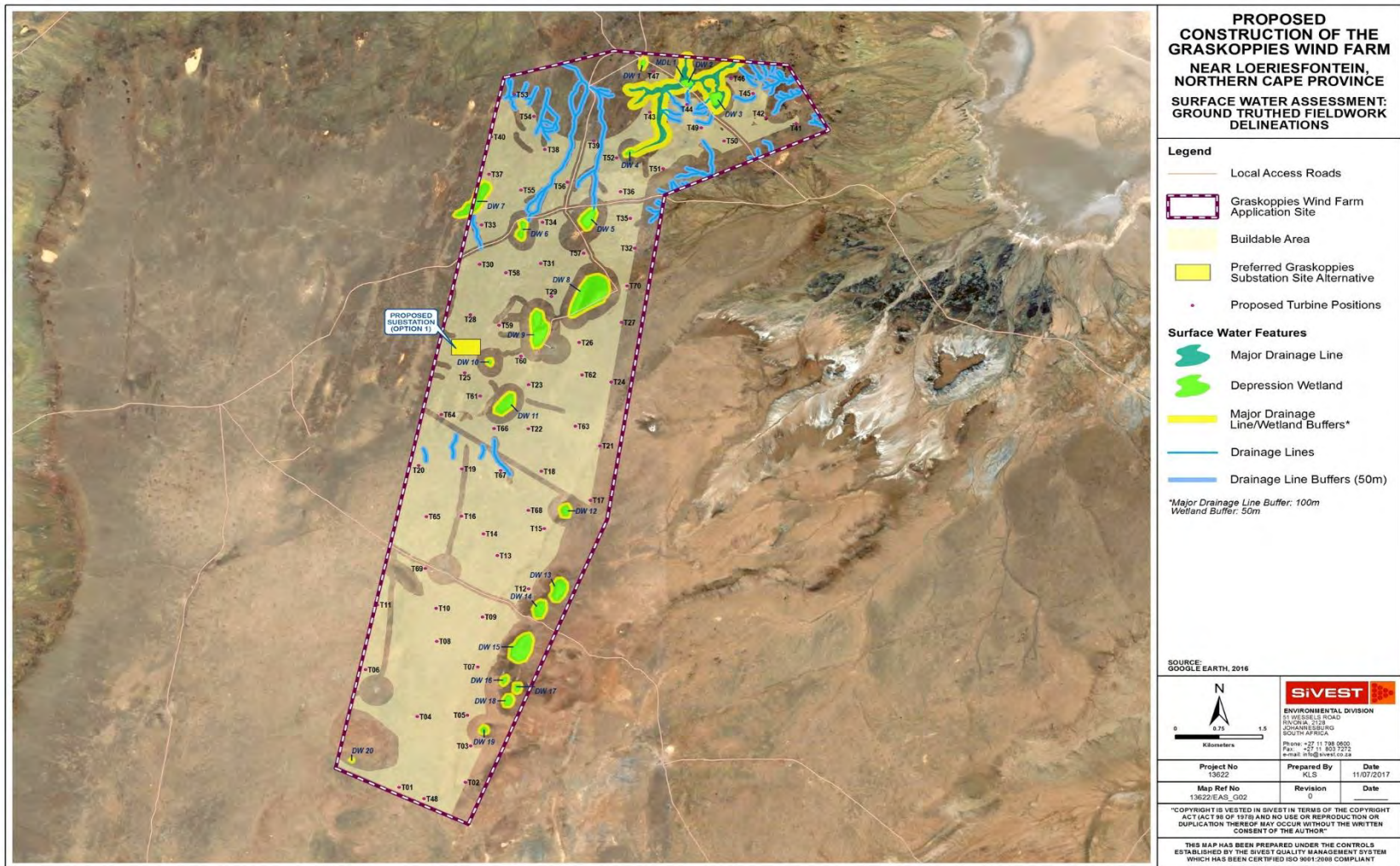
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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017



**Figure 8: Surface Water Delineation Map**

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Graskoppies Wind Farm

Surface Water Impact Assessment Report

Revision No.: 3

9<sup>th</sup> October 2017



**Figure 9: Drainage Line Channel in North Eastern (left) and Western (right) Areas of the Study Site**

According to **Lanz (2017)**, there are two land types across the study site, namely Ah25 and Fc422. **Lanz (2017)** explains that the soils of these land types are similar, and are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. As the depth of soils on the proposed development area are relatively shallow, flow is predominantly via surface run-off with limited sub-surface flow, only where the composition and depth of the soil profile permits infiltration. Soil erosion potential is limited due to limited soil depth. Overall however, erosion was very limited. Relatively good growth of a mixture of both herbaceous and graminoid species keeping soils intact. Very minor erosion was restricted to the channels of the drainage lines, mainly in the northern area of the study site. (**Figure 10**).



**Figure 10: Example of a Drainage Line lined by Herbaceous Vegetation**

### 6.2.1.2 Alluvial Soils and Deposited Materials

Fine to gravel sized sediments are transported for the surrounding landscape via overland flows eventually reaching the drainage lines. Following flows driven by rainfall events, sediments are deposited along the length within the drainage lines. Deposited sediments were therefore evident at the time of the assessment. All drainage lines were dry during the site investigation, indicating the ephemeral nature of the drainage lines.



**Figure 11: Example of Deposited Sand within a Drainage Line**

### 6.2.1.3 Vegetation

According to **Todd (2017)**, only the northern part of the site corresponds with Bushmanland Basin Shrubland, while the southern half of the site consists largely of Bushmanland Arid Grassland. As such, the drainage lines in the northern areas of the study site were found to be dominated by shrubland vegetation species including a mixture of low sturdy and spiny (and sometimes also succulent) shrubs. **Todd (2017)** states that taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. Graminoid species were also present directly within and along the banks of the drainage lines. The most notable grasses found in the northern drainage lines were that of the *Stipagrostis* family. However, a few *Prosopis glandulosa* (Category 2 Invader) species were identified in a drainage line to the north of the study site, where a sheep kraal area is based. Towards the southern areas



of the study site, **Todd (2017)** further specifies that the areas of Bushmanland Arid Grassland in this area are dominated by *Stipagrostis ciliata*, *S. brevifolia* and *S. obtusa*.



**Figure 12: Example of a Drainage Line with a Mixture of Graminoid and Herbaceous Vegetation**

#### 6.2.1.4 Comment on Ecological Condition of the Drainage Lines

Overall, the drainage lines appeared to be in a largely natural condition. Existing impacts affecting the drainage lines include mainly grazing impacts, but also anthropogenic impacts (dirt roads, fencing and sheep feeding lots in drainage lines). It is presumed that due to these existing impacts, auxiliary impacts including limited alien vegetation colonisation (*P. glandulosa*) and minor erosion impacts have resulted.

## 6.2.2 Channel (Major Drainage Line)

### 6.2.2.1 Topography Associated With a Watercourse

The topography of the single major drainage line located at the north eastern area of the study site is predominantly flat but slightly irregular in areas and very gently undulating. The major drainage line originates on the study site and flows in a north easterly direction heading towards Konnes se Pan. The major drainage line is also considered to be ephemeral, only flowing temporarily during and after heavy rainfall events. The drainage line is relatively broad in extent reaching up to 250m in some areas. The drainage line also encapsulates two pan wetlands along the course of the reach (**Figure 13**). Due to the broad and relatively flat nature of the area, some areas also open up into plains where overland flows wash through only to be constrained further downstream. The major drainage line lacks a clearly defined channel. As such, the major drainage line is also considered an A-section reach due to the lack of a distinct channel and visible saturation zone.



**Figure 13: Image of a Pan Wetland inside the Major Drainage Line**

### 6.2.2.2 Alluvial Soils and Deposited Materials

The alluvial soils and deposited materials are highly similar to the sediments found in the drainage lines consisting of a mixture of mainly fine to sandy sized grains that are deposited following flows driven by rainfall events. The major drainage line was dry during the site investigation, indicating the ephemeral nature.

### 6.2.2.3 Vegetation

The vegetation for the major drainage line was found to be similar to that found in the minor drainage lines. The vegetation consisted of a mixture of taller spinescent shrubs (*Lycium pilifolium* and *Rhigozum trichotomum*) and *Stipagrotis* species. However, with the pan wetlands inside the drainage lines, vegetation was found to be devoid in the core of the wetlands with vegetation only at the fringes.



**Figure 14: Transition from Terrestrial Vegetation into the Major Drainage Line Containing a Pan Wetland**

#### 6.2.2.4 *Comment on Ecological Condition of the Major Drainage Line*

Overall, the major drainage line appeared to be in a largely natural condition. Similar existing impacts affecting the minor drainage lines were found to also affect the major drainage line. The existing impacts included mainly grazing impacts and anthropogenic impacts (dirt roads and fencing).

#### 6.2.3 *Depression (Pan) Wetlands*

##### 6.2.3.1 *Terrain and Wetland Soil Characteristics*

Due to the predominantly flat nature of the study site, depression (pan) wetland occurrence and distribution was identified mainly midway and in the northern as well as eastern areas of the study site. Climate and landscape characteristics create favourable drainage conditions resulting in depression formation in these areas. The cluster of pan wetlands in the northern area of the study site appeared to be linked in some instances to the major and minor drainage lines, whilst others were found to be isolated. The wetlands within the major and minor drainage lines are hydrologically linked to flows through the drainage lines. On the other hand, the wetlands that are isolated are endorheic (inward draining) in nature. The pan wetlands found midway and in the northern areas of the study site did not appear to be saline. No salt precipitation was evident at the surface (**Figure 15**).



**Figure 15: Example of a Pan Wetland found in the Middle of the Study Site with no Salt Precipitation**

Soil samples drawn from the wetlands in the middle and northern areas of the study site showed that hydric conditions typically found in wetlands were present. At the surface, an Orthic A horizon was observed, whilst the sub-soils revealed hydric conditions. The composition of soil consisted mainly of fine to sandy grain materials. Hydrogeomorphic signatures in the soil were evident in the form of red iron sesquioxide mottles (concretions) indicating a Soft Plinthic B horizon (**Figure 16**). The Westleigh Soil Form could be therefore attributed to the wetlands based on the soil profile characteristics. Sampling depth was generally limited to approximately 60cm before reaching bedrock.



**Figure 16: Soil Sample Drawn from a Pan Wetland in the Northern Region of the Study Site Showing Hydric Conditions**

The cluster of the wetlands (eight (8) in total) in the eastern area of the study site were found to differ somewhat from the wetlands in the middle and northern areas of the study site. These wetlands were found to be linked geologically to a ridgeline west of the wetlands, near to the eastern boundary of the study site. The wetlands are wedged on the eastern side of the ridgeline (**Figure 17**).



**Figure 17: Example of a Saline Pan Wetland in the Eastern Area of the Study Site Wedged on the Eastern Side of the Ridgeline**

The pan wetlands in the eastern area of the study site exhibited salt precipitation at the surface, indicating saline conditions (**Figure 18**). Despite this, the A horizon could be attributed to an Orthic A. Meanwhile, the sub-soils showed typical mottling signatures as evident in the non-saline wetlands in that red iron oxide mottling was observed in the sub-soils. The presence of these sub-soils are representative of a Soft Plinthic B horizon. Black mottling signatures were also evident indicating a degree of manganese concentration in the sub-soils (**Figure 18**). It must also be stated that these soils appeared to exhibit a higher clay content. Ultimately, the Westleigh Soil Form could once again be attributed to these wetlands. Soil sampling was often limited by rock depth (approximately 60-80cm).



**Figure 18: Salt Precipitation at the Surface (left) and Red Iron and Black Manganese Accumulations observed in the Sub-soils of a Saline Wetland**

Overall, the prevailing climate acts as a constraint to the time that water is available or the duration of saturation (hydroperiod) for the wetlands. The wetlands are therefore rainfall driven and consequently temporary in nature. High temperatures, low rainfall and high evaporation rates in the region contribute to limited hydroperiod of the wetlands. For the wetlands in the eastern region of the study site, these factors also play a role in combination to the geology and soil composition of the area contributing to the salinity status of the wetlands. Given the prevailing climate and characteristics of the soils, the wetlands were deemed to be temporary in nature.

### 6.2.3.2 Wetland Vegetation

Vegetation within the wetlands varied from no vegetation in some wetlands, to complete coverage of the wetland with shrubland vegetation. It was identified that salinity could be linked to the degree of vegetation occurrence. **Todd (2017)** identified three wetland habitat types for the pans on the study site including non-saline pans with a bare centre and fringed by taller woody vegetation; non-saline pans vegetated by *Athanasia minuta* (**Figure 19**) and saline pans that are not vegetated. **Todd (2017)** further states that in the north of the site, the pans are not saline and are bare or vegetated in their centre by *Athanasia minuta* with species such as *Lycium pumilum*, *Salsola glabrescens*, *Salsola aphylla*, *Rhigozum trichotomum*, *Parkinsonia africana*, *Psilocaulon coriarium* and *Osteospermum armatum* around the fringes. He furthermore states that, the saline pans are not vegetated on account of the salt present, but are nevertheless ecologically important as they support a variety of temporary water organisms when they contain water (**Todd, 2017**).



**Figure 19: Example of a Pan Wetland colonised by *Athanasia minuta* in the Northern Area of the Study Site**



### 6.2.3.3 Comment on the Ecological Condition of the Depression Wetlands

The pan wetlands were observed to be in a largely natural condition. Prevailing impacts that were found to affect the wetlands include mainly grazing impacts. Depression wetlands 5 and 8 were found to be additionally affected by anthropogenic (dirt roads and fences) impacts. Additionally, anthropogenic heritage resources were observed in Depression Wetland 14 (**Figure 20**). According to **Fourie (2017)**, two rock built structures can be found in the depression wetland which are considered of low heritage significance.



**Figure 20: Heritage Resource found in Wetland 14**

## 6.3 Surface Water Buffer Zones

When determining the buffer zones for the watercourses and wetlands, critical factors that need to be considered that may be affected by the proposed development include the drivers of these hydrological features.

The primary threats related to the proposed wind farm and associated operation and maintenance buildings, substation and internal access roads are mainly during the construction phase. These include increased run-off, erosion and sediment inputs. Additional potential threats include direct physical degradation from vehicular activity, soil contamination and water quality impacts from spills and leakages of hazardous substances and liquids. Given this, increased run-off will have impacts

on the hydrology of the surface water resources in terms of alteration of flood peaks. Clearing of vegetation can also affect the surface roughness of the catchment thereby also contributing to accelerated surface run-off, consequent sedimentation and erosion of surface water resources. Sedimentations and erosion impacts can affect the geomorphological integrity of the surface water resources. In terms of contamination impacts, leakages and spill of hazardous substances such as fuels and oils can affect the water quality and contaminate soils of the surface water resources following transportation of these substances and liquids in surface run-off following rainfall events. Potential negative impacts to the biota and vegetation inhabiting the surface water resources may result in affecting the biodiversity and overall ecological functioning of the surface water resources.

For the operation phase, degradation impacts as a result of vehicle movement is a concern. Compaction impacts and degradation of vegetation associated with the surface water resources is the main concern for this impact from a surface water perspective. Compaction impacts negatively impacts on the geomorphological integrity of the surface water resources potentially causing alteration of the physical conditions of the soil as well as making surface water resources vulnerable to erosion. Additionally, storm water run-off impacts can be anticipated due to the increased hard and impermeable surfaces to be constructed. As such, accelerated run-off can impact on the hydrology of the surface water resources. Moreover, erosion and sedimentation risks can also be associated with increased run-off and need to be taken into consideration.

Given the above, a buffer zone of 100m for major drainage lines and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the factors above.

## **7 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED GRASKOPPIES WIND FARM**

This section will identify and contextualise each of the potential impacts on the identified surface water resources within the context of the proposed development. This section will rate these potential impacts according to an impact rating system (see **Appendix B** for a full methodology and description of the impact rating system), determine the effect of the environmental impact and provide recommendations towards mitigating the anticipated impact. The identification and rating of impacts will be undertaken for the construction, operation and de-commissioning phase of the proposed development.

## 7.1 Construction Phase Potential Impacts

### 7.1.1 Loss of Wetland and Riparian Habitat

There are a number of direct impacts during the construction phase that can potentially have an adverse effect on the identified and delineated surface water resources habitat. These include construction of the lay-down area and other components of the wind farm (i.e. wind turbines, substation, operation and maintenance buildings etc.) directly or in close proximity to surface water resources and the associated buffer zones (<50m of wetland and drainage lines buffer zones; within 100m of major drainage lines), clearing of drainage line or wetland vegetation, human degradation to surface water habitat during construction activities, and vehicle degradation.

Firstly, placement of the construction lay-down area directly within or near surface water resources can have impacts in terms of removal of vegetation and / or indirect edge impacts. Removal of vegetation will degrade the condition of the wetlands and expose the soil leaving the wetlands vulnerable to erosion. Additionally, disturbance due to construction activities may provide opportunities for pioneer and / or alien species to colonise the wetlands.

The construction lay-down area is an area that will need to be cleared of all vegetation and ideally flattened so as to establish temporary site offices, and storage areas for waste (temporary), vehicles, materials and machinery. Here removal of vegetation and edge impacts will degrade the state of vegetation associated with the surface water resources. With regards to clearing vegetation in general, the areas where the wind turbines are to be placed will need to be cleared of vegetation in order for the hard stand areas to be established. Additionally, vegetation clearing will need to take place where roads are to be established for transport of workers and materials.

Ultimately, removal of vegetation associated with surface water resources in these areas will result in loss of habitat. Moreover, degradation caused by movement of vehicles within the drainage line(s) and wetland habitat will likely result in degradation of habitat. Lastly, human degradation specifically can take the form of physical direct degradation such as lighting fires in or near the drainage lines and / or wetlands, as well as directly damaging or removing wetland vegetation. Disturbance and potential removal of drainage line and / or wetland vegetation may therefore occur.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 1** below.

**Table 1. Rating for Potential Construction Impacts to Surface Water Resources Habitat**

<b>IMPACT TABLE</b>		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of drainage line and wetland habitat	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Probable</i>	
<i>Reversibility</i>	<i>Completely reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>Medium cumulative Impact</i>	
<i>Intensity/magnitude</i>	<i>Low</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	- 45 (medium negative)	- 28 (low negative)
Mitigation measures	<p><b>Designation of Highly Sensitive Areas</b>                      The wetlands and drainage lines must be designated as “highly sensitive” and any impact must be limited to the minimum possible extent. All wetlands and drainage lines must be visibly demarcated prior to construction activities taking place where construction is within 50m of any delineated surface water resource. The demarcation of wetlands and drainage lines must be visible and last for the duration of the construction activities.</p> <p><b>Establishment of Internal Road Access Areas</b>                      For general access to the various components of the wind farm, existing roads are to be used as far as possible. No roads are to be routed through any wetlands (including buffer zones). Additionally, roads should not be planned through any drainage lines and the associated buffer zones.</p>	

	<p>Where this is not possible however, and where no other access exists to the desired construction areas, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly.</p> <p>A single access route or internal road access area is then to be established before construction takes place, if required. This should be planned to cross perpendicularly through any drainage line(s). For wetlands, the internal road access area must be planned for minimal impact on wetlands (i.e. shortest route, not routed through the core of the wetlands, minimal destruction of habitat etc.). The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings and / or similar design crossings using the stream / wetland bed as part of the road can be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to access proposed construction areas during construction the construction phase only. Where the access route will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, this design should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing, little to no modification of the stream banks or wetland will be required where banks are low (approximately 1,2m) for drainage lines or topography is flat for wetlands, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line(s) and / or wetland(s). However, where modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep</p>
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	<p>slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction.</p> <p>For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line and / or wetland beds. The weak substrate layer will need to be excavated and infilled by the rock or gravel material to the same level of the original drainage line or wetland bed. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support.</p> <p>Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction.</p> <p>In general, the width of the internal access road areas must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The internal access road areas must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings, vegetation should not be totally cleared across the entire internal road access area. Rather, only the vehicle tracks should be cleared. Remaining vegetation can be kept trimmed to below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated.</p> <p>Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken</p>
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	<p>by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary and permanent ford crossings and / or similar design crossings. Additionally, rehabilitation will need to take place if and where required.</p> <p>Overall, no wetlands and or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road access areas are only permissible after rainfall events once flows have ceased.</p> <p>Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the internal road access areas of the wetland and drainage line areas due soil instability factors.</p> <p>Construction workers are only allowed in the designated internal road access areas maintenance areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation.</p> <p><b>Control of Alien and Invasive Vegetation in Surface Water Resources</b></p> <p>Control of alien and invasive vegetation within surface water resources will be required. Where alien and invasive vegetation encroachment / colonization takes place, these areas are to be cleared as soon as practically possible. Clearing should take place by means of mechanical removal, either by physically pulling or slashing and clearing of unwanted alien and invasive vegetation near or within the surface water resources. Monitoring of alien and invasive vegetation should be undertaken in accordance with the environmental compliance monitoring during the construction phase.</p> <p><b>Avoidance of Direct Impact to Delineated Surface Water Resources</b></p>
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	<p>The lay-down area or any other permanent building structure (including wind turbines) must not be placed directly within any of the identified and delineated wetlands and / or drainage lines.</p> <p><b>Emergency Measures</b></p> <p>Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons and variable winds that the region experiences, it is recommended that a fire management and emergency plan is compiled. A suitably qualified health and safety officer must compile the fire management and emergency plan for the operation and maintenance phase of the project.</p> <p><b>Post-construction Rehabilitation</b></p> <p>Rehabilitation of the internal road access areas will be required post-construction. Ideally, the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation can re-establish where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped.</p> <p><b>Buffer Zone Specific Mitigation Measures</b></p> <p>During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as “sensitive” and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is within 50m. The demarcation of the buffer zones must be visible and last for the duration of the construction activities.</p> <p>See above for same access internal road access area mitigation measures to be implemented within buffer zones.</p>
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### 7.1.2 Impacts to the Geomorphology of Surface Water Resources

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly sensitive, sensitive and nearby surrounding areas is likely to result in exposing the soil, leaving the ground susceptible to wind and water erosion particularly during and after rainfall events. Due to the climate of the study area (generally arid with sudden sporadic rainfall) general soil erosion, as a consequence of the proposed development, is a possibility. A further impact due to erosion and potential storm water run-off impacts is increased run-off and sedimentation to surface water resources. Increased run-off can erode channels more easily, whilst an increased load of deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Soil compaction due to vehicle and worker movement within the internal road access areas within the surface water resources is another distinct possibility. This is likely to take place during the construction phase of the proposed development. Vehicles (heavy and light) will require access to the various wind farm components.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 2** below.

**Table 2. Rating for Potential Construction Impacts to the Geomorphology of the Surface Water Resources**

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of the soils associated with the drainage lines and wetlands	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Definite</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>High cumulative Impact</i>	
<i>Intensity/magnitude</i>	<i>High</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a slightly lower level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4

Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	2
Significance rating	- 48 (medium negative)	- 32 (medium negative)
Mitigation measures	<p><b>General Mitigation Measures</b></p> <p>Apply same mitigation measures stipulated in <b>Section 7.1.1</b> above in terms of the following:</p> <ul style="list-style-type: none"> <li>▪ Designation of Highly Sensitive Areas</li> <li>▪ Establishment of Internal Road Access Areas</li> <li>▪ Avoidance of Direct Impact to Delineated Surface Water Resources</li> <li>▪ Emergency Measures</li> <li>▪ Post-construction Rehabilitation</li> <li>▪ Buffer Zone Specific Mitigation Measures</li> </ul> <p><b>Preventing Increased Run-off, Erosion and Sedimentation Impacts</b></p> <p>Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future.</p> <p>An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.</p> <p>In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to prevent erosion in susceptible construction areas. Grass blocks on the perimeter of the wind turbine hard stand areas and building structure footprints can also be used to reduce run-off and onset of erosion. Wind turbine locations that are in close proximity to the buffer zones of the surface water</p>	

	<p>resources which will require such measures include the following:</p> <ul style="list-style-type: none"> <li>▪ T44, T45 &amp; T 53.</li> </ul> <p>Where required more permanent structures such as attenuation ponds and gabions can be constructed if needs be, however this is unlikely given the study area. All impacted areas are to be adequately sloped to prevent the onset of erosion.</p> <p>Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated above) are to be implemented as and where required.</p>
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### 7.1.3 Impacts to Soil and Water in Surface Water Resources

With the movement of vehicles and personnel potentially in surface water resources, there is the possibility of soil and water contamination. Soil contamination may take place as a result of oil, fuel leakages and / or cement spills from the vehicles passing in close proximity or directly within surface water resources. Similarly, where and when surface water is present, water contamination from the same source may result. In addition, other amenities and / or storage of substances may also lead to both soil and water contamination either directly or indirectly. Where temporary toilets for workers are placed within the buffer zones, indirect contamination may result where leakages from temporary toilet units drain into surface water resources. Moreover, direct soil and water contamination can take place where temporary toilets are placed directly in surface water resources and where leakage takes place.

In terms of other substances, fuel, paints and oil in storage areas may similarly spill, leak and drain directly within surface water resources where these substance and liquids are stored and or used directly in surface water resources. Indirectly, soil and water contamination may equally take place where storage areas are situated within buffer zones and spills of leaks take place. Furthermore, run-off from storage areas can also accumulate such hazardous liquids and drain into surface water resources. Lastly, from a construction point of view specifically, mixing cement and cleaning construction tools in the wetland can affect the water quality of the wetland.

Altering the chemical composition of the soil and water disrupts the natural baseline condition to which organisms and vegetation have adapted to in order to survive. Contamination of water and soil may affect the functionality of organisms and vegetation, even potentially leading to death.

Importantly, altering the chemical composition of water is considered pollution and must be prevented in terms of the NWA.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 3** below.

**Table 3. Rating for Potential Construction Impacts to the Soil and Water Contamination Impacts to Surface Water Resources**

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the contamination of the soils and water associated with the drainage lines and wetlands	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Probable</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>Medium cumulative Impact</i>	
<i>Intensity/magnitude</i>	<i>High</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	<p><b>General Mitigation Measures</b>            Apply same mitigation measures stipulated in <b>Section 7.1.1</b> above in terms of the following:</p> <ul style="list-style-type: none"> <li>▪ Designation of Highly Sensitive Areas</li> <li>▪ Establishment of Internal Road Access Areas</li> <li>▪ Avoidance of Direct Impact to Surface Water Resources</li> <li>▪ Emergency Measures</li> <li>▪ Post-construction Rehabilitation</li> </ul>	

	<ul style="list-style-type: none"> <li>▪ Buffer Zone Specific Mitigation Measures</li> </ul> <p><b>Preventing Soil and Water Contamination</b></p> <p>No vehicles are to be allowed in the highly sensitive and sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles and machinery are not to be allowed into any drainage sensitive and highly sensitive areas.</p> <p>All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive and sensitive areas.</p> <p>Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available and fire extinguishers.</p> <p>Storage areas for fuel, oil, paints and other hazardous substance are not to be stored directly within surface water resources or the associated buffer zones. These substances must also be contained in bunded areas with a capacity of at least 110%.</p> <p>No “long drop” toilets are allowed on the construction site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must not be placed directly within any surface water resource(s) or the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills.</p> <p>No cement mixing is to take place in any surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the</p>
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	load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive and sensitive areas.
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#### 7.1.4 Impacts to Fauna associated with Surface Water Resources

The possibility of impacts to fauna associated with surface water resources may occur during the construction phase. Fauna are often hunted, trapped, killed or eaten by workers for various reasons.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 4** below.

**Table 4. Rating for Potential Construction Impacts to the Fauna associated with Surface Water Resources**

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts to fauna associated with drainage lines and wetlands	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Possible</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Medium term</i>	
<i>Cumulative effect</i>	<i>Low cumulative impact</i>	
<i>Intensity/magnitude</i>	<i>Medium</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced to an even lower level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1

Significance rating	- 22 (low negative)	- 6 (low negative)
Mitigation measures	<p><b>Preventing Impacts to Fauna Associated with Drainage lines and Wetlands</b></p> <p>No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed, may not be killed. Additionally, these animals are to be relocated outside the RoW or construction areas, within relative close proximity where they were found.</p>	

## 7.2 Operation Phase Potential Impacts

### 7.2.1 Impacts to the Geomorphology and Hydrology of Surface Water Resources

Vehicle access may be required to the wind turbines, structures, buildings and infrastructure (such as roads, cables and power lines) in and / or through and / or over (spanning) surface water resources. It is therefore important that access routes and service roads to wind turbines, structures, buildings and infrastructure are not planned and constructed within surface water resources as far as practically possible. However, where this is required and the relevant environmental authorization and water use license is obtained, access routes and service roads for vehicles in or through surface water resources may be susceptible to soil compaction and consequent erosion impacts. Regular vehicle movement in surface water resources can compact the soil affecting the hydrology of the surface water resources. Similarly, regular movement from vehicles can flatten the ground surface making it a preferential flow path for storm water and thereby becoming susceptible to accelerated run-off which may result in progressive erosion. Compaction from vehicles can also create incisions which may induce donga erosion over time.

The impact of stormwater run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces and foundations are to be laid for wind turbines, buildings and associated infrastructure. These can act as preferential flow paths for storm water. In general, flat and hard surfaces aid with the acceleration and generation of run-off which can also indirectly impact on nearby surface water resources through the onset of erosion, as well as by means of increased sedimentation.

With the above in mind, stormwater and erosion control management will be important so that where impacts to surface water resources are permitted, stormwater and erosion is controlled so as not to drastically alter the hydrology and structural integrity and sediment regime of the potentially affected surface water resources. Altering the hydrology of the surface water resources can disrupt the drainage dynamics of the landscape. Likewise, long term erosion of surface water resources compromises the structural integrity of the surface water resources and can lead to long term degradation and possibly failure.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 5** below.

**Table 5. Impacts to the Geomorphology of Surface Water Resources**

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the geomorphological and hydrological impacts associated with the drainage lines and wetlands	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Definite</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>High cumulative impact</i>	
<i>Intensity/magnitude</i>	<i>High</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	1
Irreplaceable loss	2	2



Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	- 48 (medium negative)	- 28 (low negative)
Mitigation measures	<p><b>Minimising Vehicle Damage to the Surface Water Resources</b></p> <p>Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones.</p> <p>Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as stormwater flow pipes, culverts, culvert bridges etc.) be submitted to the relevant environmental and water departments for approval prior to construction.</p> <p>Internal access and services roads authorised in sensitive areas will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall the roads will need to be checked for erosion. Rehabilitation measures will need to be employed should erosion be identified.</p> <p><b>Erosion Management</b></p> <p>Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the surface water resources. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland / aquatic specialist must be obtained in this respect should this be required.</p> <p>Control of erosion on the construction site in general must be managed through implementation of an erosion management plan. Erosion and subsequent sedimentation of surface water resources are</p>	

	<p>considered significant impacts in terms of the proposed development that must be managed adequately throughout the operation of the proposed development.</p> <p><b>Stormwater Management</b>  Any hardstand area or building within 50m proximity to a surface water resource and the associated buffer zone must have energy dissipating structures in an appropriate location to prevent increased run-off entering adjacent areas or surface water resources. This can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example).</p> <p>A suitable operational storm water management plan should be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering adjacent areas or surface water resources, thereby also preventing erosion. This must be submitted to the relevant environmental and water authority for approval, if undertaken.</p>
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### 7.3 Decommissioning Phase Potential Impacts

#### 7.3.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar impacts are therefore expected to occur and the stipulated mitigation measures where relevant and appropriate must be employed as appropriate to minimise impacts

## 7.4 Potential Cumulative Impacts

Cumulative impacts are the combined impacts from different developments / facilities which, in combination, result in significant impacts that may be larger than sum of all the impacts.

The proposed renewable energy developments in the surrounding area (55km radius) outside of the study site are identified in **Table 6** and shown in **Figure 21** below.

**Table 6. Renewable energy developments proposed within a 55km radius of the Graskoppies Wind Farm application site**

Development	Current status of EIA/development	Proponent	Capacity	Farm details
<b>Dwarsrug Wind Farm</b>	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
<b>Khobab Wind Farm</b>	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
<b>Loeriesfontein 2 Wind Farm</b>	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
<b>Hartebeest Leegte Wind Farm</b>	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
<b>Ithemba Wind Farm</b>	EIA ongoing	Mainstream Renewable Power	140MW	Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216
<b>Xha! Boom Wind Farm</b>	EIA ongoing	Mainstream Renewable Power	140MW	Portion 2 of Georg's Vley No 217
<b>Loeriesfontein PV3 Solar Energy Facility</b>	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
<b>Hantam PV Solar Energy Facility</b>	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228

<b>PV Solar Energy Facility</b>	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
<b>PV Solar Power Plant</b>	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
<b>Kokerboom Wind Farm 1</b>	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwegrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
<b>Kokerboom Wind Farm 2</b>	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwegrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
<b>Kokerboom Wind Farm 3</b>	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	<ul style="list-style-type: none"> <li>• Remainder of the Farm Aan De Karree Doorn Pan No. 213;</li> <li>• Portion 1 of the Farm Karree Doorn Pan No. 214; and</li> <li>• Portion 2 of the Farm Karree Doorn Pan No. 214.</li> </ul>

<b>Wind Farm</b>	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213
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It must be noted that surface water resources change from one site to another and can range from a number of surface water resources in one area to very few on a neighbouring property depending on factors such as topography, geology, local rainfall and other environmental factors. Additionally, the characteristics of surface water resources can change along its course where longitudinal hydrological systems are involved. Nonetheless, the most important factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur, these are likely to have an impact downstream to some degree.



The main potential cumulative surface water impacts from a catchment perspective in the local area include both potential direct and indirect impacts. Direct impacts include cumulative loss of as well as further degradation of surface water resources due to the footprints of developments encroaching or destroying surface water resources in the greater catchment. The indirect impacts relate mainly to increased run-off, sedimentation and erosion for linear and endorheic hydrological systems. The indirect impacts to hydrological systems (i.e. drainage lines) which are connected across several farm boundaries have a greater risk for potential cumulative impacts from developments upstream.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level.

The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 2.2km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a north eastern direction, whilst drainage for the Kokerboom 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely.

Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

## **8 LEGISLATIVE IMPLICATIONS**

### **8.1 National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2017)**

In the context of NEMA (1998) and the EIA Regulations (2017), it is provisionally identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to roads access roads through surface water resources, thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below. Importantly, the applicability of these triggered activities can however only be confirmed once a more detailed layout is available.

8.1.1 *Environmental Impact Assessment Regulations 2017, Listing Notice 1, GN. 327, Activity 12:*

*The development of-*

- (x) buildings exceeding 100 m<sup>2</sup> in size;*
- (xii) infrastructure or structures with a physical footprint of 100 m<sup>2</sup> or more;*

*where such development occurs-*

- a) within a watercourse (wetland);*
- b) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse (wetland); -*

Where access roads will route directly through or within 32m of any of the identified surface water resources, this activities will be triggered.

8.1.2 *Environmental Impact Assessment Regulations 2017, Listing Notice 1, GN. 327, Activity 19:*

*The infilling or depositing of any material of more than 10 m<sup>3</sup> into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m<sup>3</sup> from-*

*(l) a watercourse;*

Where access roads will route directly through any of the identified surface water resources and will be associated with the infilling or depositing of any material of more than 10 m<sup>3</sup> into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m<sup>3</sup> from surface water resources, this activities will be triggered.

## **8.2 National Water Act, 1998 (Act No. 36 of 1998)**

In the context of the NWA (1998) and the proposed development, a “water use” is required to be registered where construction activities will impact directly or indirectly (within the regulated area as per Government Notice 509 of 2016 (No. 40229)) on a water resource. The regulated area as per Government Notice 509 of 2016 (No. 40229) is defined as follows:

- Activities within 500 meter radius of a wetland or pan;
- Activities within the outer edge of the 1:100 year flood line or riparian habitat (whichever is greatest);



- Activities within 100m from the edge of a watercourse (annual bank fill flood bench) in absence of the 1:100 year flood line or riparian habitat.

In this light, “water use” is defined *inter alia* as follows:

- a) Taking water from a water resource;
- b) Storing water;
- c) Impeding or diverting the flow of water in a watercourse;
- d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
- e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38 (1) of the NWA;
- f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- g) Disposing of waste in a manner which may detrimentally impact on a water resource;
- h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
- i) Altering the bed, banks, course or characteristics of a watercourse;
- j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
- k) Using water for recreational purposes.

In this context, a water use license will be required where any of the above water uses are required for a development. As such, for the proposed development, it has been identified that surface water resources may be affected by construction of roads, and it is therefore possible that water uses (c) and (i) may be applicable thereby requiring a water use license. Additionally however, if it can be determined that the proposed development will be associated with a LOW risk as per the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229), it may be possible that General Authorisation can be issued. The applicability of these water uses and the relevant licensing process can however only be confirmed once a more detailed layout containing road infrastructure is available.

## 9 SPECIALIST RECOMMENDATIONS

Specialist recommendations in terms of the proposed development are as follows:

- All surface water resources and buffer zones must be avoided as far as practically possible in the layouts (including road access and service roads) to be designed in order to minimise and potentially avoid potential impacts as far as possible.
- Where it is not possible to avoid impacts to surface water resources as a result of roads, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
- All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.

- With implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding road design) and therefore, may be environmentally authorised.

## 10 CONCLUSION

SiVEST have been appointed by Mainstream to undertake an Environmental Impact Assessment (EIA) and Environmental management Programme (EMPr) for the proposed construction of the Graskoppies Wind Farm, near Loeriesfontein in the Northern Cape Province. As part of the EIA study, the need to undertake a surface water impact assessment was identified. In this study, an impact level surface water assessment is provided.

Findings from the fieldwork undertaken show that the following surface water resources were identified on the study site:

- Twenty (20) Depression Wetlands;
- One (1) Major Drainage Line (drainage lines with channel width >5m);
- Seventy five (75) Drainage Lines (drainage lines with a channel width <5m).

An ecological buffer zone of 100m for major drainage lines and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied to protect the above surface water resources. These buffer zones have been implemented to provide additional safety against the potential direct and indirect impacts on the drivers (hydrology, soils, water quality, biota and habitat) of the hydrological systems that may occur in the construction and operation phases of the proposed development.

No comparative assessment was undertaken as no alternative layouts have been proposed.

It was identified that several potential impacts may affect the surface water resources within the proposed development area during the construction, operation and decommissioning phases as alluded to above. The potential impacts for each phase of the proposed development are summarised as follows:

<b>CONSTRUCTION PHASE</b>		
	<b>Pre-mitigation Rating</b>	<b>Post-mitigation Rating</b>
Loss of Wetland and Riparian Habitat	- 45 (medium negative)	- 28 (low negative)
Impacts to the Geomorphology of Surface Water Resources	- 48 (medium negative)	- 32 (medium negative)

Impact to Soil and Water in Surface Water Resources	- 42 (medium negative)	- 26 (low negative)
Impacts to the Fauna associated with Surface Water Resources	- 22 (low negative)	- 6 (low negative)
<b>OPERATION PHASE</b>		
	<b>Pre-mitigation Rating</b>	<b>Post-mitigation Rating</b>
Impacts to the Geomorphology and Hydrology of Surface Water Resources	- 48 (medium negative)	- 28 (low negative)

It is not anticipated that the proposed development will need to be decommissioned. Should this need to take place, the same impacts as identified for the construction phase of the proposed development can be anticipated. Hence, the same impacts are expected to occur and the stipulated mitigation measures where relevant must be employed to minimise impacts.

Potential cumulative impacts from a direct impact perspective established that there is no direct impact to surface water resources on the proposed project site. As such, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 2.2km from the proposed development site. Therefore, there is a considerable distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a north eastern direction, whilst drainage for the Kokerboom 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2017), as no specific road layout was available at this time, it has been provisionally identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to potential direct impacts due to roads, thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that there are a number of surface water resources which may be affected by roads and it is therefore possible that water uses (c) and (i) may be applicable, thereby requiring a water use license. Additionally however, if it can be determined that the proposed development will be associated with a LOW risk as per the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229), it may be possible

that General Authorisation can be issued. The applicability of these water uses and the relevant licensing process can however only be confirmed once a more detailed layout containing road infrastructure is available.

Finally, specialist recommendations include the following:

- All surface water resources and buffer zones must be avoided as far as practically possible in the layouts (including road access and service roads) to be designed in order to minimise and potentially avoid potential impacts as far as possible.
- Where it is not possible to avoid impacts to surface water resources as a result of roads, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
- All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.
- With implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding road design) and therefore, may be environmentally authorised.

## 11 REFERENCES

1. Collins, N.B., 2005: Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.
2. Department of Water Affairs and Forestry (DWAF), 2005: *A practical field procedure for identification and delineation of wetlands and riparian areas* (edition 1). DWAF, Pretoria.
3. Fourie, W., 2017: Graskoppies Wind Energy Facility: Heritage Impact Report, PGS Heritage.
4. Lanz, J., 2017: Agricultural and Soils Impact Assessment for the Proposed Graskoppies Wind Farm and Associated Infrastructure near Loeriesfontein, Northern Cape – Scoping Phase Report.
5. Mucina, L & Rutherford, M. C., 2006: The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
6. Ollis, D. J., Snaddon, C. D., Job, N. M & Mbona, M., 2013: Classification System for Wetlands and other Aquatic Ecosystems in South Africa, User Manual: Inland Systems.
7. Todd, S., 2017: Graskoppies Wind Farm near Loeriesfontein: Fauna and Flora Specialist Scoping Report, Simon Todd Consulting.



## **Appendix A: Specialist Credentials**

**Name** Shaun Taylor

**Profession** Environmental Scientist

**Name of Firm** SiVEST SA (Pty) Ltd

**Present Appointment** Environmental Scientist:  
Environmental Division

**Date of Birth** 02 February 1984

**ID Number** 8402025020082

**Nationality** South African



### Education

MSc – Aquatic Health  
 BSc (Hons) – Geography & Environmental Studies  
 BA – Geography and Environmental Science

### Professional Qualifications

MSc – Aquatic Health, Johannesburg University  
 Research Project: The physico-chemical and biological characteristics of selected seasonal pans in the Kruger National Park, South Africa

BSc (Hons) – Geography & Environmental Studies, Witwatersrand University (First class)  
 Research Project: Sitatunga Habitat Suitability in the Okavango Delta, Botswana

BA – Geography & Environmental Science, Monash University South Africa (Distinction)

Certification in Wetland Delineation and Rehabilitation Training Course from the School of Continuing Education, University of Pretoria

### Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

### Employment Record

Oct 2010 – Present (Full-time) SiVEST SA (Pty) Ltd Environmental Division – Environmental Scientist

Oct 2009 – Mar 2010 (Part-time) Envirokey cc – Junior Environmental Consultant and GIS support

Aug 2007 – Sep 2009 (Part-time) Holgate, Meyer and Associates Environmental Management Services – Junior Environmental Consultant

## Key Experience

Shaun joined SiVEST in October 2010 and is based in the Johannesburg office in the capacity of an Environmental Scientist.

Shaun has a passion for working in the environmental and water (wetlands) field. From an environmental management perspective, Shaun has completed a number of environmental impact assessments, basic assessments, strategic environmental assessments, environmental management plans/programmes, exemption applications, amendment applications and conducted environmental auditing. Within the water field, Shaun has undertaken water use licensing (WUL) and WUL compliance monitoring for various developments. In terms of specialist work, Shaun has completed numerous wetland and riparian assessments for renewable energy projects, linear projects as well as site specific projects. Shaun has also undertaken several wetland rehabilitation plans for developments.

Through his time at SiVEST, Shaun has acquired the following skills:

- Excellent computer skills (Word, excel, powerpoint etc.);
- Excellent proposal and report writing skills;
- Environmental Impact Assessments;
- Environmental Management Plans/Programmes;
- Environmental Compliance and Auditing;
- Environmental Amendment and Exemption Applications;
- Wetland and riparian assessment techniques (including functional assessments);
- Wetland Rehabilitation Plans;
- Water Use License Applications.

## Projects Experience

Shaun is responsible for the following activities: conducting EIA, BA and WULA processes, undertaking amendment and exemption applications, general project management, report writing, proposal writing, invoicing, conducting specialist riparian/wetland delineation and functional assessments, environmental and water related compliance monitoring and auditing. Current and completed projects / activities are outlined in detail below.

### STRATEGIC ENVIRONMENTAL ASSESSMENTS

- Molemole Local Municipality Strategic Environmental Assessment, Limpopo Province (2014/2015);
- Blouberg Local Municipality Strategic Environmental Assessment, Limpopo Province (2015/2016).

### ENVIRONMENTAL IMPACT ASSESSMENTS

- Mookodi Integration Project Environmental Impact Assessment (2011/2012);
- Noupoort Wind Farm, Northern Cape Province (2011/2012);
- Loeriesfontein Wind Farm and PV Plant, Northern Cape Province (2011/2012);
- Renosterberg Wind Farm and PV Plant near De Aar, Northern Cape Province (2012).

### BASIC ASSESSMENTS

- Proposed Installation of a 500m<sup>3</sup> Bulk Storage Fuel Oil Tank at Grootvlei Power Station, Mpumalanga Province (2011/2012);
- Proposed development of a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);



## CURRICULUM VITAE

Shaun Taylor

- Proposed development of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province (2012);
- Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province (2013);
- Wilger 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Limestone 1 – 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Limestone 2 – 132kV Overhead Distribution Power Line, Northern Cape Province (2013/2014);
- Proposed Tweespruit to Welroux Power Line and Substations, Free State Province (2014/2015);
- Sir Lowry's Pass River Flood Alleviation Project, Western Cape Province (2014/2015);
- Loeriesfontein 70MW Photovoltaic and 132kV Power Line, Northern Cape Province (2015/2016);
- Rooipunt CSP 132kV Power Line and Associated Infrastructure, Northern Cape Province (2016);
- Rooipunt CSP Water Pipeline and Associated Infrastructure, Northern Cape Province (2016);
- Kalkaar CSP 132kV Power Line and Associated Infrastructure, Northern Cape Province (2016).

### ENVIRONMENTAL MANAGEMENT PLANS / PROGRAMMES

- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Transmission Infrastructure (2011);
- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Substations (2011);
- Mookodi Integration Project Environmental Management Plan – Transmission Infrastructure and Substations (2011/12);
- Noupoot Wind Farm Environmental Management Programme (2012);
- Environmental Management Programme for a 500m<sup>3</sup> Bulk Storage Fuel Oil Tank at Grootvlei Power Station (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province (2012);
- Karowe Diamond Mine Environmental Management Plan Review and Update, Boteti District, Botswana (2012);
- Environmental Management Programme for the Frankfort Strengthening Project: 88kV power line from Heilbron (via Frankfort) to Villiers, Free State Province (2013);
- Environmental Management Programme for the Wilger Photovoltaic 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 1 Photovoltaic – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 2 Concentrated Solar Power – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Final Environmental Management Programme for the Khobab 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Loeriesfontein 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Noupoot 80MW Wind Farm, Northern Cape Province (2014);
- Environmental Management Programme for the Tweespruit to Welroux 132kV Power Line and Substations, Free State Province (2014/2015);
- Environmental Management Programme for the Loeriesfontein 70MW Photovoltaic and 132kV Power Line, Northern Cape Province (2015/2016).

### AMENDMENT APPLICATIONS

- Loeriesfontein 140MW Wind Farm, Northern Cape Province: Substantive and Minor Amendments (2013/2014);

- Khobab 140MW Wind Farm, Northern Cape Province: Substantive and Minor Amendments (2013/2014);
- Loeriesfontein 50MW Wind Farm, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Loeriesfontein 100MW Solar Photovoltaic Plant, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Noupoot 188MW Wind Farm, Northern Cape Province: Environmental Authorisation Minor Amendments (2013/2014);
- Loeriesfontein 132kV Power Line, Northern Cape Province: Environmental Authorisation Minor Amendment (2015).

#### ENVIRONMENTAL CONSTRAINTS\FATAL FLAWS

- Social Housing Projects in Sasolburg and Secunda Final Environmental Constraints Analysis Report (2011);
- Establishment of Wind Farms in Northern and Eastern Cape Provinces Environmental Constraints Analysis Report (2011).

#### ENVIRONMENTAL AND WATER USE LICENSE COMPLIANCE AUDITING

- Environmental Compliance Auditing for the Nigel Substation to Jameson Park (Inland Terminal 2) 88kV power lines – Construction Phase (2011);
- Water Use License Compliance Auditing for Grootvlei Power Station, Mpumalanga Province, South Africa (2012);
- Environmental Compliance Auditing for the Meadow Feeds Standerton Broiler Feed Mill, Mpumalanga Province (2012/2013);
- Kusile Power Station Armcors Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Ash Dump Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Pollution Dams Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Stream Diversion and Water Pipeline Crossings Water Use License Compliance Audit, Mpumalanga Province (2014 & 2015);
- Kusile Power Station Geotechnical Water Use License Compliance Audit, Mpumalanga Province (2015);
- Ga-rankuwa 11kV Underground Power Cable Water Use License Compliance Audit, Gauteng Province (2015/2016);
- Transnet Rail Water Use License Compliance Audit, Northern Cape Province (2014, 2015 & 2016).

#### WATER USE LICENSES

- Integrated Water Use License Application for the Construction of a CSP and CPV/ PV Plant in De Aar, Northern Cape Province of South Africa (2010);
- Water Use License for Ga-rankuwa Substation, Gauteng Province (2013);
- Water Use License for Klevebank to Dalkieth 88kV Power Line, Gauteng Province (2013);
- Water Use License Application for the Frankfort Strengthening Project: 88kV Power Line from Heilbron (via Frankfort) to Villiers, Free State Province (2014/2015);
- Water Use Licensing for the Integrated Polokwane Rapid Public Transport Network, Limpopo Province (2014/2015);
- Water Use License for the Rooipunt Concentrated Solar Power Project, Northern Cape Province (2015);
- Water Use License for the Katulo Tsatsi Solar Park, Northern Cape Province (2015);

- Water Use License for the Limestone Concentrated Solar Power Project, Northern Cape Province (2015);
- Water Use License for the Wilger Photovoltaic Project, Northern Cape Province (2015);
- Water Use License for the Hertzogville Solar Park, Free-State Province (2015);
- Water Use License for the Dwarsrug Wind Farm, Northern Cape Province (2015);
- Water Use License for the Loeriesfontein 70MW Photovoltaic and 132kV Power Line Project, Northern Cape Province (2015);
- Water Use License for the Tweespruit to Driedorp 132kV Power Line, Driedorp Substation and Associated Infrastructure, Free State Province (2016);
- Water Use License for the Redstone Concentrated Solar Power to Olien Substation 132kV Power Line, Northern Cape Province (2016);
- Water Use License for the Victoria West 140MW Wind Farm near Victoria West, Northern Cape Province (2016);
- Water Use License for the Growthpoint Properties (Woodlands Office Park) near Woodmead, Gauteng Province (2016); and
- Water Use License for the Twinsaver Expansion of Facilities, Gauteng Province (2016).

#### WETLAND AND RIPARIAN DELINEATION AND FUNCTIONAL ASSESSMENTS

- Construction of a Wind Farm in Noupoort, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a Wind Farm in Prieska, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a Wind Farm in Loeriesfontein, Northern Cape Province, South Africa: Surface Water Report – Scoping Phase Assessment (2010);
- Construction of a 132KV Distribution Line from the Kudu Substation to Dorstfontein Substation in Mpumalanga Province: Surface Water Impact Assessment (2010);
- EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Northern Corridor: Eastern Cape Province (2011);
- EIA for the Thyspunt Transmission Lines Integration Project: Surface Water Impact Assessment Report – EIA – Southern Corridor: Eastern Cape Province (2011);
- Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province, South Africa – Surface Water Assessment – Scoping Phase Assessment (2011);
- Environmental Management Framework for the Mogale City Local Municipality Surface Water Report – Desired State Report: Gauteng Province (2011);
- Proposed Township Development on the Remainder of Portion 27 of the Farm Middelburg and Townsland 287 JS, Mpumalanga Province: Surface Water Assessment (2011);
- Construction of a CSP and a CPV/ PV Plant in De Aar, Northern Cape Province, South Africa: Surface Water Impact Assessment (2011);
- Construction of a CSP and a CPV/ PV Plant in Kimberley, Northern Cape Province, South Africa: Surface Water Impact Assessment (2011);
- Proposed Mixed Use Industrial Township Development in the Daspoort Area of Tshwane, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
- Westrand Strengthening Project from Westgate Substation to Hera Substation and Westgate Substation Extension, Gauteng Province, South Africa (2011);
- Mookodi Integration Project 2 Basic Assessment Surface Water Impact Assessment, North West Province, South Africa (2012);
- Wetland Site Investigation Report for Arundo Estate in the Midrand Area, Gauteng Province, South Africa (2011);
- Construction of a Gabion Structure at Waterval Substation in the Midrand Area, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
- Proposed Construction of a Single 400kV Power Line from Borutho to Nzhlele, North West Province, South Africa: Scoping and Impact Surface Water Assessment (2011/2012);

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- Proposed Construction of an 88kv Power Line at Palmridge in the Ekurhuleni Metropolitan Municipality, Gauteng Province, South Africa: Surface Water Impact Assessment (2011);
  - Proposed Construction of a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province, South Africa: Surface Water Impact Assessment (2012);
  - Proposed Rebuilding of a 88kV Power Line from Henneman Substation to Serfontein Substation near Kroonstad, Free State Province, South Africa: Surface Water Impact and Eco-Services Functional Assessment (2012);
  - Proposed Deconstruction and Construction of an 11kV Power Line near Delmas, Mpumalanga Province, South Africa: Wetland Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012);
  - Proposed Construction of a Solar Photovoltaic Power Plant near De Aar, Northern Cape Province, South Africa: Surface Water Scoping Assessment (2012);
  - Proposed Construction of a Wind Farm near De Aar, Northern Cape Province: Surface Water Scoping Assessment (2012);
  - Proposed Construction of a Low Cost Housing Development in the Soutpan area of Tshwane, Gauteng Province, South Africa: Wetland Assessment (2012);
  - Proposed Construction of a 132kV Power Line near Kimberley, Northern Cape Province: Surface Water Assessment (2012);
  - Proposed Extension of Delmas Substation and Associated Power Lines, Mpumalanga Province, South Africa: Wetland Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012);
  - Proposed Construction of a Substation in the Midrand area of Gauteng Province: Wetland Delineation and Impact Assessment (2012);
  - Construction of an 88kV Power Line at Lochvaal Kudu in the Emfuleni Municipality, Gauteng Province: Surface Water Impact Assessment and Rehabilitation Plan (2012);
  - Proposed construction of an 88kV Power Line from Klevebank Substation to Dalkeith Substation, Gauteng Province: Wetland and Riparian Delineation, Impact, Functional Assessment and Rehabilitation Plan (2012/2013);
  - Proposed Construction of an 88kV Power Line from Heilbron Substation to Villiers Substation, Free State Province: Surface Water Impact Assessment (2013);
  - Proposed Construction of a 132kV Power Line, Substation and the Extension of Homestead Substation Associated with the 75MW Concentrating Photovoltaic (CPV) / Photovoltaic (PV) Plant (PV 3) on the Farm Droogfontein in Kimberley, Northern Cape Province: Surface Water Assessment (2013);
  - Moddershaft Underground to Overhead Cable Replacement of an 11kV Power Line from Moddershaft Substation to a Minisub near Anzac, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Construction of an 11kV Underground Power Cable from Civic Centre to Zola Substation, Gauteng Province: Wetland Assessment (2013);
  - Proposed Construction of a Substation on Portion 265 Randjesfontein 405-JR, Gauteng Province: Wetland Delineation and Impact Assessment (2013);
  - Proposed Re-build of a Section of the Mathibestad Danhauser 33kV Power Line Network, North West Province: Wetland Assessment (2013);
  - Proposed Re-build of a Section of the Existing 33kV Mathibestad-Danhauser Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Re-build of a Section of the Existing 33kV Mothutlung North Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Re-build of a Section of the Existing 33kV Mothutlung South Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Re-build of a Section of the Existing 33kV Nonyane Madidi North Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Re-build of a Section of the Existing 33kV Nonyane Swartdam Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
  - Proposed Rebuild of a Section of the Existing 33kV Pelly Klipdrift Network, Gauteng and North West Provinces: Surface Water Impact Assessment (2013);

- Proposed Re-build of a Section of the Existing 33kV Zonderwater Kraal Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Hammanskraal Lusthof Power Line Network, Gauteng Province: Surface Water Impact Assessment (2013);
- Proposed Re-build of a Section of the Existing 33kV Klipgat Circle Power Line Network, Gauteng Province: Wetland Assessment (2013);
- Proposed Re-build of Sections of the Existing 33kV Erasmus Aviva Power Line Network, Gauteng Province: Surface Water Assessment (2013);
- Proposed Construction of an 11kV Underground Power Cable at the Ga-Rankuwa Substation, Gauteng Province: Wetland Assessment (2013);
- Mamatwan Manganese Mine, Northern Cape Province: Surface Water Assessment (2014);
- Two 5MW Photovoltaic Plants, Free State Province: Surface Water Assessment (2014);
- Dwarsrug Wind Farm, Northern Cape Province: Surface Water Assessment (2014);
- Manzimtoti Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Compensation Flats Development, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Tinley Manor South Road Development, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Ntuzuma Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Esphiva Sewer Line Project, Kwa-Zulu Natal Province: Surface Water Assessment (2014);
- Frankfort 132kV Power Line Wetland Walk-down Assessment, Free State Province (2014);
- Proposed Construction of the Esphiva Water Pipeline near Ulundi, KwaZulu-Natal Province: Surface Water Assessment (2014);
- Grootvlei Power Station Wetland Assessment, Mpumalanga Province (2014/2015);
- Proposed Construction of the Embangweni and Bhekabantu Irrigation Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Construction of the Nondabuya and Khwehle Primary Agriculture Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Expansion of the Makhathini Irrigation Scheme, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Construction of the Mbaliyezwe Irrigation Schemes, KwaZulu-Natal Province: Wetland and Aquatic Assessment (2015);
- Proposed Mixed Use Development on the Remainder of Portion 27 of the Farm Middelburg Town and Townlands 287 JS, Steve Tshwete Local Municipality in the Mpumalanga Province: Wetland Assessment (2015);
- Proposed Construction of Two Power Lines and Two Substations for the Mainstream Wind Facilities near Beaufort West, Western Cape Province: Surface Water Assessment (2015);
- Proposed eThekweni Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province: Wetland Assessment (2015);
- Proposed Coal Railway Siding at the Welgedacht Marshalling Yard and associated Milder Road Upgrade near Springs, Gauteng Province: Wetland Assessment (2015);
- Proposed Development of a 22kV Medium Voltage Power Line in Mofofutso, North West Province: Surface Water Assessment (2015);
- Mookodi Integration Power Line Project, North West Province: Wetland Walk-down Assessment (2015);
- Proposed Construction of a Coal Loading Facility within the existing Bronkhorstspuit Railway Siding near Bronkhorstspuit, Gauteng Province (2015);
- Proposed Construction of the Two 75MW Tlisitseng Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Tlisitseng Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Two 75MW Sendawo Solar Photovoltaic Energy Facilities near Lichtenburg, North West Province: Surface Water Assessment (2015);
- Proposed Construction of the Sendawo Solar Substation and associated 400kV Power Line near Lichtenburg, North West Province: Surface Water Assessment (2015);

- Proposed Construction of a 75MW Solar Photovoltaic Power Plant near Dennilton, Limpopo Province: Surface Water Assessment (2015);
- Proposed Construction of the Helena 1, 2 & 3 Photovoltaic Energy Facilities near Copperton, Northern Cape Province: Surface Water Assessment (2015);
- Proposed Construction of a 70MW Photovoltaic Facility and 132kV Power Line near Loeriesfontein, Northern Cape Province: Surface Water Assessment (2015);
- Proposed Construction of the Eureka West 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Eureka East 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Eureka 132kV Power Line near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Aletta 140MW Wind Farm near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Aletta 132kV Power Line near Copperton, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the Grasskoppies, Itemba, Xhaboom and Hartebeestleegte 140MW Wind Farms near Loeriesfontein, Northern Cape Province: Surface Water Assessment (2016);
- Proposed Construction of the 140MW Beaufort West Wind Farm, near Beaufort West, Northern Cape Province: Surface Water Assessment (2016); and
- Proposed Construction of the 140MW Victoria West Wind Farm near Victoria West, Northern Cape Province: Surface Water Assessment (2016).

#### WETLAND AND RIPARIAN REHABILITATION / POST-REHABILITATION / AUDITING ASSESSMENTS

- Post-rehabilitation Assessment of Three Wetland Crossing Sites for Chemwes (Pty) Ltd for the Re-working of a Tailings Dam Project near Stilfontein, North West Province (2011);
- Fourways 22kV Feeder Cable Wetland and River Rehabilitation Plan (2011);
- Post-rehabilitation Assessment of the Inland New Multi-Purpose Pipeline in the Mpumalanga and Gauteng Provinces (2012);
- John Ross Highway Wetland Rehabilitation Plan, KwaZulu-Natal Province (2014);
- Proposed eThekweni Integrated Rapid Transport Network (IRPTN) – Bus Rapid Transport (BRT) Phase 1: Route C1A, KwaZulu-Natal Province: Wetland and Riparian Rehabilitation Plan (2015).

#### **ENVIROKEY CC - JUNIOR ENVIRONMENTAL CONSULTANT AND GIS SUPPORT - OCT 2009 – MAR 2010**

Responsible for managing basic assessments, report writing, conducting specialist wetland assessments, auditing procedures and GIS mapping. Full list of activities completed available on request.

#### **JUNIOR ENVIRONMENTAL CONSULTANT AUG 2007 – SEP 2009**

Responsible for managing basic assessments, report writing, conducting specialist wetland assessments, environmental auditing procedures and GIS mapping. Full list of activities completed available on request.

#### **Conferences and Publications**

Taylor, S. R., 2008: A Critical Review of Strategic Environmental Assessment in South Africa and looking towards Future Considerations, presented at the South African Students Geography Conference, University of Cape Town, Cape Town.

#### **Academic and Work Related Achievements**

- Awarded Monash Dean's recognition award for outstanding academic results for second semester of 2006;
- Awarded Monash Dean's recognition award for outstanding academic results for first semester of 2007;
- Awarded Monash Dean's recognition award for outstanding academic results for second semester of 2007;
- Awarded Golden Key membership and certificate to the International Honours Society for outstanding academic achievements in undergraduate studies for Monash 2008;
- Awarded Study Sponsorship from Holgate, Meyer and Associates for Honours study in 2008/09;
- Awarded Certificate of Merit from University of Witwatersrand for outstanding work for the course of Honours in 2009/10;
- Awarded Merit Bursary for MSc from the University of Johannesburg 2010 for excellent academic results;
- Numerous short-course certificates (grass identification, wildflower identification, veld management, wetland buffer assessments and water use licensing).



University of Pretoria  
Faculty of Natural and Agricultural Sciences  
Department of Botany

This is to certify that

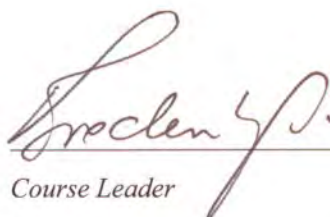
*SR Taylor*

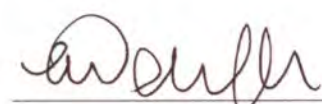
has successfully completed the

**Wetland Training Course on  
Delineation, Legislation and Rehabilitation**

**26 to 30 May 2008**

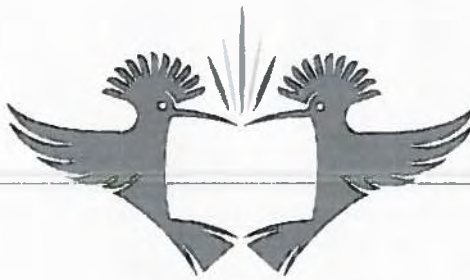
*This certificate is awarded with distinction*

  
Course Leader

  
Operations Manager: CE at UP



2011-10-15  
 C.S.C  
 HONEYDEW  
 SOUTH AFRICAN POLICE SERVICE



**UNIVERSITY**  
**OF**  
**JOHANNESBURG**

The Council and the Senate of the  
 UNIVERSITY OF JOHANNESBURG  
 hereby certify that the degree

**MAGISTER SCIENTIAE**

with field of study

**Aquatic Health**

with all its associated rights and privileges  
 in accordance with the Statute of the  
 University has been conferred upon

**SHAUN TAYLOR**

at a congregation of the University

Verification of Documents  
 Certified True Copy of Original Document  
 There are no indications that the original document has been altered by unauthorised persons.  
 Signature: *[Signature]*  
 Full Names: *[Signature]*  
 Commissioner of Oaths  
 Registration (rank) office, Republic of South Africa or reference number capacity and terms of appointment in terms of section 6 of the and commission of oath act 1963  
*Shaun Taylor Honeydew 8/10/11*

  
 Vice-Chancellor

  
 Registrar

04 OCTOBER 2011  
 Johannesburg  
 ID 8402025020082



# Curriculum Vitae: **Michiel Jonker**

<b>Name:</b>	Michiel Jonker	<b>Marital status:</b>	Single
<b>Date of birth:</b>	25/05/1984	<b>Driver's license:</b>	Code 8
<b>ID No.:</b>	840525 5110 085	<b>Contact No:</b>	084 585 7479
<b>Place of birth:</b>	Johannesburg, South Africa	<b>Email:</b>	michiel@ecotone-sa.co.za
<b>Postal address:</b>	PO Box 84 Florida, Johannesburg, South Africa, 1710		
<b>Experience:</b>	10 Years		

## Education

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### University of Johannesburg

#### 2011 **M. Sc (Environmental Management)**

This is a lectured Masters degree focussing on the concepts and principles of environmental management. The MSc. includes three modules: (1) Environmental management, biosphere and the environment. (2) Environmental management skills and (3) A mini dissertation in related field works.

#### 2009 **M.Sc (Aquatic Health) *cum laude***

This Masters study has an ecotoxicological basis. It deals with the effects of androgenic and estrogenic growth-promoting hormones, used in cattle feeding lots, on aquatic freshwater ecosystems. It aims to incorporate biomarkers in fish (metabolomics and cellular energy allocation) as well as studies of general water quality, sediment composition and invertebrate community structures

#### 2006 **B.Sc Honours (Zoology) *cum laude***

**Related course work:** Laboratory and field skills, Philosophy and research methodology, population genetics, project management, mammal diversity, eco-physiology, parasite ecology, ichthyology, research project, biological systems integrity, terrestrial ecology, nature conservation.

#### 2005 **B.Sc (Natural and Environmental Sciences)**

Majors: Geography and Zoology

Minors: Environmental management, botany, chemistry, environmental chemistry, biogeochemistry, statistics, information science

**Related course work:** Cartography, biogeography, soil science, climatology and geomorphology, economic and urban geography, GIS, Geography of Africa and South Africa, invertebrate and vertebrate diversity, parasitology, ecotoxicology, terrestrial ecology and limnology, animal physiology, economic and ethno-botany, plant diversity, plant-water relations, organic and physical chemistry.

## Employment and Work Experience

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Feb '08 – Pres      **Ecotone Freshwater Consultants CC**  
**Member and Freshwater Ecologist**

Recent projects:

- **SMD / EIMS** aquatic ecology and impact assessment - Scoping and EIA/EMP Report for the proposed expansion of the Kao Diamond Mine, Lesotho (May 2016).
- **Vaalbult Colliery** aquatic specialist assessment, proposed road crossing, Carolina, Mpumalanga (February 2016 – Present).
- **EkolInfo** aquatic biomonitoring plan and implementation for the Elands River associated with the Maseve mining operations near Sun City, in the North West Province, (January 2016- present).
- **Exxaro**, Zonderwater Coal Proposal, Wetland Specialist Assessment (November 2013 – Present).
- **Dyambyini** wetland and aquatic ecology assessment, management and biomonitoring plan for Water Use Licence Authorisation for the Proposed expansion of the Hendrina Ash Disposal Facility and related Power Line infrastructure (March 2016).
- **Delta Mining** wetland assessment and watercourse management plan for mining operations associated with the Proposed Rietkuil operations. Rietkuil, Delmas, Mpumalanga (February 2016).
- **SLR Consulting-** Biodiversity assessment, management and biomonitoring plan for the proposed expansion of the Holfontein Toxic Waste Disposal Facility, Gauteng (January 2016).
- **Envirolutions (Eskom)** Pre-, during- and post construction biomonitoring for pylon constructions crossing smaller tributaries of the Vaal River, Vereeniging, Gauteng (January 2015- present).
- **WPC** Ngonye Falls- 52 MW Hydroelectric Power Plant. Baseline biodiversity study and Environmental Flow Assessment, Zambia (October 2015 to present).
- **Ara-sul** Aquatic baseline assessment of the Sabie River, up- and downstream of Corumana Dam, Kruger National Park and Mozambique (November 2015 to January 2016).
- **EcoGain** Wetland and Impact assessment associated with the proposed Opencast Mining Operation, Delmas (October 2015 to present).
- **Envirolutions** Water quality Assessment, Broadacres Retirement Village, Broadacres Gauteng Province (November 2015).
- **ERM, Ncondezi Coal Mine**, Freshwater Ecology baseline study and Desktop Environmental Flow Assessment, Tete, Mozambique (November 2014 – May 2015).
- Hydrological Alteration-Aquatic Ecology Assessment-**New Largo** (July 2010 - Present).
- **Goliath Gold** Aquatic and impact assessment associated with the proposed de-water of a mine shaft, Heidelberg, Gauteng (January – May 2015).
- **Zambezi River Authority**, Kariba Dam wall upgrade, Freshwater Ecology baseline, impact assessment and Environmental Flow Assessment, Zambia/Zimbabwe (October 2014 - March 2015)
- **Dyambyini, Majuba Power Station**, Wetland Specialist Assessment (December - January 2015).
- **Doogvallei Rail Siding Company (Pty) Ltd**, Aquatic Biomonitoring Assessment of associated drainage lines, Carolina Mpumalanga (September 2012 – January 2015).
- **Pembani Coal**: Aquatic Biomonitoring Assessment, Carolina (March 2012 –January 2015).
- **Kumba Iron Ore**, Wetland and River study for WULa, Thabazimbi, Limpopo (December 2014).

- **FFMES, Cominco Phosphate Mine**, Hinda Project Freshwater Baseline Study and critical habitat assessment, Republic of Congo (March to August 2014).
- **Lidwala**, Majuba Wetland Rehabilitation Proposal, Wetland Specialist Assessment (March-July 2014).
- **Imperata**, NKP Terminal 2, Wetland Monitoring Assessment (June – July 2014).
- **Jeffars and Green**, Thabong Interchange, Wetland Rehabilitation Plan (June 2014).
- **Envirobility**, Sand Quarry, Diepsloot, Wetland Specialist Assessment (March 2014 – May 2014).
- **Lidwala, Majuba** Wetland Assessment Augmentation, Wetland Specialist Assessment (April 2014).
- **WSP, Kathu CSP Project**, Northern Cape, Wetland Specialist Assessment (January 2014 – April 2014).
- **ERM, Mulungushi Hydropower Project**, Aquatic Specialist (February, 2013).
- **ERM, Muchinga Hydropower Stations**, Aquatic Specialist, Zambia (April, 2013).
- **FFMES, Exxaro DMC Iron Congo Project**, Aquatic specialist study, Mayoko, Republic of Congo (September 2012).
- **ERM**, Sasol Twistdraai Export Plant, Wetland Specialist Assessment (November 2013 – May 2014).
- **GladAfrica, Centurion Lake Sediment Trap**, Aquatic Specialist Study, Gauteng, South Africa (November, 2012).
- **MSA, Meyerton Waste Water Treatment Works Upgrade**, Aquatic Specialist Study, Gauteng, South Africa (November 2012).
- **Eskom Majuba Ash Disposal Facility**, Wetland Specialist Study for the Scoping/EIA, Mpumalanga, South Africa (September, 2012).
- **Eskom Tutuka Ash Disposal Facility**, Wetland Specialist Study for the EIA, Mpumalanga, South Africa (September, 2012).
- **FFMES, Sintoukola Project**, Aquatic specialist study, Republic of Congo (May 2012; July 2012).
- **Coffey Environments, Tete Iron Project**, Aquatic specialist study of the Revuboe River, Chiúta and Moatize districts, Tete, Mozambique (March 2012).
- **Shanduka Coal**, wetland and impact assessment for a proposed 400kV line relocation, Middleburg, Mpumalanga (April, 2012).
- **Worldwide Coal Carolina**, aquatic biomonitoring assessment, Carolina, Mpumalanga (March, 2012).
- **Homeland Mining and Energy SA**, proposed Eloff Opencast Mine, specialist wetland assessment ( $\pm$  1400 ha) just outside the town of Delmas, Mpumalanga (February, 2012).
- **Exxaro MagVanTi Project** -Aquatic Ecology Baseline Study, Limpopo (January, 2012).
- **Shanduka Coal**, wetland and impact assessment of a pan located in the Graspan Colliery, Middleburg, Mpumalanga (January, 2012).
- **African Barrick Gold North Mata Mine** - Aquatic Consultant: Ecotoxicological risk assessment for discharge of treated waste water into the Mara River, North Mara, Tanzania (August, 2011).
- **Moamba Dam Project, Moamba, Mozambique**, Aquatic Consultant- Impacto: Aquatic ecology assessment for proposed (July, 2011).
- Fresh water Ecology **scoping study-Hendrina-Mpumalanga**( May 2011)
- Aquatic Biomonitoring Assessment-Blesbokspruit- **Hydro Testing** (May 2011)
- Aquatic Consultant- Lidwala environmental and engineering consultants: Sanral N14 river/stream crossing aquatic assessment (May 2011).
- Aquatic Consultant- Randwater: Proposed water and treated water residue pipeline near **Lethabo power station** in Vereeniging (May 2011).
- Aquatic Consultant- Anglo Coal: Assessment on non-perennial drainage lines associated with proposed coal mining development near All days in Limpopo (May, 2011).

- Hydro Testing Biomonitoring(KP290+100) **KwaZulu-Natal- Aquatic Ecology Assessment** (February 2011)
- Aquatic Consultant- Riversdale: Aquatic specialists on the **Benga Coal Project**, Tete, Mozambique (January, 2011).
- Aquatic Consultant- Transnet: Aquatic biomonitoring - **Ladysmith pump station oil spill**, Ladysmith, Natal (January, 2011).
- Aquatic Consultant – Imperata – Aquatic assessment for a proposed **Rand Water pipeline** crossing over the Pienaars River near Pretoria (May, 2010).
- Aquatic Consultant – Ekoinfo – Aquatic assessment for a **NuCoal mine** (Vuna colliery) near Middelburg Mpumalanga (March 2010- Current)
- Aquatic Consultant – EcoAgent – A MSA project – Detailed Aquatic assessment for the propped **Veremo Magnetite mine** in the Eastern Bushveld near Stofberg Mpumalanga (May 2010)
- Aquatic Consultant – New Multi Purpose Pipeline (NMPP) a combined Transnet, **Group Five and Spiecapag project** –Aquatic assessment and monitoring of associated river crossings in the Upper Vaal, Thukela and Mvoti Water Management Areas (October 2009- Current).
- Aquatic Consultant – **Intergraded Landscape Architects** – Raslouw Riparian delineation and aquatic assessment, Johannesburg (November 2009).
- Aquatic Consultant – Ekoinfo – **Klipriviersberg** Full Aquatic assessment (January. 2009)
- Aquatic Consultant – Ekoinfo – **Lonmin** Aquatic biodiversity assessment (January 2009).
- Aquatic Consultant – NSS– Optimum **Coal Fish** diversity assessment (March 2009)
- Aquatic Consultant –NSS – **Rio Tinto Chapudi** proposed coal mine diversity assessment (March 2009).
- Aquatic Consultant – **Lonmin platinum**- aquatic biodiversity assessment and action plan (January, 2009).
- Aquatic Consultant – **SASOL** – aquatic ecosystem impact assessment for proposed pipeline development (January 2009).
- Aquatic Consultant – Arcus Gibb - Aquatic biodiversity assessment for proposed coal **Eskom Mulilo coal mining development** (December 2008).
- Aquatic Consultant – **ESKOM** - Biomonitoring for proposed **Majuba railroad construction** for Eskom (October 2008- current).

Feb 07 – Jan 08

**EnviRoss Environmental Scientific Consultants Cc  
Consultant**

- Junior Scientist – Enviross cc - Aquatic macro-invertebrate biodiversity study for proposed feedlot **Mpumalanga** 2007. (November 2007)
- Junior Scientist – Enviross cc - **Tshwane** sewerage works bio-monitoring. (September 2007).
- Junior Scientist – Econ@uj - Ecological state of five estuaries in the **Wild coast** for proposed heavy mineral mining (October 2007).
- Aquatic Consultant – Ekoinfo - Aquatic ecological assessment for proposed golf course development in **North West province for Sun City** (August 2007).
- Junior Scientist – Enviross cc - Firgrove industrial development in **Somerset West** 2007 (July 2007) 2007.
- Junior Scientist – Enviross cc - Aquatic health determination and eco-classification for **ANGLO coal** (Mpumalanga) in 2007 (2007).
- Junior Scientist – Econ@uj - Aquatic health determination and eco-classification for **TOTAL coal** in 2006 (May 2006).
- Junior Scientist – Econ@uj - Aquatic health and fish diversity assessment at **Klipplaat nature reserve**, 2006 (September 2006).

- Technical Assistant - **University of Johannesburg Zoology department** - Aquatic health and biodiversity of the **Crocodile West Marico and Magaliesburg system**, 2007 (February 2007).
- Technical Assistant – Enviross cc - **Owl surveys** (March 2007).
- Project Manager - University of Johannesburg Zoology department - Aquatic health and biodiversity of **lake Chrissie in Mpumalanga**, 2007 (April 2007)
- Technical Assistant - University of Johannesburg Zoology department - PhD study regarding effects of pesticides on the freshwater aquatic health in the **Levubu River in Venda (Limpopo Province)** (February 2008)
- Researcher - University of Johannesburg Zoology department - Presented poster at Zoological society South Africa (ZSSA) in July 2007: Abiotic factors influencing invertebrate community structures in pan and dams in the **Mpumalanga highveld area** (June 2007)

## Workshops and Courses

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<b>2011</b>	<b>Tools for Wetland Assessment Short Course</b> Department of Environmental Science Rhodes University; Grahamstown Port Elizabeth
<b>2009</b>	<b>Environmental Management Systems –WTH Management and Training</b> ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg
<b>2008</b>	<b>Wetland and Riparian Delineation Course</b> Accredited wetland delineator Wetland Consulting Services and Department of Water Affairs and Forestry (DWAFF) Pretoria, South Africa.
<b>2008</b>	<b>Skippers Course</b> License Holder of a Category “R” skippers license
<b>2007</b>	<b>SASS5 Accredited Practitioner</b> Auditors: Christa Thirion (DWAFF, RQS), Colleen Todd (DWAFF, RQS) and Hermien Roux (North West Nature Conservation).
<b>2007</b>	<b>Multivariate Statistics Training</b> Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam
<b>2006</b>	<b>Advanced 4x4 driving course</b>

## Societies and Accreditations

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<b>2009</b>	<b>The South African Council for Natural Scientific Professions (SACNASP)</b> Professional Natural Scientist <i>Pr. Sci. Nat.</i> (Aquatic Health, Zoological & Ecological Sciences) Registration number: 400275/12
<b>2009</b>	<b>Member of the International Association of Impact Assessment-SA (IAIA SA).</b>

- 2006      **Member of the Zoological Society of Southern Africa (ZSSA)**
- 2006      **Member of the Southern African Society of Aquatic Scientists (SASAqS)**

## Presentations

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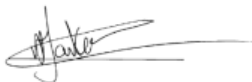
- Jun 2010**      **South African Society of Aquatic Scientists (SASAqS) Congress**  
MN Jonker, G. Walsh & JHJ van Vuren  
*Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.*
- Oct 2009**      **Department of Geography and Energy studies, University of Johannesburg**  
MN Jonker, M Sherwood and R Rowles. 2009.  
*Historical overview of water quality associated with the Blesbokspruit RAMSAR site. Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).*
- Jul 2007**      **Zoological Society of Southern Africa Conference, Potchefstroom.**  
MN Jonker  
*Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.*

## Publications

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1. Van der Zee, J., Walsh, G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occurring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa*.
2. Walsh, G., Jonker, M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noubi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.  
*Checklist Journal* **10 (4)**: 900 - 912.
3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3)**.
4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

I, Michiel Jonker, do hereby declare that all the information furnished above is true to the best of my knowledge.



**Michiel Jonker**

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# SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

**Mr Michiel Nell Jonker**  
Registration number: 400275/12

is registered as a

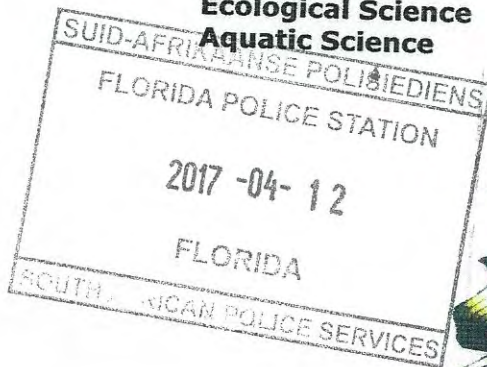
**Professional Natural Scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)

in the following field(s) of practice (Schedule I of the Act)

**Zoological Science**  
**Ecological Science**  
**Aquatic Science**

**15 August 2012**  
**19 September 2012**  
**30 January 2013**



I CERTIFY THAT THE INFORMATION CONTAINED IN THIS REGISTERED DOCUMENT IS TRUE AND CORRECT AND THAT I AM A MEMBER OF THE SACNASP REGISTERED PROFESSION. I FURTHER CERTIFY THAT I HAVE NOT MADE AN AMENDMENT OR A CHANGE TO THE ORIGINAL DOCUMENT.

AND TELEPHONE/SIGNATURE  
RANG  
RANG  
D.N. 11000A MC

15 August 2012

Pretoria

President

Executive Director



## Appendix B: Impact Rating Methodology

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

### Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 7**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

### Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

#### *Rating System Used to Classify Impacts*

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

**Table 7.** Example of the significance impact rating table

<b>NATURE</b>		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
<b>GEOGRAPHICAL EXTENT</b>		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
<b>PROBABILITY</b>		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
<b>REVERSIBILITY</b>		

This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
<b>IRREPLACEABLE LOSS OF RESOURCES</b>		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
<b>DURATION</b>		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

<b>CUMULATIVE EFFECT</b>		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
<b>INTENSITY / MAGNITUDE</b>		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
<b>SIGNIFICANCE</b>		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on		

the environmental parameter. The calculation of the significance of an impact uses the following formula:

**(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.



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To whom it may concern

**REVIEW OF REPORT: PROPOSED CONSTRUCTION OF THE FOLLOWING WIND FARMS AND ASSOCIATED LINEAR INFRASTRUCTURE: XHA! BOOM, GRASKOPPIES, ITHEMBA AND HARTEBEEST LEEGSTE**

**Surface Water Delineation and Assessment Report**

**1. Experience of the Peer Reviewer**

Michiel Jonker is the lead freshwater ecology specialist and a founding member of Ecotone Freshwater Consultants. He holds Masters Degrees in Aquatic Health and Environmental Management from the University of Johannesburg, and is a registered Professional Natural Scientist practitioner in the field of freshwater ecology for the past 9 years. Michiel is also an accredited South African Scoring System version 5 (SASS5) practitioner and wetland delineator (Department of Water Affairs). He has extensive experience in aquatic ecology assessments, biomonitoring, impact and wetland assessments nationally and internationally.

**2. Acceptability of the Terms of Reference**

The terms of reference are provided within the introduction as:

- Identify, delineate and classify surface water resources.
- Assessment of watercourses.
- Complete an alternative selection based on proximity to surface water resources.
- Ascertain the legal requirements in relation to surface water resources.
- Complete a pre-construction, construction and cumulative impact assessment.
- Provide mitigation measures.

**3. Methodology**

The methods applied for the following components of the assessment are appropriate in the context of the study:

- Desktop literature review;
- Wetland delineation;
- Buffer determination and
- Impact assessment.

A more detailed assessment will be required for a Water Use License (WUL) application. However, the assumptions and limitations, in this regard, are articulated within the report:

*"...Wetland or river health, present ecological status (PES), ecosystem services and the ecological importance (EI)/ecological sensitivity (ES) categories have not been assessed for identified surface water resources. Only*



*desktop information in terms of PES/EI/ES (where available) from the databases were provided as per the scoping assessment information”.*

#### **4. Validity of the Findings**

The hydrological functioning of the different watercourses is discussed and baseline information is provided in terms of topography, vegetation and soil. The results inform a regional project alternative selection. The main impacts are suitably identified and assessed. The extent of all surface watercourses is identified and are generally considered sensitive. Potential impacts are identified and assessed in terms of loss of habitat, hydrology, geomorphology, water quality and alien vegetation.

#### **5. Suitability of the Mitigation Measures and Recommendations**

Mitigation measures provided are relevant and suitable. The main recommendation is to avoid surface watercourses during construction and operations. However, generic mitigation measures are provided for the conceivable instances where activities will occur within or close to surface watercourses.

In instances where impacts on watercourses may not be avoidable the impact assessment will have to be augmented with more site and activity specific information. The author correctly identifies the requirement for a risk assessment in terms Regulation 509 once a final design is available.

#### **6. Appropriateness of Reference Literature**

The references applied are appropriate.

#### **7. Additional Comments**

No site visit took place as part of the review process.

## CURRICULUM VITAE

<b>Name:</b>	Michiel Jonker	<b>Marital status:</b>	Single
<b>Date of birth:</b>	25/05/1984	<b>Driver's license:</b>	Code 8
<b>ID No.:</b>	840525 5110 085	<b>Contact No:</b>	084 585 7479
<b>Place of birth:</b>	Johannesburg, South Africa	<b>Email:</b>	michiel@ecotone-sa.co.za
<b>Postal address:</b>	PO Box 84 Florida, Johannesburg, South Africa, 1710		
<b>Experience:</b>	10 Years		

## Education

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### University of Johannesburg

#### 2011 M. Sc (Environmental Management)

This is a lectured Masters degree focussing on the concepts and principles of environmental management. The MSc. includes three modules: (1) Environmental management, biosphere and the environment. (2) Environmental management skills and (3) A mini dissertation in related field works.

#### 2009 M.Sc (Aquatic Health) *cum laude*

This Masters study has an ecotoxicological basis. It deals with the effects of androgenic and estrogenic growth-promoting hormones, used in cattle feeding lots, on aquatic freshwater ecosystems. It aims to incorporate biomarkers in fish (metabolomics and cellular energy allocation) as well as studies of general water quality, sediment composition and invertebrate community structures

#### 2006 B.Sc Honours (Zoology) *cum laude*

**Related course work:** Laboratory and field skills, Philosophy and research methodology, population genetics, project management, mammal diversity, eco-physiology, parasite ecology, ichthyology, research project, biological systems integrity, terrestrial ecology, nature conservation.

#### 2005 B.Sc (Natural and Environmental Sciences)

Majors: Geography and Zoology

Minors: Environmental management, botany, chemistry, environmental chemistry, biogeochemistry, statistics, information science

**Related course work:** Cartography, biogeography, soil science, climatology and geomorphology, economic and urban geography, GIS, Geography of Africa and South Africa, invertebrate and vertebrate diversity, parasitology, ecotoxicology, terrestrial ecology and limnology, animal physiology, economic and ethno-botany, plant diversity, plant-water relations, organic and physical chemistry.

## Employment and Work Experience

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Feb '08 – Pres Ecotone Freshwater Consultants CC  
Member and Freshwater Ecologist

Recent projects:

- **ESKOM / EIMS – Arnot Power Station**, Wetland Specialist report - Integrated Environmental Impact Assessment Process (Waste Management License Application, Environmental Authorisation Application And Associated Environmental Management Programme) and

Water Use License Application For The New Ash Disposal Facility at Arnot Power Station In Mpumalanga (August 2016-Present).

- **Imperata / AHTech** Aquatic assessment of the Moreletaspruit associated with the Menlyn diesel spill (October 2016).
- **ERM** Environmental Flow assessment, Yiben Dam Project, Sierra Leone (July 2016).
- **SMD / EIMS** aquatic ecology and impact assessment - Scoping and EIA/EMP Report for the proposed expansion of the Kao Diamond Mine, Lesotho (May 2016).
- **Vaalbult Colliery** wetland specialist assessment, proposed road crossing, Carolina, Mpumalanga (February 2016 – Present).
- **Ekolinfo** aquatic biomonitoring plan and implementation for the Elands River associated with the Maseve mining operations near Sun City, in the North West Province, (January 2016-present).
- **Exxaro**, Zonderwater Coal Proposal, Wetland Specialist Assessment (November 2013 – April 2016).
- **Dyambyini / ESKOM – Hendrina Power Station**, wetland and aquatic ecology assessment, management and biomonitoring plan for Water Use Licence Authorisation for the Proposed expansion of the Hendrina Ash Disposal Facility and related Power Line infrastructure (March 2016).
- **Delta Mining** wetland assessment and watercourse management plan for mining operations associated with the Proposed Rietkuil operations. Rietkuil, Delmas, Mpumalanga (February 2016).
- **SLR Consulting-** Biodiversity assessment, management and biomonitoring plan for the proposed expansion of the Holfontein Toxic Waste Disposal Facility, Gauteng (January 2016).
- **Envirolutions (Eskom)** Pre-, during- and post construction biomonitoring for pylon constructions crossing smaller tributaries of the Vaal River, Vereeniging, Gauteng (January 2015- present).
- **WPC** Ngonye Falls- 52 MW Hydroelectric Power Plant. Baseline biodiversity study and Environmental Flow Assessment, Zambia (October 2015 to present).
- **Ara-sul** Aquatic baseline assessment of the Sabie River, up- and downstream of Corumana Dam, Kruger National Park and Mozambique (November 2015 to January 2016).
- **EcoGain** Wetland and Impact assessment associated with the proposed Opencast Mining Operation, Delmas (October 2015 to present).
- **Envirolutions** Water quality Assessment, Broadacres Retirement Village, Broadacres Gauteng Province (November 2015).
- **ERM, Ncondezi Coal Mine**, Freshwater Ecology baseline study and Desktop Environmental Flow Assessment, Tete, Mozambique (November 2014 – May 2015).
- Hydrological Alteration-Aquatic Ecology Assessment-**New Largo** (July 2010 - Present).
- **Goliath Gold** Aquatic and impact assessment associated with the proposed de-water of a mine shaft, Heidelberg, Gauteng (January – May 2015).
- **Zambezi River Authority**, Kariba Dam wall upgrade, Freshwater Ecology baseline, impact assessment and Environmental Flow Assessment, Zambia/Zimbabwe (October 2014 - March 2015)
- **Dyambyini / ESKOM - Majuba Power Station**, Wetland Specialist Assessment (December - January 2015).
- **Doogvallei Rail Siding Company (Pty) Ltd**, Aquatic Biomonitoring Assessment of associated drainage lines, Carolina Mpumalanga (September 2012 – January 2015).
- **Pembani Coal**: Aquatic Biomonitoring Assessment, Carolina (March 2012 –January 2015).
- **Kumba Iron Ore**, Wetland and River study for WULa, Thabazimbi, Limpopo (December 2014).

- **FFMES, Cominco Phosphate Mine**, Hinda Project Freshwater Baseline Study and critical habitat assessment, Republic of Congo (March to August 2014).
- **Lidwala**, Majuba Wetland Rehabilitation Proposal, Wetland Specialist Assessment (March-July 2014).
- **Imperata**, NKP Terminal 2, Wetland Monitoring Assessment (June – July 2014).
- **Jeffars and Green**, Thabong Interchange, Wetland Rehabilitation Plan (June 2014).
- **Envirobility**, Sand Quarry, Diepsloot, Wetland Specialist Assessment (March 2014 – May 2014).
- **Lidwala / ESKOM - Majuba Power Station**, Wetland Assessment Augmentation, Wetland Specialist Assessment (April 2014).
- **WSP, Kathu CSP Project**, Northern Cape, Wetland Specialist Assessment (January 2014 – April 2014).
- **ERM, Mulungushi Hydropower Project**, Aquatic Specialist (February, 2013).
- **ERM, Muchinga Hydropower Stations**, Aquatic Specialist, Zambia (April, 2013).
- **FFMES, Exxaro DMC Iron Congo Project**, Aquatic specialist study, Mayoko, Republic of Congo (September 2012).
- **ERM, Sasol Twistdraai Export Plant**, Wetland Specialist Assessment (November 2013 – May 2014).
- **GladAfrica, Centurion Lake Sediment Trap**, Aquatic Specialist Study, Gauteng, South Africa (November, 2012).
- **MSA, Meyerton Waste Water Treatment Works Upgrade**, Aquatic Specialist Study, Gauteng, South Africa (November 2012).
- **ESKOM, Majuba Ash Disposal Facility**, Wetland Specialist Study for the Scoping/EIA, Mpumalanga, South Africa (September, 2012).
- **ESKOM, Tutuka Ash Disposal Facility**, Wetland Specialist Study for the EIA, Mpumalanga, South Africa (September, 2012).
- **FFMES, Sintoukola Project**, Aquatic specialist study, Republic of Congo (May 2012; July 2012).
- **Coffey Environments, Tete Iron Project**, Aquatic specialist study of the Revuboe River, Chiúta and Moatize districts, Tete, Mozambique (March 2012).
- **Shanduka Coal**, wetland and impact assessment for a proposed 400kV line relocation, Middleburg, Mpumalanga (April, 2012).
- **Worldwide Coal Carolina**, aquatic biomonitoring assessment, Carolina, Mpumalanga (March, 2012).
- **Homeland Mining and Energy SA**, proposed Eloff Opencast Mine, specialist wetland assessment ( $\pm$  1400 ha) just outside the town of Delmas, Mpumalanga (February, 2012).
- **Exxaro MagVanTi Project** -Aquatic Ecology Baseline Study, Limpopo (January, 2012).
- **Shanduka Coal**, wetland and impact assessment of a pan located in the Graspan Colliery, Middleburg, Mpumalanga (January, 2012).
- **African Barrick Gold North Mata Mine** - Aquatic Consultant: Ecotoxicological risk assessment for discharge of treated waste water into the Mara River, North Mara, Tanzania (August, 2011).
- **Moamba Dam Project, Moamba, Mozambique**, Aquatic Consultant- Impacto: Aquatic ecology assessment for proposed (July, 2011).
- Fresh water Ecology **scoping study-Hendrina-Mpumalanga**( May 2011)
- Aquatic Biomonitoring Assessment-Blesbokspruit- **Hydro Testing** (May 2011)
- Aquatic Consultant- Lidwala environmental and engineering consultants: Sanral N14 river/stream crossing aquatic assessment (May 2011).
- Aquatic Consultant- Randwater: Proposed water and treated water residue pipeline near **Lethabo power station** in Vereeniging (May 2011).

- Aquatic Consultant- Anglo Coal: Assessment on non-perennial drainage lines associated with proposed coal mining development near All days in Limpopo (May, 2011).
- Hydro Testing Biomonitoring(KP290+100) **KwaZulu-Natal- Aquatic Ecology Assessment** (February 2011)
- Aquatic Consultant- Riversdale: Aquatic specialists on the **Benga Coal Project**, Tete, Mozambique (January, 2011).
- Aquatic Consultant- Transnet: Aquatic biomonitoring - **Ladysmith pump station oil spill**, Ladysmith, Natal (January, 2011).
- Aquatic Consultant – Imperata – Aquatic assessment for a proposed **Rand Water pipeline** crossing over the Pienaars River near Pretoria (May, 2010).
- Aquatic Consultant – Ekoinfo – Aquatic assessment for a **NuCoal mine** (Vuna colliery) near Middelburg Mpumalanga (March 2010- Current)
- Aquatic Consultant – EcoAgent – A MSA project – Detailed Aquatic assessment for the proposed **Veremo Magnetite mine** in the Eastern Bushveld near Stofberg Mpumalanga (May 2010)
- Aquatic Consultant – New Multi Purpose Pipeline (NMPP) a combined Transnet, **Group Five and Spiecapag project** –Aquatic assessment and monitoring of associated river crossings in the Upper Vaal, Thukela and Mvoti Water Management Areas (October 2009- Current).
- Aquatic Consultant – **Intergraded Landscape Architects** – Raslouw Riparian delineation and aquatic assessment, Johannesburg (November 2009).
- Aquatic Consultant – Ekoinfo – **Klipriviersberg** Full Aquatic assessment (January. 2009)
- Aquatic Consultant – Ekoinfo – **Lonmin** Aquatic biodiversity assessment (January 2009).
- Aquatic Consultant – NSS– Optimum **Coal Fish** diversity assessment (March 2009)
- Aquatic Consultant –NSS – **Rio Tinto Chapudi** proposed coal mine diversity assessment (March 2009).
- Aquatic Consultant – **Lonmin platinum-** aquatic biodiversity assessment and action plan (January, 2009).
- Aquatic Consultant – **SASOL** – aquatic ecosystem impact assessment for proposed pipeline development (January 2009).
- Aquatic Consultant – Arcus Gibb - Aquatic biodiversity assessment for proposed coal **Eskom Mulilo coal mining development** (December 2008).
- Aquatic Consultant – **ESKOM** - Biomonitoring for proposed **Majuba railroad construction** for Eskom (October 2008- current).

**Feb 07 – Jan 08**

**EnviRoss Environmental Scientific Consultants Cc  
Consultant**

- Junior Scientist – Enviross cc - Aquatic macro-invertebrate biodiversity study for proposed feedlot **Mpumalanga** 2007. (November 2007)
- Junior Scientist – Enviross cc - **Tshwane** sewerage works bio-monitoring. (September 2007).
- Junior Scientist – Econ@uj - Ecological state of five estuaries in the **Wild coast** for proposed heavy mineral mining (October 2007).
- Aquatic Consultant – Ekoinfo - Aquatic ecological assessment for proposed golf course development in **North West province for Sun City** (August 2007).
- Junior Scientist – Enviross cc - Firgrove industrial development in **Somerset West** 2007 (July 2007) 2007.
- Junior Scientist – Enviross cc - Aquatic health determination and eco-classification for **ANGLO coal** (Mpumalanga) in 2007 (2007).

- Junior Scientist – Econ@uj - Aquatic health determination and eco-classification for **TOTAL coal** in 2006 (May 2006).
- Junior Scientist – Econ@uj - Aquatic health and fish diversity assessment at **Klipplaat nature reserve**, 2006 (September 2006).
- Technical Assistant - **University of Johannesburg Zoology department** - Aquatic health and biodiversity of the **Crocodile West Marico and Magaliesburg system**, 2007 (February 2007).
- Technical Assistant – Enviross cc - **Owl surveys** (March 2007).
- Project Manager - University of Johannesburg Zoology department - Aquatic health and biodiversity of **lake Chrissie in Mpumalanga**, 2007 (April 2007)
- Technical Assistant - University of Johannesburg Zoology department - PhD study regarding effects of pesticides on the freshwater aquatic health in the **Levubu River in Venda (Limpopo Province)** (February 2008)
- Researcher - University of Johannesburg Zoology department - Presented poster at Zoological society South Africa (ZSSA) in July 2007: Abiotic factors influencing invertebrate community structures in pan and dams in the **Mpumalanga highveld area** (June 2007)

## Workshops and Courses

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<b>2011</b>	<b>Tools for Wetland Assessment Short Course</b> Department of Environmental Science Rhodes University; Grahamstown Port Elizabeth
<b>2009</b>	<b>Environmental Management Systems –WTH Management and Training</b> ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg
<b>2008</b>	<b>Wetland and Riparian Delineation Course</b> Accredited wetland delineator Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF) Pretoria, South Africa.
<b>2008</b>	<b>Skippers Course</b> License Holder of a Category “R” skippers license
<b>2007</b>	<b>SASS5 Accredited Practitioner</b> Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux (North West Nature Conservation).
<b>2007</b>	<b>Multivariate Statistics Training</b> Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam
<b>2006</b>	<b>Advanced 4x4 driving course</b>

## Societies and Accreditations

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<b>2009</b>	<b>The South African Council for Natural Scientific Professions (SACNASP)</b> Professional Natural Scientist <i>Pr. Sci. Nat.</i> (Aquatic Health, Zoological & Ecological Sciences)
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Registration number: 400275/12

- 2009**      **Member of the International Association of Impact Assessment-SA (IAIA SA).**
- 2006**      **Member of the Zoological Society of Southern Africa (ZSSA)**
- 2006**      **Member of the Southern African Society of Aquatic Scientists (SASAqS)**

## Presentations

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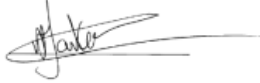
- Jun 2010**      **South African Society of Aquatic Scientists (SASAqS) Congress**  
MN Jonker, G. Walsh & JHJ van Vuren  
*Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.*
- Oct 2009**      **Department of Geography and Energy studies, University of Johannesburg**  
MN Jonker, M Sherwood and R Rowles. 2009.  
*Historical overview of water quality associated with the Blesbokspruit RAMSAR site.* Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).
- Jul 2007**      **Zoological Society of Southern Africa Conference, Potchefstroom.**  
MN Jonker  
*Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.*

## Publications

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1. Van der Zee, J., Walsh, G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occurring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa*.
2. Walsh, G., Jonker, M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noubi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.  
*Checklist Journal* **10 (4)**: 900 - 912.
3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3)**.
4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

I, Michiel Jonker, do hereby declare that all the information furnished above is true to the best of my knowledge.



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Main Road & Campground Roads  
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**Cape Town**  
7708

Your reference N/a  
Our reference 13622 - Graskoppies  
Date 25 October 2017

**ATTENTION: MRS REBECCA THOMAS**

Dear Mrs. Thomas

## **SURFACE WATER SPECIALIST LETTER FOR THE PROPOSED CONSTRUCTION OF THE GRASKOPPIES WIND FARM NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE**

### **1. BACKGROUND**

Since the completion of the surface water impact assessment for the above-mentioned proposed development, Mainstream Renewable Power South Africa (Pty) Ltd (hereafter referred to as, "Mainstream") have proposed that the final turbine layout and turbine specifications be amended taking into account environmental sensitivities as far as possible. Accordingly SiVEST have been requested to provide specialist comment on the potential impact to surface water resources in this regard.

The amendments being assessed are as follows:

- The number of turbines proposed have been reduced from 70 to 47;
- The spatial distribution of the turbines on the site have changed;
- The range of the turbines have changed from 2 - 5MW to 4 – 8MW, although the hub height, rotor diameter and maximum output per turbine will remain the same;
- The material for turbine towers have changed from steel only, to a steel and concrete combination, although concrete batching will not be undertaken on the site;
- Buildable area have been established;
- Internal road network have been established; and
- Hardstand areas for wind turbines have been included.

### **2. SPECIALIST COMMENT**

Overall, whilst the capacity change of wind turbines from 2 – 5MW to 4 – 8MW, and the change in materials to be used for the wind turbines have no discernible impact on surface water resources, the change in number and distribution of wind turbines have generally resulted in a decrease in overall construction phase potential impact. Mitigation measures have been stipulated which have reduced the impact to a low level.

Despite the above, there are a number of hardstand areas which encroach (to a greater and lesser extent) into the buffer zones of the surface water resources. Specifically, these include the hardstand areas of wind turbines T26 and T33.

In addition to this, direct impacts can also be expected as a result of the internal road network. The segments of roads which cross surface water resources directly include the following:

1. Road Segment 1 between Wind Turbines T05-T29
2. Road Segment 2 between Wind Turbines T33-T04
3. Road Segment 3 between Wind Turbines T42-T07
4. Road Segment 4 between Wind Turbines T07-T45
5. Road Segment 5 between Wind Turbines T45-T44

### 3. CHANGES TO POTENTIAL IMPACTS AND MITIGATION MEASURES

Given that the wind turbine locations, hard stand areas and internal road networks are now known, the potential impacts have resulted in a decrease of potential construction phase impacts. The potential impacts that have changed in terms of impact significance rating and corresponding mitigation measures are provided in **Appendix 1**. In summary, the change in potential impact significance ratings from the original surface water impact report and the changed potential impact significance ratings in this letter (**Appendix 1**) are provided in **Table 1** below.

**Table 1. Summary of Change in Significance**

Impact Type	Original Impact Phase Surface Water Report Significance Rating		Revised Significance Rating	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Loss of Riparian Habitat	- 45 (medium negative)	- 28 (low negative)	- 30 (medium negative)	- 28 (low negative)
Impacts to the Geomorphology of Surface Water Resources	- 48 (medium negative)	- 32 (medium negative)	- 30 (medium negative)	- 28 (low negative)

### 4. SURFACE WATER IMPACT STATEMENT

Given the above, the impacts identified in the original surface water assessment remain relevant to the amended layout as proposed. However, where specific impacts have come to light (i.e. road network and wind turbine hardstand areas), there will generally be a decrease in the construction phase potential impacts for loss in riparian habitat and impacts to the geomorphology of surface water resources. With mitigation, the potential impact will be reduced to a lower level. It is therefore SiVEST's opinion that the surface water potential impacts identified are not significant enough to prevent the project from proceeding. A water use license or general authorisation will be required due to direct impacts on surface water resources however.

Yours sincerely



Shaun Taylor  
Environmental Scientist  
**SiVEST Environmental**

# Appendix 1

## Potential Impact Rating and Mitigation Measures Tables

### Construction Phase

The changed potential impacts and associated mitigation measures are provided in the Table 2 & Table 3 below.

**Table 1. Rating for Potential Construction Impacts to Drainage Line Habitat**

<b>IMPACT TABLE</b>		
Environmental Parameter	Major / Minor Drainage Lines	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of drainage lines	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Definite</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>Medium cumulative Impact</i>	
<i>Intensity/magnitude</i>	<i>Medium</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	- 30 (medium negative)	- 28 (low negative)
Mitigation measures	<p><b>Designation of Highly Sensitive Areas</b> Same as impact phase surface water report.</p> <p><b>Establishment of Internal Road Crossing Areas</b> For general access to the various components of the wind farm, existing roads are to be used as far as</p>	

possible. Where no other access exists to the desired construction areas and roads will be required into the surface water resources and the associated buffer zones, environmental authorisation and a water use license / general authorisation will be required before construction takes place. All mitigation measures are to be implemented accordingly.

A single access route into the internal road crossing areas through surface water resources are to be established before construction takes place, where required. The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings using the drainage line bed as part of the road and / or similar design crossings are to be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to temporarily access proposed construction areas during construction the construction phase only. Where the access routes will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, the ford designs should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing, little to no modification of the drainage line will be required where banks are low (approximately 1,2m) for drainage lines, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line. However, where

modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction.

For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line beds. The weak substrate layer will need to be excavated and infilled by the rock or gravel material to the same level of the original drainage line. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support.

Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction.

In general, the width of the internal road crossing areas must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The internal road crossing areas must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings and / or similar design crossings, vegetation should not be totally cleared across the entire internal road crossing areas. Rather, only the vehicle tracks should be

cleared. Remaining vegetation can be kept trimmed to below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated.

Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary / permanent ford crossings and / or similar crossing designs. Additionally, rehabilitation will need to take place if and where required.

Overall, no wetlands and / or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road crossing areas are only permissible after rainfall events once flows have ceased.

Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the internal road crossing areas drainage lines due soil instability factors.

Construction workers are only allowed in the designated internal road crossing areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation.

#### **Control of Alien and Invasive Vegetation in Surface Water Resources**

Same as impact phase surface water report.

	<p><b>Avoidance of Direct Impact to Delineated Surface Water Resources</b> Same as impact phase surface water report.</p> <p><b>Emergency Measures</b> Same as impact phase surface water report.</p> <p><b>Post-construction Rehabilitation</b> Same as impact phase surface water report.</p> <p><b>Buffer Zone Specific Mitigation Measures</b> During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as “sensitive” and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is within 50m. The demarcation of the buffer zones must be visible and last for the duration of the construction activities.</p> <p>The buffer zone areas are also to be included as part of the internal road crossing areas through the surface water resources.</p> <p>All wind turbine hardstand areas within buffer zones are to be lined at the edges with grass blocks or similar run-off energy dissipating soft structures to prevent siltation within drainage lines downstream during construction. For the operation phase, permanent run-off dissipating structures are to be implemented as part of the stormwater designs and management plan.</p> <p>See above for same access internal road crossing area mitigation measures to be implemented within buffer zones.</p>
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**Table 2. Rating for Potential Construction Impacts to the Geomorphology of the Drainage Lines**

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of the soils associated with the drainage lines	
<i>Extent</i>	<i>Site</i>	
<i>Probability</i>	<i>Definite</i>	
<i>Reversibility</i>	<i>Partly reversible</i>	
<i>Irreplaceable loss of resources</i>	<i>Marginal loss of resources</i>	
<i>Duration</i>	<i>Long term</i>	
<i>Cumulative effect</i>	<i>Medium cumulative Impact</i>	
<i>Intensity/magnitude</i>	<i>Medium</i>	
<i>Significance Rating</i>	<i>Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	- 30 (medium negative)	- 28 (low negative)
Mitigation measures	<p><b>General Mitigation Measures</b></p> <p>Apply same mitigation measures stipulated in <b>Table 2</b> above in terms of the following:</p> <ul style="list-style-type: none"> <li>▪ Designation of Highly Sensitive Areas</li> <li>▪ Establishment of Internal Road Crossing Areas</li> <li>▪ Avoidance of Direct Impact to Delineated Surface Water Resources</li> <li>▪ Emergency Measures</li> <li>▪ Post-construction Rehabilitation</li> <li>▪ Buffer Zone Specific Mitigation Measures</li> </ul>	

**Preventing Increased Run-off, Erosion and Sedimentation Impacts**

Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future.

An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas.

In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to prevent erosion in susceptible construction areas during the construction phase. Grass blocks on the perimeter of the wind turbine hard stand areas or similar soft engineering structures can also be used to reduce run-off and onset of erosion. Wind turbine locations that encroach on the buffer zones of the surface water resources which will require such measures include the hardstand areas of wind turbines T26 and T33.

Where required more permanent structures such as attenuation ponds and gabions can be constructed if needs be, however this is unlikely given the study area. All impacted areas are to be adequately sloped to prevent the onset of erosion.

Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated

	above) are to be implemented as and where required.
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