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Peer review of the Surface Water Impact Assessment report for the Proposed Construction of the Eureka 140MW Wind Farm Facility near Copperton, Northern Cape Province

1 Experience of the peer reviewer

Ina Venter is an ecologist with a Masters of Science Degree (M.Sc) from the Department of Botany at the University of Pretoria. She has been involved in ecological and wetland assessments since 2004 and has been involved in several large scale wetland projects as well. Wetland experience are mostly in Gauteng, Mpumalanga, KwaZulu-Natal and North-West provinces, with some experience in the Limpopo, Free State, Eastern Cape and Northern Cape provinces, as well as Lesotho, Botswana and Mosambique. With more than 12 years working experience she were involved in over 100 wetland assessments, as well as numerous ecological assessments.

2 Acceptability of the terms of reference

In general, the terms of reference is acceptable. It includes both a desktop assessment and field delineation of the water resources and an impact assessment is included. No mention is however made of an assessment of the ecological state of the water resources. The PES and EIS of the watercourses was not determined, but it is suggested that it be mentioned that PES and EIS assessments are mostly not applicable to these systems. Determining the PES and EIS of the systems to which it is applicable is however suggested, since it can affect decision making.

3 Methodology

No mention is made of consulting the 1:50 000 topographical maps of the site for potential wetlands and watercourses. This is also a fairly accurate database, although most of the watercourses are also include in NFEPA. The Department of Water and Sanitation (DWS) Resource Quality Information System (RQIS) is a system separate from NFEPA and generally gives an overall view of the status of river systems and their catchment areas and can be consulted as well (https://www.dwa.gov.za/iwqs/default.aspx).

One of the largest limitations of several of the wetland databases, including the NFEPA database, is that only wetland with a permanent wetness zone is included in the dataset. This limitation must be indicated in the methods.

Field delineation: The DWAF wetland and riparian delineation guidelines used is the appropriate method of delineation for wetland and riparian areas and this method is therefore strongly supported. The described delineation method for drainage pathways are also highly appropriate and a variation of the DWAF wetland riparian delineation guidelines.

Wetland delineation: It is stated in the third paragraph of pg 15 that three wetness zones are normally present in a wetland, the permanent, seasonal and temporary wetness zones. This is untrue. Wetland do not normally have all three wetness zones present, most wetland only have the temporary or temporary and seasonal wetness zones present. Please change the sentence to reflect this.

Buffer zones: This is appropriate.

Impact assessment: This is a variation of the most common impact assessment methodology and is considered to be very appropriate to the project.

4 Validity of the findings

Drainage lines: The description of the drainage lines is clear and typical of ephemeral drainage lines in this area. There are no methods available to assess the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of these systems. Excluding these assessments are therefore appropriate. A general description of the status of these systems are included in the text, but it is suggested that a single sentence be included at the end of the description indicating that these systems are mostly in a natural to largely natural condition.

Depression wetlands: Once again the description is clear. It is however recommended a sentence be included to state that no PES was determined but what the apparent status of the systems are. Eg, the wetland are mostly largely natural.

Artificial systems: Are you absolutely certain the excavation pits are artificial? Figure 15 bare some resemblance to natural systems as well, but this may be an illusion due to the lack of perspective in the photograph. If any uncertainty exist, please indicate this. If no uncertainty exist, please ignore this comment.

Buffers: the suggested buffer zones are reasonable and the reasoning is sound.

5 Suitability of the mitigation measures and recommendations

The mitigation measures and recommendations are suitable and applicable to the project. The following comments should be taken into consideration:

Section 9.2.1: Watercourses and their buffer zones should be designated as a high sensitivity area, not only the watercourses. Include recommendations on what watercourse crossing should look like should authorisation be granted for tracks crossing the RoW. Eg. Do not clear the vegetation across the entire RoW. Preferably, the only cleared portion will be the vehicle tracks. No structures will need to be in place to cross the watercourses, since the systems are ephemeral, no bog mats or gravel running tracks would therefore be required. None of the watercourses may be crossed during or directly after a rainfall event. No tracks may cross the depression wetlands.

Section 9.2.2: Animals may only be removed by the ECO, where such animals pose a threat to the construction workers, such as snakes in the ROW. These animals may not be killed, but must be relocated outside the ROW, within close proximity to where they were found. (Including a mitigation measure that states that no animals may be captured, harmed etc. makes is impossible to remove animals that are posing a threat to the workers, but by stating that they must be removed by the ECO, the removal is controlled.)

I am not sure that placing sanitary facilities along the RoW in a bunded area will be feasible. This may result in more problems than they solve. The temporary ablution facilities must however be cleaned regularly to prevent spills.

No additional minor shortcomings were identified in the mitigation measures and recommendations.

6 Appropriateness of reference literature

Only four references are included. All are appropriate to the project. Please also include Hoare, 2016.

7 Additional comments

No site visit took place as part of the review process. The report is generally easy to read and understand, but the sentences are too long. Try to break up the sentences to make them more understandable and concise, especially in Sections 7 to 9. Section 7 is difficult to read and does not flow very well. Try to rephrase if possible. The mitigation recommendation sentences in the impact tables in section 9 are also very long and cumbersome. Try to shorten them if possible. The section is however understandable although slightly harder to read than the majority of the report.

Section 7: Please mention that the size and location of the wind turbines will only be finalised after approval and can therefore not be used as project alternatives. The entire footprint of the turbines must however remain outside the watercourses and their buffer zones.

The alternative locations of the substations are mentioned in both reports and may result in some confusion, especially since the substation forms part of a different BA application, but is listed in this report as project alternatives. Can the subject of a different application be used as a project alternative?

CURRICULUM VITAE

Name:	**Catharina Elizabeth Venter** trading as Kyllinga Consulting
Position:	Senior Ecologist and Wetland Scientist
Date of Birth:	29 December 1979
Nationality:	South African
Languages:	Afrikaans, English

EDUCATIONAL QUALIFICATIONS

- M.Sc (Botany), University of Pretoria (2003)
- B.Sc Hons (Botany), University of Pretoria (2001)
- B.Sc (Environmental Sciences), University of Pretoria (2000). Majored in Geography and Botany
- Matriculated, Sasolburg High School (1997)

<u>Additional</u>

- Introduction to ArcGIS 1 (2006)
- Bringing your data into ArcGIS (2006)
- Introduction to ArcView 3.x (2003).

FIELDS OF EXPERTISE

- **Ecological Assessment:**
  Ecological Assessments as part of the Environmental Impact Assessment Process
- **Wetland Assessment:**
  Wetland Assessments as part of the Environmental Impact Assessment Process and Water Use Applications, as well as rehabilitation plans for wetlands, including planning or the Working for Wetlands programme. Large scale wetland assessments (catchment scale).
- **GIS:**
  Compilation of maps for submission as part of Environmental Impact Assessment Process. Creating spatial databases and large scale wetland maps (catchment scale). Projection conversions and matching/overlaying different format GIS maps.
- **Environmental Impact Assessment**
  Undertaken numerous Environmental Scoping Reports, as required by the Environment Conservation Act, 1989 (Act 73 of 1989), the National Environmental Management Act, 1998 (Act 107 of 1998), as amended and the Development Facilitation Act, 1995 (Act 67 of 1995). Project experience includes the establishment of various housing typologies, golf courses, commercial and industrial projects, infrastructure development (roads), resorts and/or game lodges as well as filling stations.
- **Public Participation:**
  Undertaken numerous public participation processes, ranging from basic to extensive, as required by relevant environmental legislation.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- Professional Natural Scientist (Pr.Sci.Nat) in the field of Botanical Science (Reg no. 400048/08)
- Member of the Botanical Society of South Africa

EMPLOYMENT HISTORY EXPERIENCE

Kyllinga Consulting (July 2015 - present)

Senior Ecologist responsible for wetland and ecological specialist assessments.

Spatial Ecological Consulting (February 2010 – June 2015)

Senior Ecologist responsible for wetland and ecological specialist assessments.

- Wetland Related Assessments

More than 40 wetland assessments conducted between 2010 and 2015.

- Vegetation Assessments

Approximately 16 vegetation assessments between 2010 and 2015.

- Management Plans

Completed two ecological management plans.

MSA Group Services (previously Exigent Environmental CC) (August 2004 – January 2010)

Environmental Scientist responsible for ecological and wetland assessments and the compilation of maps. Also conducted various scoping and EIA applications and EMPRs.

- Ecological Assessments

In excess of 50 ecological assessments conducted between 2004 and 2010, including managing the inclusion of the fauna specialist assessments.

- Wetland Assessments

More than 60 wetland verification projects, wetland delineations and wetland assessments, completed between 2004 and 2010.

- As well as:

Rehabilitation Projects; Fatal Flaw / Screening Assessments; National Department of Agriculture Authorisations; Mining Related Assessments; Private, Public Partnership Projects; Resource Management Plans (RMP); Environmental Management Plans; Environmental Management Programme; Environmental Exemption Processes; Basic Assessments; Environmental Impact Assessments

Part-time employment (2002-2004)

Tutor for botany practicals; Assisting Wildlife management students with Braun-Blanquette analysis; Researcher for a project on the vegetation communities and ecology of the Kruger National Park; Research assistant for the analysis of street trees in Tshwane urban forest; Various part time projects related to vegetation and wetlands

COUNTRIES OF WORK EXPERIENCE

- South Africa
- Lesotho
- Botswana
- Mozambique

PAPERS AND PUBLICATIONS

Co-author and data contributor to: SIEBEN, E. *et al*. The vegetation of inland wetlands with salt-tolerant vegetation in South Africa: description, classification and explanatory environmental factors, submitted to the South African Journal of Botany for review in Feb 2015.

Co-author and data contributor to: SIEBEN, E. *et al*. The herbaceous vegetation of subtropical freshwater wetlands in South Africa: description, classification and explanatory environmental factors, submitted to the South African Journal of Botany for review in Feb 2015.

Co-author and data contributor to: SIEBEN, E. *et al*. The vegetation of grass lawn wetlands of floodplains and pans in semi-arid regions of South Africa: description, classification and explanatory environmental factors, submitted to the South African Journal of Botany for review in Jan 2015.

Co-author of several vegetation descriptions in: MUCINA, L. & RUTHERFORD, M.C. (eds) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

VENTER, C.E. & BREDENKAMP, G.J. In prep. Major plant communities on the Mfabeni swamp, St Lucia. *Bothalia.*

VENTER, C.E.; BREDENKAMP, G.J. & GRUNDLING, P-L. 2003. Plant community types, and their association with habitat factors as ecosystem driving forces, of Mfabeni swamp. Proceedings of the congress: *Environment of the St Lucia Wetland: Processes of Change*, Cape Vidal, September 4th- 7th, 2003.

VENTER, C.E.; BREDENKAMP, G.J.; GRUNDLING P-L. 2002. Vegetation change on rehabilitated peatland on Rietvlei Nature Reserve. *Kudu* 46(1):53-63.

PRESENTATIONS

Venter, C.E.; Bredenkamp, G.J. & Grundling, P-L. 2003. Plant community types, and their association with habitat factors as ecosystem driving forces, of Mfabeni Swamp. *Environment of the St Lucia Wetland: Processes of Change*, Cape Vidal, September 4th- 7th, 2003.

<u>Poster Presentations</u>

Venter, C.E.; Bredenkamp, G.J.; Grundling P-L. 2002. Baseline vegetation surveys of rehabilitated peatland on Rietvlei Nature Reserve. SAAB Converence. Grahamstown.

Venter, C.E.; Bredenkamp, G.J.; Grundling P-L. 2003. Vegetation change on rehabilitated peatland on Rietvlei Nature Reserve. SAAB Converence. Pretoria.

BIOTHERM ENERGY (PTY) LTD

Proposed Construction of the Aletta 140MW Wind Farm Facility near Copperton, Northern Cape Province

Surface Water Impact Assessment Report

Issue Date: 18 January 2017
Revision No.: Final
Project No.: 13169

Date:	18 January 2017
Document Title:	Proposed Construction of the Aletta 140MW Wind Farm Facility near Copperton, Northern Cape Province – Surface Water Impact Assessment Report
Author:	Shaun Taylor
Revision Number:	Final
Externally Reviewed by:	Ina Venter (Kylinga Consulting) *Pr. Sci. Nat.* (Reg No. 400048/08)
Approved:	Andrea Gibb
Signature:	
For:	SiVEST Environmental Division

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 Aletta 140MW Wind Farm Facility near Copperton, Northern Cape Province – Surface Water Impact Assessment Report

Specialist:	SiVEST South Africa (Pty) Ltd		
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Project Consultant:	SiVEST South Africa (Pty) Ltd		
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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.

Signature of the specialist

SiVEST Environmental

Name of company (if applicable)

18 January 2017

Date

BIOTHERM ENERGY (PTY) LTD

PROPOSED CONSTRUCTION OF THE ALETTA 140MW WIND FARM FACILITY NEAR COPPERTON, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

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PROPOSED CONSTRUCTION OF THE ALETTA 140MW WIND FARM FACILITY NEAR COPPERTON, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as “BioTherm”) are proposing the construction of the 140MW Aletta Wind Farm facility and associated infrastructure near Copperton, Northern Cape Province (hereafter referred to as the “proposed development”). In addition, a 132kV power line and a Substation (part of a separate on-going BA process) will also be required in order to connect the proposed 140MW Aletta Wind Farm facility to Eskom’s National Grid. However, the proposed development will form part of a separate Environmental Impact Assessment (EIA).

In terms of the EIA Regulations (08 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 been identified that an EIA process is to be followed which will require scoping and impact phase assessments for the proposed 140MW Aletta Wind Farm facility. As mentioned above, the associated 132kV on-site Aletta Substation and 132kV power line will be treated separately for the purpose of this EIA process and a separate BA process will therefore be undertaken.

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 surface water report will provide information obtained at a desktop level as well as detailed information obtained as a result of on-site fieldwork undertaken to verify and groundtruth initial desktop findings. The fieldwork information will also include any additional findings that were not identified in the desktop assessment where relevant. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), provide a surface water environmental baseline study, comparative assessment of the alternatives to be considered, the anticipated legislative implications and requirements, the potential environmental impacts that could be associated with the proposed development and other surrounding developments, and finally specialist recommendations.

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:
    - o That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - o That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - o 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 8 & 9**).

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

For wetlands specifically, 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 are 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 vegetation species occurrence within the surface water resources.

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.

Use of database information for the desktop assessment included the 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.

Application of the **DWAF (2005)** 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.

As a separate independent avifaunal impact 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.

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, BioTherm are proposing to establish a Wind Farm facility near Copperton 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

3.1 Project Location

The proposed development will be located approximately 17km east of Copperton, within the Pixley ka Seme District Municipality of the Northern Cape Province. More specifically, the proposed development is situated within the Siyathemba Local Municipality (Figure 1). The study area is located on the following properties:

- Portion 1 of Drielings Pan No. 101;

- Portion 2 of Dreilings Pan No. 101;
- Portion 3 of Dreilings Pan No. 101; and
- Remainder of Drielings Pan No. 101.

The project application site has been identified through pre-feasibility studies conducted by BioTherm based on grid connection suitability, competition, flat topography, land availability and site access.

The project application site and the specific proposed development area is shown in the locality map (**Figure 2**) below.

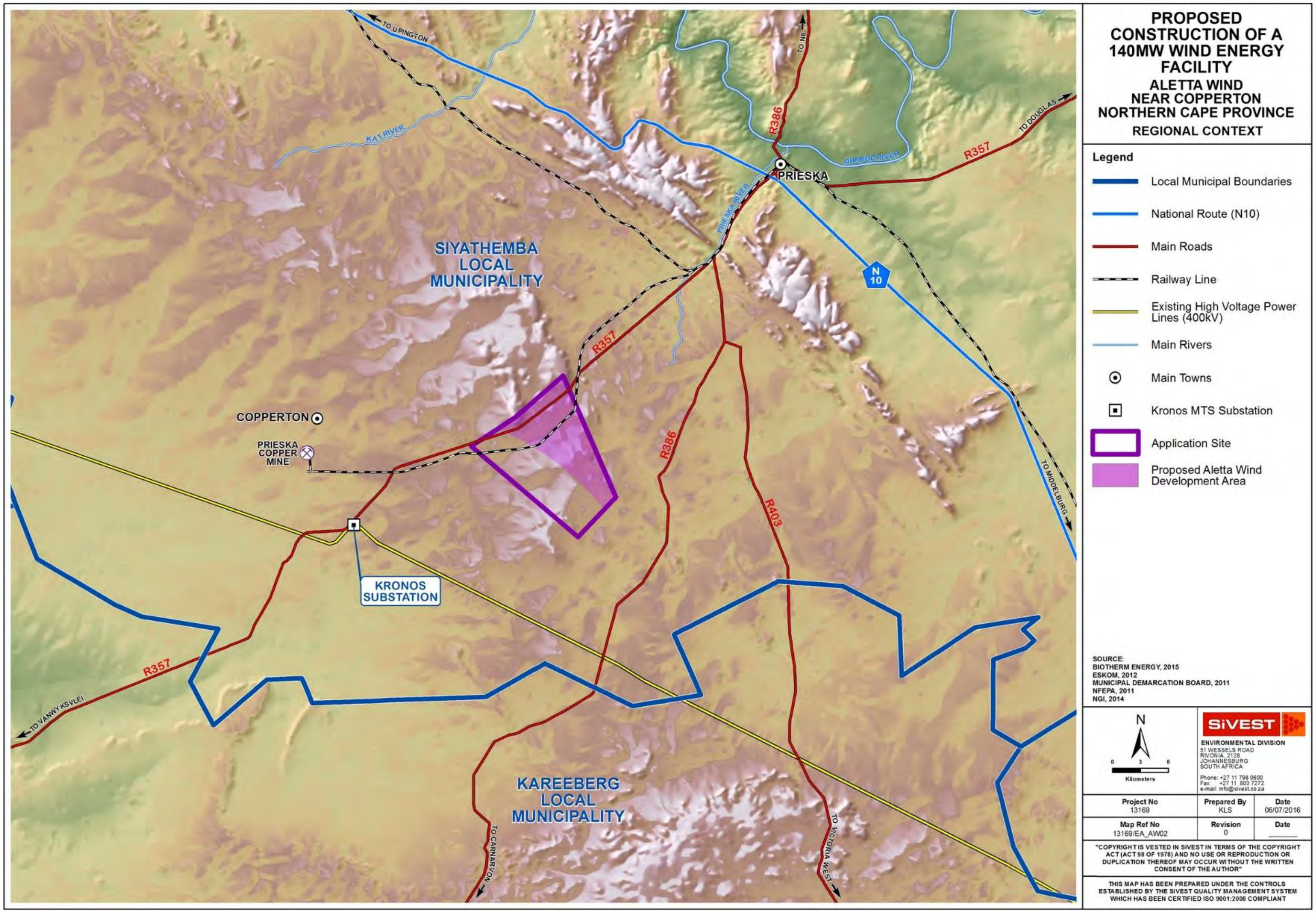

Figure 1: Regional Context Map

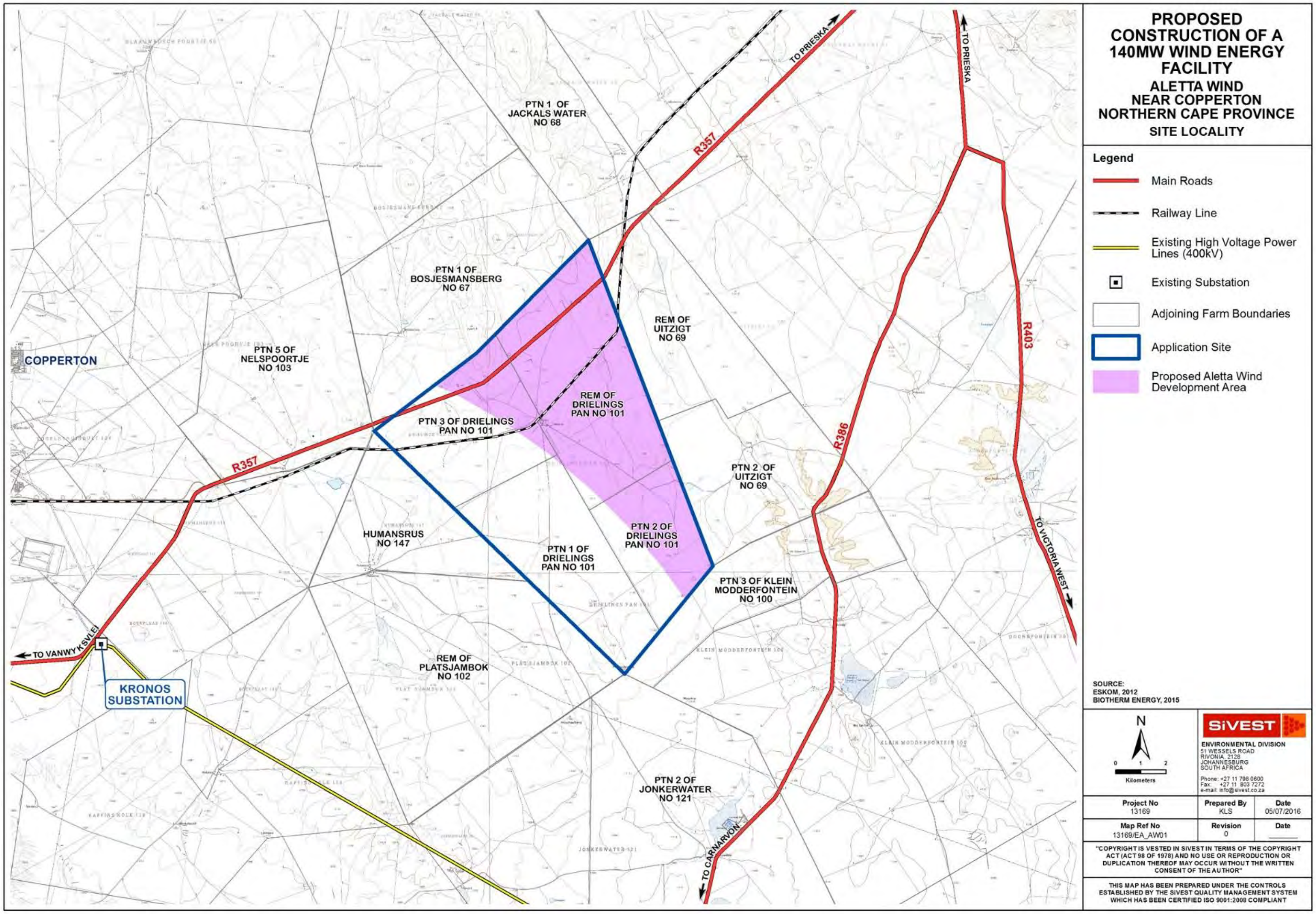

Figure 2: Locality map

3.2 Wind Farm Technical Details

The key technical details and infrastructure required is presented in the table below (**Table 1**).

Table 1: Aletta Wind Farm summary

Project Name	DEA Reference	Farm name and area	Technical details and infrastructure necessary for the proposed project
Aletta Wind Farm	14/12/16/3/3/2/945	▪ Portion 1 of Drielings Pan No.101 ▪ Portion 2 of Drielings Pan No.101 ▪ Portion 3 of Drielings Pan No.101 ▪ Remainder of Drielings Pan No.101 Development Area: 5 646 ha	▪ **60 wind turbines** with a total export capacity of up to 140MW. Turbines will have a hub height of up to 120m and a rotor diameter of up to 150m. ▪ **132kV onsite Aletta IPP Substation** ▪ The turbines will be connected via **medium voltage cables** to the proposed 132kV onsite Aletta IPP Substation**.** ▪ Internal **access roads** are proposed to be between 4m to 6m wide. ▪ A temporary construction **lay down area.** ▪ A **hard standing area / platform** per turbine. ▪ The **operations and maintenance buildings**, including an on-site spares storage building, a workshop and an operations building. ▪ **Fencing** (if required) will be up to 5m where required and will be either mesh or palisade.

The key components of the project are explained in more detail below.

3.2.1 Turbines

The total proposed development area is approximately 5 646 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 development area and the total generation capacity that can be produced as a result. The wind turbines will therefore likely have a hub height of up to 120m and a rotor diameter of up to 150m (**Figure 3**). The blade rotation direction will be clock-wise. Each wind turbine will have a foundation diameter of up to 20m, and will be approximately 3m deep, however, these dimensions may be larger if geotechnical conditions dictate as such. The area occupied by each wind turbine will be up to 0.5 hectares (85m x 60m). The excavation area will be approximately 1 000m² in sandy soils due to access requirements and safe slope stability requirements. A hard standing area / platform of approximately 2 400m^2 (60m x 40m) per turbine will be required for turbine crane usage. There will be approximately 60 wind turbines constructed with a total generation capacity of up to 140MW. The electrical generation capacity for each turbine will range from 2 to 4MW 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 Department of Energy's (DoEs) Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). This is as a result of technology constantly changing as time progresses.

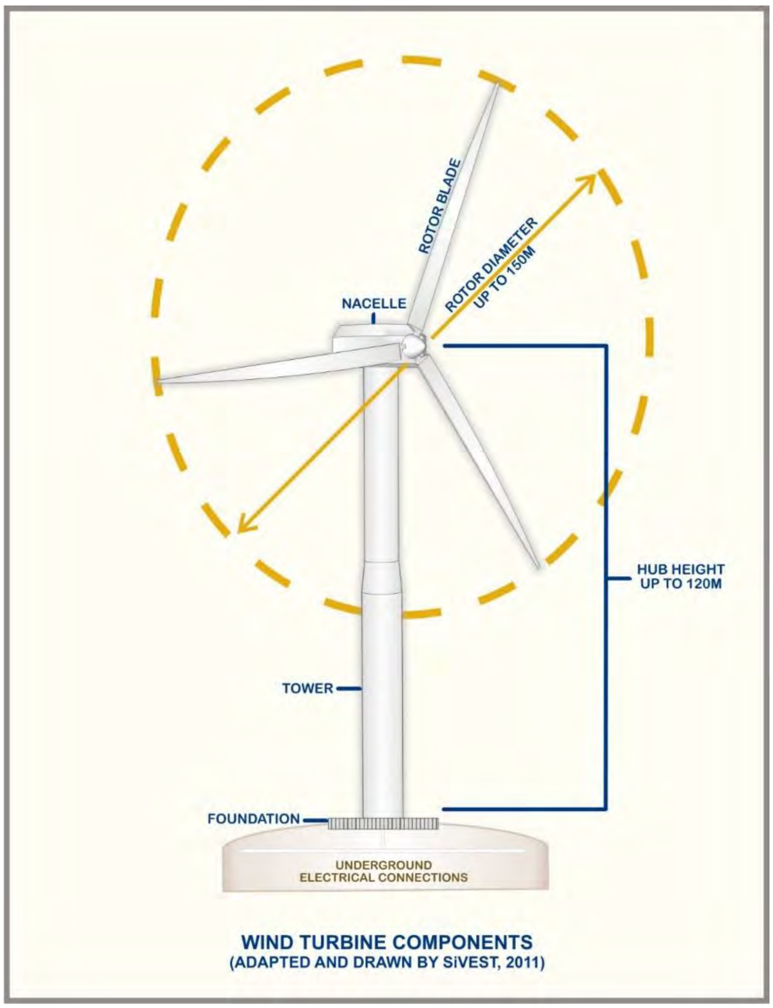

Figure 3: Typical Components of a Wind Turbine

3.2.2 *Electrical Connections*

The wind turbines will be connected (**Figure 4**) to the proposed onsite Aletta 132kV substation using buried (up to a 1.5m depth) medium voltage cables 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.

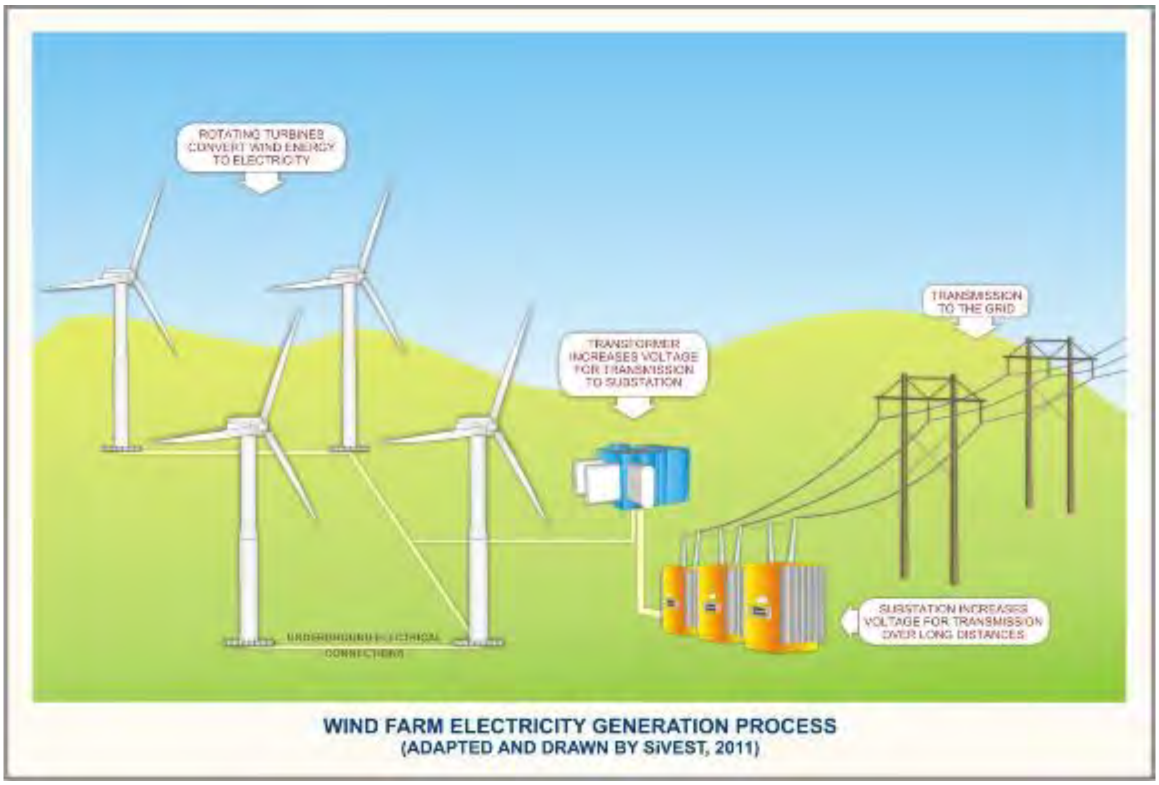

Figure 4: Conceptual Wind Farm Electricity Generation Process showing Electrical Connections

3.2.3 *Roads*

The internal access roads are proposed to be between 4m to 6m wide and up to 60km each. This will include the net load carrying surface (excluding any V drains) that might be required. Double width roads will be required in strategic places for vehicle passing.

3.2.4 Temporary Construction Area

The temporary construction lay down area will be approximately 2 400m² (60m x 40m). The lay-down / staging area will be approximately 11 250m² whilst the lay-down area for concrete towers (only if required) will be approximately 40 000m².

3.2.5 Operation 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 300m². The operation and maintenance buildings will be situated in proximity to the wind energy facility 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.

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:

- Two (2) alternative site locations for the proposed on-site 132kV Aletta substation;
- Two (2) alternative site locations for the proposed O&M buildings; and
- 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 Delineation 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**).

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^{3+} 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)** guidelines, “A practical field procedure for the identification and delineation of wetlands and riparian areas”. According to the **DWAF (2005)** 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 Pathways

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 Aletta Wind Farm facility is generally accessible from the R357 which leads from Prieska to Van Wyksvlei. Land cover in the area is mainly vacant land used for grazing purposes but also includes mining, a small airport, rural residential areas and various renewable energy developments. 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 application 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 Arid Grassland and Lower Gariep Broken Veld vegetation units (**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 Arid Grassland Vegetation Unit

The vegetation and landscape features of the Bushmanland Aird Grassland unit is characterised by extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi desert “steppe”. In places low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected.

A third of the area for this vegetation unit geology and soils is covered by recent (Quaternary) alluvium and calcrete. Superficial deposits of the Kalahari Group are also present in the east. The extensive Palaeozoic diamictites of the Dwyka Group also outcrop in the area as do gneisses and metasediments of Mokolian age. The soils of the most of the area are red-yellow apedal soils, freely drained, with high base status and <300mm deep, with about one fifth of the area deeper than 300mm, typical of Ag, and Ae land types.

Rainfall largely occurs in late summer and early autumn (major peak) and very variable from year to year. Mean Annual Precipitation (MAP) ranges from about 70mm in the west to 200mm in the east. Mean maximum and minimum monthly temperatures in for Kenhardt are 40.6°C and -3.7°C for January and July, respectively. Corresponding values for Pofadder are 38.3°C and -0.6°C. Frost incidence ranges from around 10 frost days per year in the northwest to about 35 days in the east. Whirl winds (dust devils) are common on hot summer days.

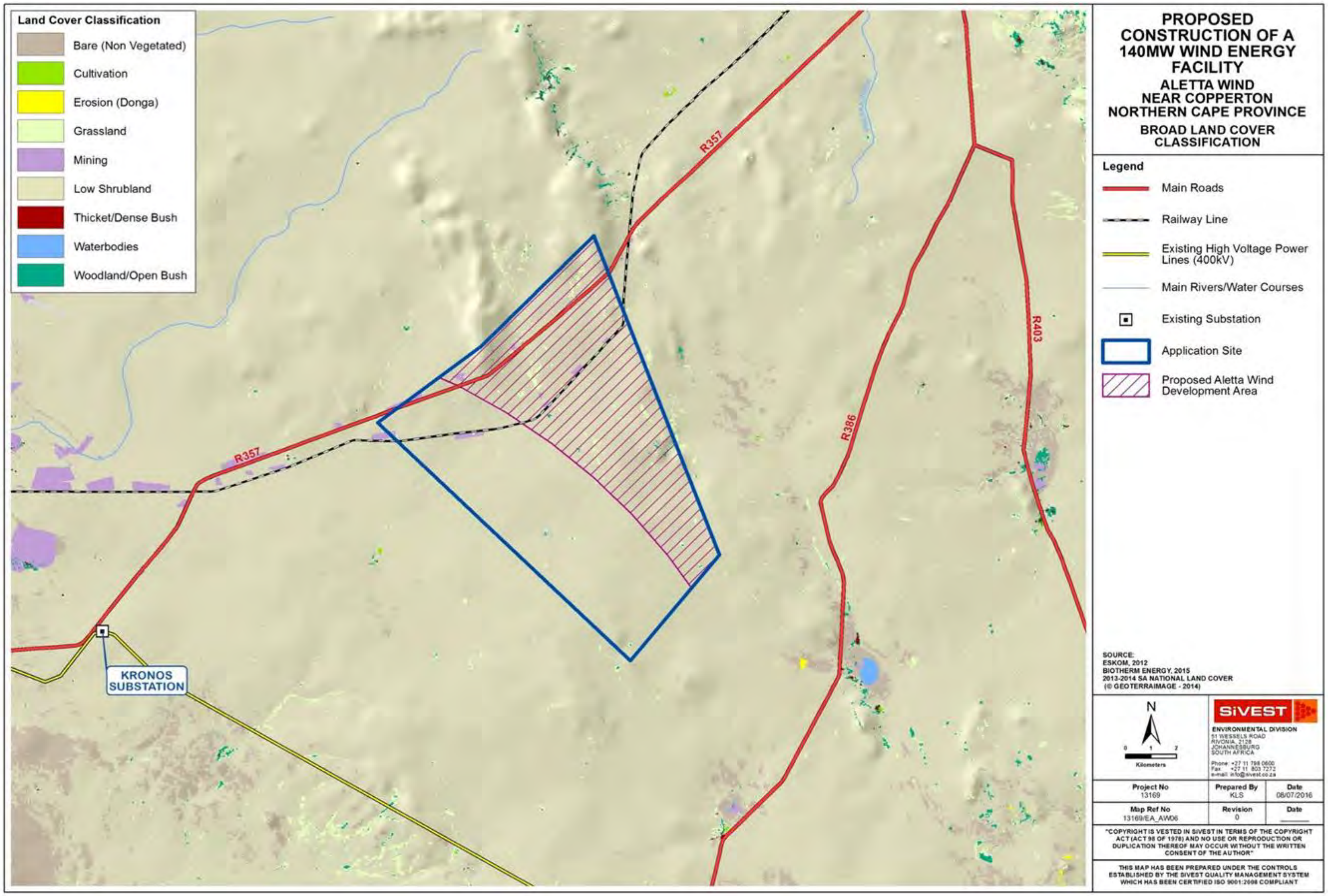

Figure 5: Land Cover Map

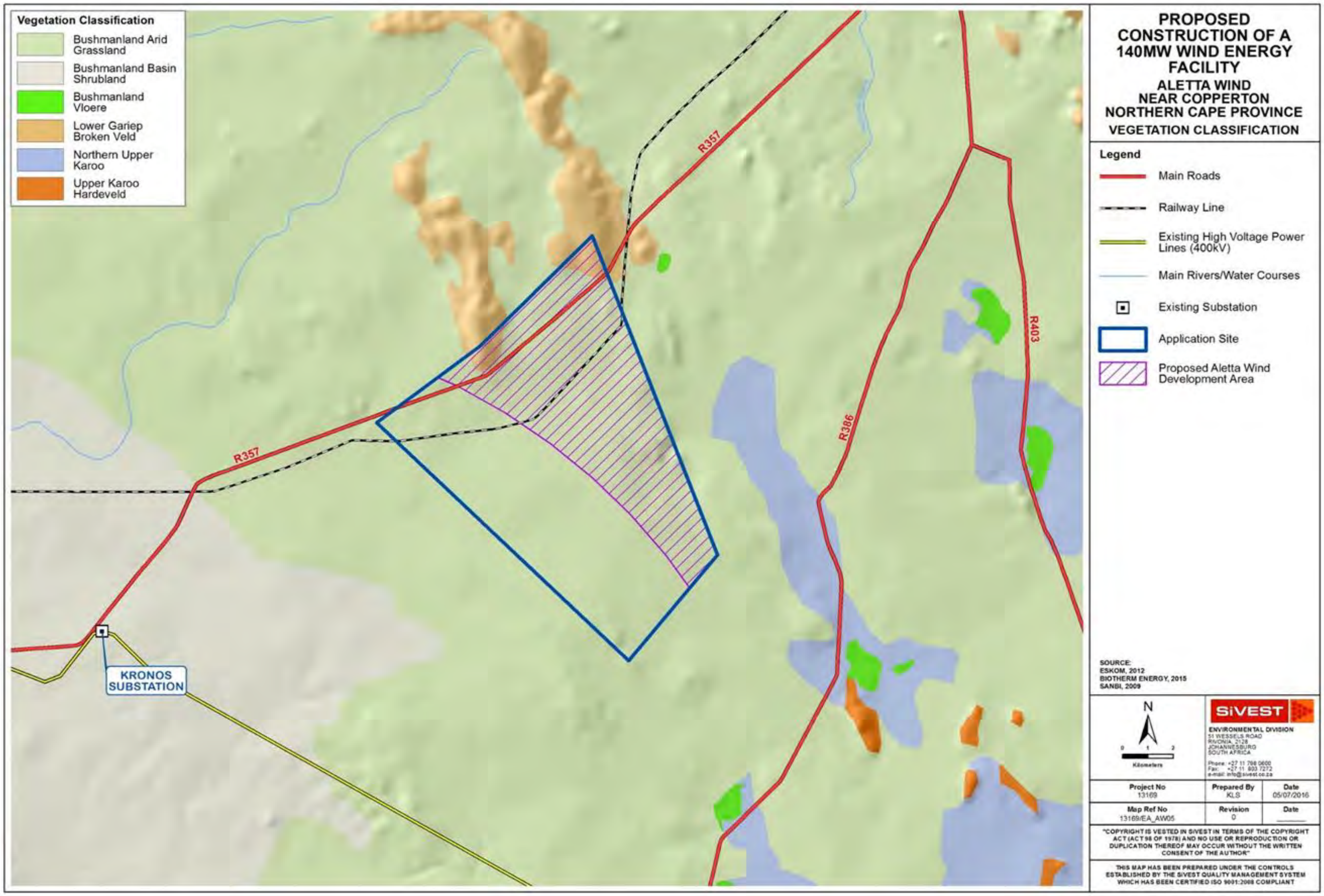

Figure 6: Vegetation Unit Map

The conservation status of the vegetation unit is described as least threatened (Target 21%). Only small patches are statutorily conserved in Augrabies Falls National Park and Goegab Nature Reserve. Very little of the area has been transformed. Erosion is very low (60%) and low (33%).

5.2 Lower Gariep Broken Veld

The vegetation and landscape features of the Lower Gariep Broken Veld are characterised hills and low mountains, slightly irregular plains but some rugged terrain with sparse vegetation dominated by shrubs and dwarf shrubs, with annuals conspicuous, especially in spring, and perennial grasses and herbs. Groups of widely scattered low trees such as *Aloe dichotoma* var. *dichotoma* and *Acacia melifera* subsp. *detinens* occur on slopes of koppies and on sandy soils of foot slopes respectively.

The geology and soils have a complicate geology: banded iron formation and amphibolites of the Asbestos Hills Subgroup are Vaalian and carbonates and cherts the Campbell Group are of the same Era. Metamorphic rocks of the Mokolian Erathem include quartzites and gneisses of the Korannaland Supergroup as well as the Riemvasmaak gneiss. Metamorphosed clastic sediments of the Uitdraai Formation are also Mokolian. The remaining half of the area is composed of many other srtatigraphies, metamorphosed sediments and outcrops of the ultrametamorphic rocks of the Namaqualand Metamorphic Complex. The soils are shallow and skeletal (dominant soil forms are Mispah and Glenrosa), typical mainly of Ib and Ic land types, and to a lesser extent also of Fb land type.

Mean Annual Precipitation (MAP) ranges from about 70mm in the west to 240mm in the east. Mean maximum and minimum monthly temperatures for Kakamas are 41.3°C and -2°C for January and July, respectively. Corresponding values for Prieska (near the eastern extremity) are 39.7^{o}C and -2^{o}C. Frost incidence varies from less than 10 days of frost per annum in the west to around 30 days in the east.

The conservation status of the vegetation unit is described as least threatened (Target 21%). Statutorily conserved in Augrabies Falls National Park (4%). Only a very small part is transformed. Erosion is low (58%), very low (27%) and moderate (14%).

6 FINDINGS OF ASSESSMENT

6.1 Surface Water Desktop Baseline Information

In terms of the National **ENPAT (2000)** database, the proposed application site can be found within the Lower Orange Water Management Area. Moreover, the proposed development is within the Orange Primary Catchment. At a finer level of detail, the Aletta Wind Farm site traverses two (2) quaternary catchments including D54D and D62H. The north east boundary of the proposed development site can be found along the boundary of quaternary catchment D72A.

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

6.2 In-field Investigations, Verification and Refinement of Desktop Delineations

The in-field wetland delineation assessment took place from the 27th to the 29th of July 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 results are displayed in **Figure 7**.

Within the proposed development area, two types of hydrogeomorphic units were identified. These include nine (9) watercourses (drainage lines) and twenty two (22) depressions (depression wetlands). For the depression wetlands, these were sub-divided into two sub-categories for the fifteen (15) natural depression wetlands and the seven (7) artificial (man-made) depression wetlands identified. 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 (Drainage Lines)

6.2.1.1 Topography Associated With a Watercourse

The proposed development area is predominantly flat to gently undulating for the majority of the central and western areas. However, near the eastern boundary of the proposed development area, an area of greater relief in the form of low hills and ridges can be found. As a result of the generally flat nature of the topography, overland sheet run-off is common and only in the northern areas does drainage flow either along broad valley bottoms (northern areas) and / or within more constrained but shallow channels (north western areas). 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, but flow briefly after rainfall events (**Figure 8**). Hence, all drainage lines were identified as ephemeral watercourses. The direction of flow for all watercourses appeared to be in a southern direction.

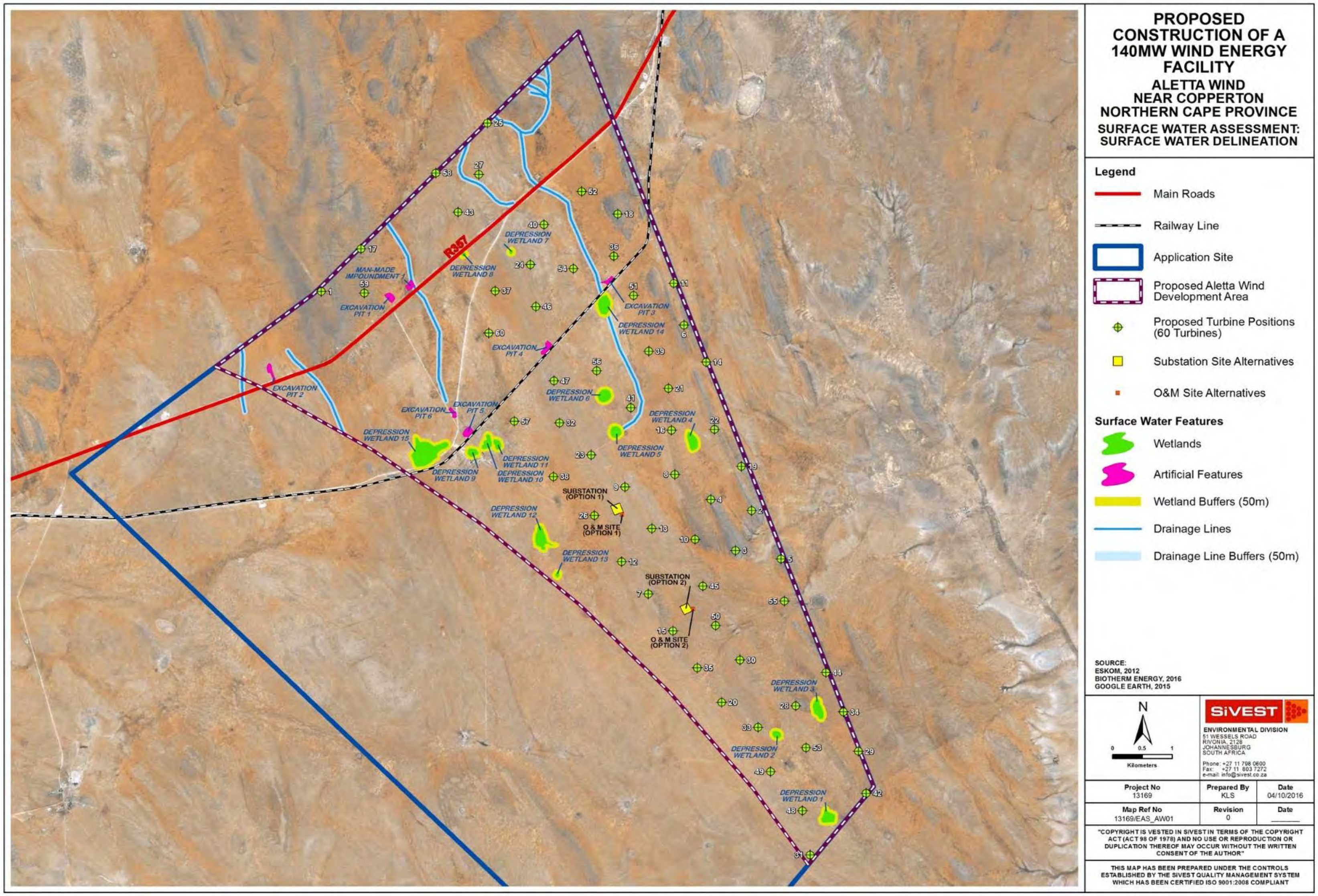

Figure 7: Aletta Wind Farm Facility Surface Water Delineation Map

Figure 8: Drainage Line

The depth of soils on the proposed development area are relatively shallow (approx. 0.1-0.5m), which means that flow is predominantly via surface run-off with limited sub-surface flow only where the depth and composition of the soil profile permits infiltration. Rocky outcrops are not uncommon across the proposed development area, especially along the northern and eastern boundary. Soil erosion is limited due to limited soil depth, but it is evident in few areas which compromises the geomorphological integrity of the drainage lines to a limited degree. Surface run-off in some drainage lines can transition to open wash areas where very little vegetation is present making these areas somewhat more susceptible to erosion Otherwise, geomorphological modification within the drainage lines have taken place in the form of berms which have been created to take advantage of flows when present for storage (presumably for cattle and sheep drinking water) purposes. Additionally, historical farming practices (tilling) have taken place within the drainage lines which have disrupted the soil profile (**Figure 9**).

Figure 9: Example of historical farming (tillage) practices.

6.2.1.2 Alluvial Soils and Deposited Materials

Run-off from the surrounding landscape transports soil particles which get deposited in the drainage lines when flow subsides following rainfall events. The grain size of deposited materials range from fine clays, sand and gravel further along the more developed drainage lines. Stones and cobbles are more common in the drainage lines lying in the rocky flat areas of the application site.

Figure 10: Open Exposed Bare Areas (Wash Plains) found within the Broader Drainage Lines

6.2.1.3 Vegetation

The vegetation within the drainage lines can be described as comprising loose thickets of *Parkinsonia africana*, *Lebeckia linearifolia* and *Acacia karroo* (Hoare, 2016). Ultimately, the vegetation therefore consists of thicket and some bushland. In terms of the thickets associated with the watercourses, these can be defined as riparian habitats.

Figure 11: Example of Loose Linear Thickets forming the Riparian Habitat within a Drainage Line in the Distance

6.2.1.4 Comment on Ecological Condition of the Drainage Lines

Overall, the drainage lines appeared to be in a moderately modified condition. Existing impacts affecting the drainage lines include grazing impacts, anthropogenic impacts (construction of berms and historical tilling / agricultural activities) and minimal erosion impacts due to limited soil depth.

6.2.2 Depression Wetlands (Natural)

6.2.2.1 Terrain and Wetland Soil Characteristics

The depression wetlands identified within the proposed development area have formed in shallow hollowed out depressions which drain small localized catchments. The majority of the depression wetlands are endorheic (in-ward draining), with the exception of Depression Wetlands 5 and 14 which are situated within a drainage line. These two wetlands are therefore hydrologically connected to the ephemeral watercourse.

The distribution of the depression wetlands were found to be mainly situated in the northern half of the proposed development area. However, a few wetlands could be found in the southern half of the proposed development area. The scattered distribution across of depression wetlands across the proposed development area means that surface water occurrence is good when water is available following rainfall events. However, 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 ephemeral in nature. High temperatures and high evaporation rates in the region contribute to limited hydroperiod for the wetlands. However, substrates that contain higher amounts of clays are conducive to a slightly longer hydroperiod. These are typically the larger wetland systems with slightly deeper soil profiles, whilst the smaller shallower wetland systems tend to dry up quicker.

Soils samples were drawn from the wetlands to ascertain the characteristics of the substrate. The substrate of the wetlands was found to consist of a mixture of loamy light brown sandy and clay soil particles. Overall, the degree of loam and clay materials varied between the wetlands, with a slightly higher composition of loam sediments in the smaller wetlands, whilst a greater build-up of clays in the larger wetland systems were observed. Red iron oxide accumulations (mottles) were observed within the extracted soil matrix intermixed amongst grey depletions revealing redoximorphic characteristics within the wetland soil profile (**Figure 12**). Redoximorphic characteristics are indicative wetland soil signatures. The Westliegh Soil Form could be attributed to the wetlands on account of the soil characteristics explained above. The redoximorphic characteristics signify distinct wetting and drying phases and are indicative of ephemeral saturation cycles.

Figure 12: Soil Sample drawn from a Small Depression Wetland

Overall, most the depression wetlands were found to be geomorphologically intact, with the exception of Depression Wetlands 9, 10, 11, 14 and 15 which had been affected by previously farming practices. Past disturbance of the soil as a result of tilling activities were evident. These wetlands appeared to still be recovering from these impacts.

6.2.2.2 Wetland Vegetation

The general vegetation type covering most of the proposed development area can be described as shrubland and low fynbos (Hoare, 2016). Within the wetlands specifically, the depression wetlands were generally well vegetated and were predominantly scrub dominated by *Rhigozum trichotomum* and various species of *Salsola* and *Lycium*, with a mixture of karroid dwarf shrubs (Hoare, 2016) (**Figure 13**). These scrubs are generally salt resistant and tend to dominate these wetlands as a result. Due to high evaporation rates, salts tend to remain in the soil profile of the wetlands which is a common occurrence under the prevailing climatic conditions. Interestingly however, hydrophytic vegetation (*Juncus* sp.) was observed in Depression Wetland 15. This wetland was found to also be affected by excavation activities near the southern edge of the wetland. Presumably, as a result of the deepened excavation, periodic pooling after rainfall events above the shallow bedrock produces suitable conditions for the establishment of *Juncus* sp.

Figure 13: Example of a Small Scrubs in a Wetland (Depression Wetland 2)

6.2.2.3 Comment on Ecological Condition of the Natural Depression Wetlands

The natural depression wetlands were in a good condition with the exception of Depression Wetlands 9, 10, 11, 14 and 15 which had been affected by previously farming practices. Past disturbance of the soil as a result of tilling activities were evident, as previously mentioned. The main existing impact affecting all of the natural depression wetlands were grazing impacts. Otherwise, the majority of the natural depression wetland systems were found to be intact and well vegetated. Overall the ecological condition appeared to range from largely natural (for the depression wetlands unaffected by previous farming practices and excavation activities) to moderate (for the depression wetlands affected by previous farming practices and excavation activities).

6.2.3 Depression Wetlands (Artificial)

6.2.3.1 Terrain and Wetland Soil Characteristics

The artificial depression wetlands identified on the proposed development area comprised mostly old excavation pits, presumably created due to the need for construction materials for the existing road and railway infrastructure. However, one man-made impoundment created within a drainage line near the north western boundary of the proposed development area was identified. The man-made impoundment was presumably created to capture any flow within the drainage line when in present.

As a consequence of the excavation activities, the excavation pits were of greater depth (as opposed to the relatively shallow nature of the natural depression wetlands) often reaching bedrock (**Figure 14**). The excavation pits are expected to hold water at the surface until completely evaporated or taken up by vegetation colonizing the pits. These artificial wetlands are therefore expected to be ephemerally saturated. Where soil samples could be drawn, the soils generally did not show any specific soil signatures and were generally well drained. The only wetland to display soil signatures akin to the natural depression wetlands was the man-made impoundment. Again, the Westliegh Soil Form could be attributed to the wetlands on account of the sediment (loamy/clay) composition and mottling characteristics.

Figure 14: Exposed Bedrock within an Excavation Pit

From excavation activities, the edges of the artificial wetlands are generally steepened and susceptible to erosion during rain fall events. As a result, the edges are characteristically eroded. Erosion varies amongst the excavation pits from moderate to more severe in some cases (**Figure 15**). The man-made impoundment on the other hand was found to be geomorphologically intact.

Figure 15: Eroded Edges of an Excavation Pit

6.2.3.2 Vegetation

Vegetation varied between the artificial wetlands from those which had little to no vegetation present (**Figure 16**) to those which had a more sparse distribution of the scrub species as per the vegetation description for the natural depression wetlands in **Section 6.2.2.2** above.

Figure 16: Vegetation observed within an Excavation Pit

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 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 the main concern. Compaction impacts and degradation of vegetation associated with the surface water resources is the main concern 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.

Given the above, a buffer zone of 50m for watercourses and the natural depression wetlands have been applied in consideration of the factors above. No buffer zone was applied to the artificial depression wetlands as these were not identified to be of any major ecological significance. The artificial depression wetlands would however need to be avoided and should be viewed as exclusion zones.

7 ALTERNATIVES COMPARATIVE ASSESSMENT

As previously mentioned, two (2) onsite substation and two (2) operation and maintenance (O&M) building alternative site locations have been investigated for the proposed wind energy facility development. These alternatives have been comparatively assessed in order to determine the preferred alternative from a surface water perspective. Note that the wind turbines will only be finalized should environmental authorization be granted, and therefore no alternatives were provided for this component of the proposed development. The entire footprint of the wind turbines however must remain outside all surface water resources and the associated buffer zone.

The following factors were taken into account when comparatively evaluating the proposed alternatives:

- Size and number of potentially impacted surface water resource(s) in the proposed alternative;
- Proximity to the nearest surface water resource(s);
- The location of any surface water resources present and the ability of the proposed development to be constructed out of, around or away from any nearby surface water resources;
- Number of sub-catchments affected; and
- Existing impact factors (such as existing infrastructure, roads and impacted land).

In terms of the first criteria, the size and number of surface water resources within an alternative area was relevant. The more surface water resources that are present and the greater the area each occupies, it is likely that the impact of the proposed development will be greater.

The second criteria to consider is proximity of the proposed development positioning to any nearby surface water resources. The type of surface water resource and the distance of the proposed development to it will have a bearing on whether there may be direct or indirect impacts that could affect it.

The third criteria focuses on whether the proposed development may be able to be constructed with surface water resources present. It may be possible for the proposed development to be constructed if there are few surface water resources present and the facility component or infrastructure is repositioned to avoid the surface water feature. In this instance, manoeuvrability of the site layout may only also be possible should any surface water resources be located on the boundary of the proposed development area under consideration.

The fourth criteria includes sub-catchment areas that will be affected by the proposed development. The sub-catchments include the wetland specific catchment areas for the endorheic systems as well as the general catchment areas containing several wetland features. Where more sub-catchment areas are affected (both directly / indirectly), more potential contamination pathways can be present thereby influencing the extent and severity of impact.

The final criteria of significance, when selecting the most suitable alternative, is existing infrastructure (power lines, roads, railway etc.) and impacted land (agricultural fields, urban areas etc.). Disturbance to an existing impacted area will be less than if undisturbed, or where less impacted land is affected.

The preference ratings for the onsite substation and O&M building site alternatives are provided in **Table 2** below. The alternatives are rated as being either preferred (the alternative will result in a low surface water impact / reduce the surface water impact), not-preferred (the alternative will result in relatively high surface water impact / increase the surface water impact), favourable (the surface water impact will be relatively insignificant) or no preference (the alternative will result in equal impacts). This is shown in the key below.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 2: Surface Water Comparative Assessment Table

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION AND O & M BUILDING ALTERNATIVES		
Option 1	Preferred	There are no surface water resources either directly within, or within a radius of 1km of this alternative. No direct potential impacts are therefore anticipated. As a result, this option is preferred.
Option 2	Preferred	There are no surface water resources either directly within, or within a radius of 1km of this alternative. No direct potential impacts are therefore anticipated. As a result, this option is preferred.

8 LEGISLATIVE IMPLICATIONS

8.1 National Environmental Management Act, 1998 (Act No. 108 of 1998) and Environmental Impact Assessment Regulations (2014)

In the context of NEMA (1998) and the EIA Regulations (2014), considering the layout of the proposed development, no listed activities will be triggered based on the wind turbine, substation and operation and maintenance building facility layout since none of these structures are directly within or within close proximity (within 32m) to the identified surface water resources. However, it is presumed that internal access roads will be required which will need to route to the respective wind turbines locations and various buildings and infrastructure to be constructed. Since the drainage lines can extend for some kilometres and the distribution of the wetlands are amongst the wind turbine locations, there is a good chance the internal access roads and other associated infrastructure not shown on the current layout will need to cross or be within close proximity to the delineated surface water resources. Therefore, provisionally, Activities 12 and 19 of Government Notice 983 Listing Notice 1 are identified to potentially be triggered thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below.

8.1.1 Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 983, Activity 12:

The development of-

(xii) *infrastructure or structures with a physical footprint of 100 m^2 or more;*

where such development occurs-

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

8.1.2 Environmental Impact Assessment Regulations 2014, Listing Notice 1, GN. 983, Activity 19:

The infilling or depositing of any material of more than 5 m^3 into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 m^3 from-

(i) a watercourse;

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 where construction activities will impact on a water resource. 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, since there is no anticipated direct impact or any potential indirect impact based on the current wind turbine, substation and operation and building layout, it is anticipated that no water uses will be triggered. However, as stated in Section 8.1 above, it is anticipated the internal roads and other associated infrastructure not displayed on the current layout may need to cross or be within 500m of the identified wetlands and / or watercourses thereby triggering water uses (c) and (i). The application of these water uses can however only be confirmed once the internal road layout is available.

9 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED ALETTA WIND FARM

From a surface water resource perspective, potential impacts are limited for the current wind turbine, substation and operation and maintenance building layouts. However, potential direct and indirect impacts are anticipated to take place as a result of the mainly internal access roads and other linear infrastructure being in close proximity and potentially directly within identified surface water resources. This section will identify and contextualise each of the potential impacts on the identified surface water resources within the context of the proposed development (including associated linear infrastructure) adopting a worst case scenario approach. This section will rate these potential impacts according to an impact rating system (see **Appendix A** 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 pre-construction, construction, operation and de-commissioning phase of the proposed development.

9.1 Pre-Construction Phase Potential Impacts

9.1.1 Impacts associated with the Construction Lay-down Area

A construction lay-down area is likely to be required for the proposed development. The location of the construction lay-down area will be important as placing this area in a wetland or any other surface water resource is likely to result in direct negative physical impacts. Direct negative impacts can include vegetation clearing and degradation, and soil compaction impacts due to temporary structures and vehicle movement. Impacts related to worker ingress and the degradation of wetlands or any other surface water resource may similarly result. Potential contamination and pollution impacts from stored oils, fuels, and other hazardous substances or materials are also a possibility. Where site clearing may be required in the wetland or any other surface water resource in order for the lay-down area to be established, this will result in the clearance/removal of vegetation at the surface leaving the exposed soils of the wetland(s) or surface water resource vulnerable to erosion and sedimentation impacts. Indirect impacts can also be anticipated in the form of sedimentation and increased run-off which can induce erosion, should the location of the construction lay-down area be within close proximity (32m) to the wetlands and / or watercourses. A summary of the predicted impacts and cumulative effects is provided in **Table 3** below.

Table 3: Impacts associated with the Construction Lay-down Area directly in or in close proximity to Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Surface water resources
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area directly in or within close proximity to surface water resources
Extent	*Site*
Probability	*Possible*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Marginal loss of resources*
Duration	*Medium term*
Cumulative effect	*Low cumulative Impact*
Intensity/magnitude	*Medium*

Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the potential impact can be reduced greatly.*	
	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	**Location of the Lay-down Area** – The location of the lay-down area must not be within 50m of any of the identified surface water resources. Therefore, the location of the construction lay-down area must not be within any of the associated buffer zones by implication. Additionally, the storage of materials and machinery must also not be within 50m of any of the identified surface water resources. **Preventing Fire Risks** – Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons that the region experiences, it is recommended that a fire management and emergency plan compiled by a suitably qualified health and safety officer be compiled and implemented for the proposed development.	

9.2 Construction Phase Potential Impacts

9.2.1 Vehicle and Machinery Degradation Impacts

Construction vehicles (heavy and light) are likely to require access to the proposed development. Potential negative impacts can include the need to travel into or through surface water resources, thereby resulting in physical degradation. Moreover, leaks or spills of oils, fluids and/or fuels from vehicles and machinery in general or during re-fuelling or servicing in the surface water resources are a possibility. Should any leakage or spillage occur in and/or near the surface water resources, potential soil/water contamination can result. Fuels and oils also pose a fire risk not only to the surface water resources, but also neighbouring areas.

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

Table 4: Impact Rating for Construction Vehicle and Machinery Degradation Impacts to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	- 26 (low negative)	- 6 (low negative)
Mitigation measures	**Preventing Physical Degradation of Surface Water Resources** – Surface water resources are to be designated as "highly sensitive areas". Vehicle access is not to be allowed in the highly sensitive areas. Internal access roads are not to be routed in any surface water resources. Should this be required, environmental authorisation and a water use license will be required before construction takes place and	

	all mitigation measures are to be implemented accordingly. **Limiting Damage to Surface Water Resources** – Ideally, to minimise any impact to surface water resources, the proposed development (including buildings, wind turbines and all associated infrastructure) should seek to avoid all surface water resources as far as possible. Where this is not possible a single access route or "Right of Way" (RoW) is to be established through or in the desired construction area in the surface water resource(s). The environmentally authorized and license permitted construction area is to be demarcated and made visible. The establishment of the RoW likewise must be demarcated and made visible. The width of the RoW must be limited to the width of the vehicles required to enter the surface water resource (no more than a 3m width). An area around the locations of the proposed development buildings, wind turbines and any other associated infrastructure will be required in order for construction vehicles and machinery to operate/maneuver, only where required. This too must be limited to the smallest possible area and made visible by means of demarcation. Where crossings are required, only vehicle tracks should be made through the surface water resources. No crossings however are to be made through the natural depression wetlands. RoW areas through surface water resources should not be completely cleared of vegetation, only the tracks should be cleared. Vegetation should otherwise be trimmed appropriately such that vehicles can move through RoW areas adequately. No structures will need to be placed in the RoW crossing areas through surface water resources since these systems are ephemeral. No bog mats or gravel running tracks would therefore be required. No surface water resources are to be crossed during or directly after a rainfall event.

	Construction workers are only allowed in the designated construction areas of the proposed development and not into the surrounding surface water resources. Highly sensitive areas are to be clearly demarcated prior to the commencement of construction and no access beyond these areas is to be allowed unless in RoW areas. **Preventing Soil Contamination** – No vehicles are to be allowed in the highly sensitive areas unless authorised. Should vehicles be authorised, 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 are not to be allowed into surface water resources. 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 areas. Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby surface water resources.

9.2.2 Human Degradation of Flora and Fauna associated with Surface Water Resources

The possibility of human degradation to the surface water resources is likely to occur during the construction phase, since construction activities will take place in close proximity to surface water resources. Human degradation can take the form of physical / direct degradation such as lighting fires (purposefully or accidentally) in or near to surface water resources. Usage of the surface water resources for sanitation purposes may take place resulting in pollution of the surface water resources. The surface water resources may also be utilised as a source of water for domestic use, building and general cleaning purposes.

Fauna and avi-fauna associated with surface water resources are often hunted, trapped, killed or eaten. This impact must be prevented. Finally, flora associated with surface water resources may need to be cleared or removed for building storage purposes which can result in a loss of resources.

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

Table 5: Impact Rating for Human Degradation of Flora and Fauna associated with Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Human degradation to fauna and flora associated with surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*Low*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be further reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	- 10 (low negative)	- 6 (low negative)
Mitigation measures	**Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction and RoW areas. The highly sensitive areas are to be clearly demarcated no access into these areas are to be allowed unless authorised.	

	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 therefore 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, within relative close proximity where they were found No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from any surface water resource(s) where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. No water is to be extracted unless a water use license is granted for specific quantities for a specific water resource. No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive areas. Appropriate safety measures as stipulated above must be implemented. No cement mixing is to take place in a surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the 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 areas.

9.2.3 Degradation and Removal of Soils and Vegetation in Surface Water Resources

It may be required that wind turbines, associated buildings and infrastructure are to be located within the identified surface water resources. As a result, foundations and hard stand areas will need to be laid for the wind turbines. Additionally, foundations will need to be established for the various buildings, structures and infrastructure. Where the placement of the foundations and hard stand areas extend into the surface water resource areas, the excavation of potential soils are likely to affect the functionality of these hydrological systems. Functionality may be affected in terms of hydrogeomorphic functionality. Moreover, the implementation of the foundations will result in a relatively permanent structure, meaning that the area occupied by the foundation will ultimately result in a degree of permanent habitat and soil loss.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 6** below.

Table 6: Impact Rating for Degradation and Removal of Vegetation and Soils associated with Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with surface water resources	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be further reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	3	1
Irreplaceable loss	2	1

Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	- 42 (medium negative)	- 6 (low negative)
Mitigation measures	**Strategic Positioning of Wind Turbines, Buildings and other Linear Infrastructure** – Preferably all wind turbines, buildings and infrastructure should be placed at least 50m from any surface water resource as far as practically possible. This will significantly reduce the potential impact on surface water resources. Where this is not possible, more intense mitigation measures will be required as stipulated below. **Obtaining Relevant Authorisations and Licenses** – Before any construction or removal of soils and vegetation in any delineated surface water resources is undertaken, the relevant water use license and environmental authorisation is to be obtained and conditions adhered to. **Limiting Damage to Surface Water Resources** – Construction must be limited to the authorized RoW areas where applicable. **Limiting Removal of Excavated Soils** – Should the necessary authorisations (water use license, environmental authorisation etc.) be obtained for the proposed development to be placed in surface water resources, excavated topsoils should be stockpiled separately from subsoils so that it can be replaced in the correct order for rehabilitation purposes post-construction. Soils removed from surface water resources must only be removed if absolutely required. Furthermore, any removed soils and vegetation that are not required should be taken to a registered landfill site that has sufficient capacity to assimilate the spoil. The topsoil is to be used for rehabilitation purposes and should not be removed unless there is surplus that cannot be utilised. It is important that when the soils are re-instated, the subsoils are to be backfilled first followed by the	

	topsoil. The topsoil contains the natural seedbank from which the affected surface water resources or the associated buffer zone can naturally rehabilitate. Where the soils are excavated from the sensitive areas, it is preferable for them to be stockpiled adjacent to the excavation pit to limit vehicle and any other movement activities around the excavation areas. **Preventing Pollution Impacts** – Any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground of the surface water resource. Importantly, no mixing of cement directly on the surface is allowed in the construction and RoW areas in surface water resources. **Protection of Stockpiled Soils** – Stockpiled soils will need to be protected from wind and water erosion. Stockpiled soils are not to exceed a 3m height and are to be bunded by suitable materials. Stacked bricks surrounding the stockpiled soils can be adopted. Alternatively, wooden planks pegged around the stockpiled soils can be used. **Rehabilitation of RoW Areas** – Ideally, the affected RoW zones in the sensitive areas must be re-instated with the soils removed from the surface water resource(s), and 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.

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

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly 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 distinct possibility. A further impact due to erosion and storm water run-off impacts is increased sedimentation to surface water resources. Deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 7** below.

Table 7: Impact Rating for Increased Storm Water Run-off, Erosion and Sedimentation Impacts

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Increased storm water run-off, erosion and increased sedimentation impacting on surface water resources	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	- 39 (medium negative)	- 6 (low negative)

Mitigation measures	**Preventing Increased Run-off 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. 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. 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.

9.3 Operation Phase Potential Impacts

9.3.1 Vehicle Damage to Surface Water Resources

Vehicle access may be required to construction areas for the wind turbines, structures, buildings and infrastructure (such as roads, cables and power lines) that have been permitted to be constructed in or through 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.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 8** below.

Table 8: Impact of Vehicle Damage to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Vehicle damage to surface water resources	
Extent	*Local*	
Probability	*Possible*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low negative impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	- 42 (medium negative)	- 8 (low negative)
Mitigation measures	**Minimising Vehicle Damage to the Surface Water Resources** – Potential impacts can be avoided by the planning and routing of access / service roads outside of and away from surface water resources. 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. 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. 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/surface water specialist must be obtained in this respect should this be required.

9.3.2 Stormwater Run-off Impacts to Surface Water Resources

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. Additionally, where regular movement from vehicles flatten the ground surface making it a preferential flow path for storm water, sediment transportation from hardened gravel surfaces via run-off for internal access and service roads can result in increased sedimentation. In general, flat and hard surfaces aid with the acceleration and generation of run-off which can impact on nearby surface water resources through the onset of erosion due to increased run-off, as well as through the generation of increased sedimentation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 9** below.

Table 9: Storm-water Run-off Impacts to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Surface water resources	
Issue/Impact/Environmental Effect/Nature	Impermeable and hardened surfaces creating accelerated run-off, consequent erosion and sedimentation	
Extent	Site	
Probability	Probable	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Long term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced.*	
	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	1
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-11 (low negative)
Mitigation measures	Any hardstand area or building within 50m proximity to a surface water resource 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). Alternatively, a suitable operational storm water management design or plan can 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.	

9.4 Decommissioning Phase Potential Impacts

9.4.1 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.

9.5 Cumulative Impacts

Although it is important to assess the surface water impacts of the proposed development, it is equally important to assess the potential cumulative surface water impact that could materialise considering similar developments in the surrounding area. Cumulative impacts are the impacts, which combine from different developments / facilities and result in significant impacts that may be larger than the sum of all the impacts combined. As such there are a number of proposed renewable energy developments as well as a few that are currently under construction within the nearby vicinity of the proposed development. The renewable energy developments that are being proposed within close proximity of the study site are indicated in **Table 10** and shown in **Figure 17** below.

Table 10: Proposed Renewable Energy projects in the area

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Capacity	Farm Details
The Badudex Solar Project	14/12/16/3/3/2/546	EIA underway	Budadex (Pty) Ltd	74 MW	Portion 1 of the Farm Volgelstruis Bult No 104
The Moiblox Solar Project	14/12/16/3/3/2/547	EIA underway	Moiblox (Pty) Ltd	75 MW	Remainder of the Farm Bosjesmansberg
Garob Wind Energy Facility Project	14/12/16/3/3/2/279	Awarded Preferred Bidder Status.	Garob Wind Farm (Pty) Ltd	140 MW	Portion 5 of the Farm Nelspoortje No. 103
Copperton Wind Energy Facility	12/12/20/2099	Awarded Preferred Bidder Status.	Plan 8 Infinite Energy (Pty) Ltd	140 MW	Portion 4 of the Farm Nelspoortje No. 103; and Portion 7 of the Farm Nelspoortje No. 103.
Humansrus Solar PV Energy Facility 1 and 2	14/12/16/3/3/2/707 14/12/16/3/3/2/708	Authorised	Humansrus Solar PV Energy Facility 1 (Pty) Ltd	75 MW	Remainder the Farm Humansrus No. 147
Humansrus Solar PV Energy Facility 2 and 3	14/12/16/3/3/2/888 14/12/16/3/3/2/887	EIA underway	Humansrus Solar PV Energy Facility 3/4 (Pty) Ltd	75 MW	Remainder the Farm Humansrus No. 147
Mierdam Solar Photovoltaic Facility	12/12/20/2320/2	Authorised	South Africa Mainstream Renewable Power Mierdam (Pty) Ltd	75 MW	Portion 1 of the Farm Kaffirs Kolk No. 118
Platsjambok East and West Solar Photovoltaic Facility	12/12/20/2320/4 12/12/20/2320/5	Authorised	South Africa Mainstream Renewable Power Mierdam (Pty) Ltd	75 MW	Remainder of the Farm Platsjambok 102

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Capacity	Farm Details
Helena Solar 1, 2, and 3 PV energy facility	14/12/16/3/3/2/765 14/12/16/3/3/2/766 14/12/16/3/3/2/767	EIA underway	BioTherm Energy (Pty) Ltd	75 MW	Portion 3 of the Farm Klipgats Pan No. 117
Renewable Energy Farm near Prieska	14/12/16/3/3/2/608 14/12/16/3/3/2/609	EIA underway	NK Energie (Pty) Ltd	UNKNOWN	Portion 3 of the Farm Hedley Plains No. 64 and Portion 5 of the Farm Doonies Pan No. 106
Photovoltaic Power Generation Facility near Prieska	12/12/20/1722	Awarded Preferred Bidder Status in REIPPP Window 1.	Mulilo Renewable Energy Solar PV Prieska (RF) (Pty) Ltd	19.9 MW	Portion 1 of the Farm Volgelstruis Bult No 104
PV Energy Plant near Copperton	12/12/20/2502	Authorised	Mulilo Renewable Energy (Pty) Ltd	100 MW	Portion 1 of the Farm Volgelstruis Bult No 104
Mulilo Sonnedix Prieska PV	12/12/20/2503	Awarded Preferred Bidder Status in REIPPP Window 3. Currently being constructed.	Mulilo Sonnedix Solar Enterprises (Pty) Ltd	75 MW	Remainder of the Farm Hoekplaas No. 146
Mulilo Prieska PV	12/12/20/2501	Awarded Preferred Bidder Status in REIPPP Window 3. Currently being constructed.	Mulilo Prieska PV (Pty) Ltd	75 MW	Portion 4 of the Farm Klipgats Pan No. 117
PV 2, PV 3, PV 4, PV 5 and PV 7	14/12/16/3/3/2/486 14/12/16/3/3/2/487	EIA underway	Mulilo Renewable Energy (Pty) Ltd	75 MW	Portion 4 of the Farm Klipgats Pan No. 117

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Capacity	Farm Details
Energy Plants on the Farm Klipgats Pan	14/12/16/3/3/2/488 14/12/16/3/3/2/489 14/12/16/3/3/2/491				
PV 2, PV 3, PV 4, PV 6, PV 7, PV 11 and PV 12 Solar Energy Plants on the Farm Hoekplaas	14/12/16/3/3/2/493 14/12/16/3/3/2/494 14/12/16/3/3/2/495 12/12/16/3/3/2/497 14/12/16/3/3/2/498 14/12/16/3/3/2/502 14/12/16/3/3/2/503	EIA underway	Mulilo Renewable Energy (Pty) Ltd	75 MW	Remainder of the Farm Hoekplaas No. 146

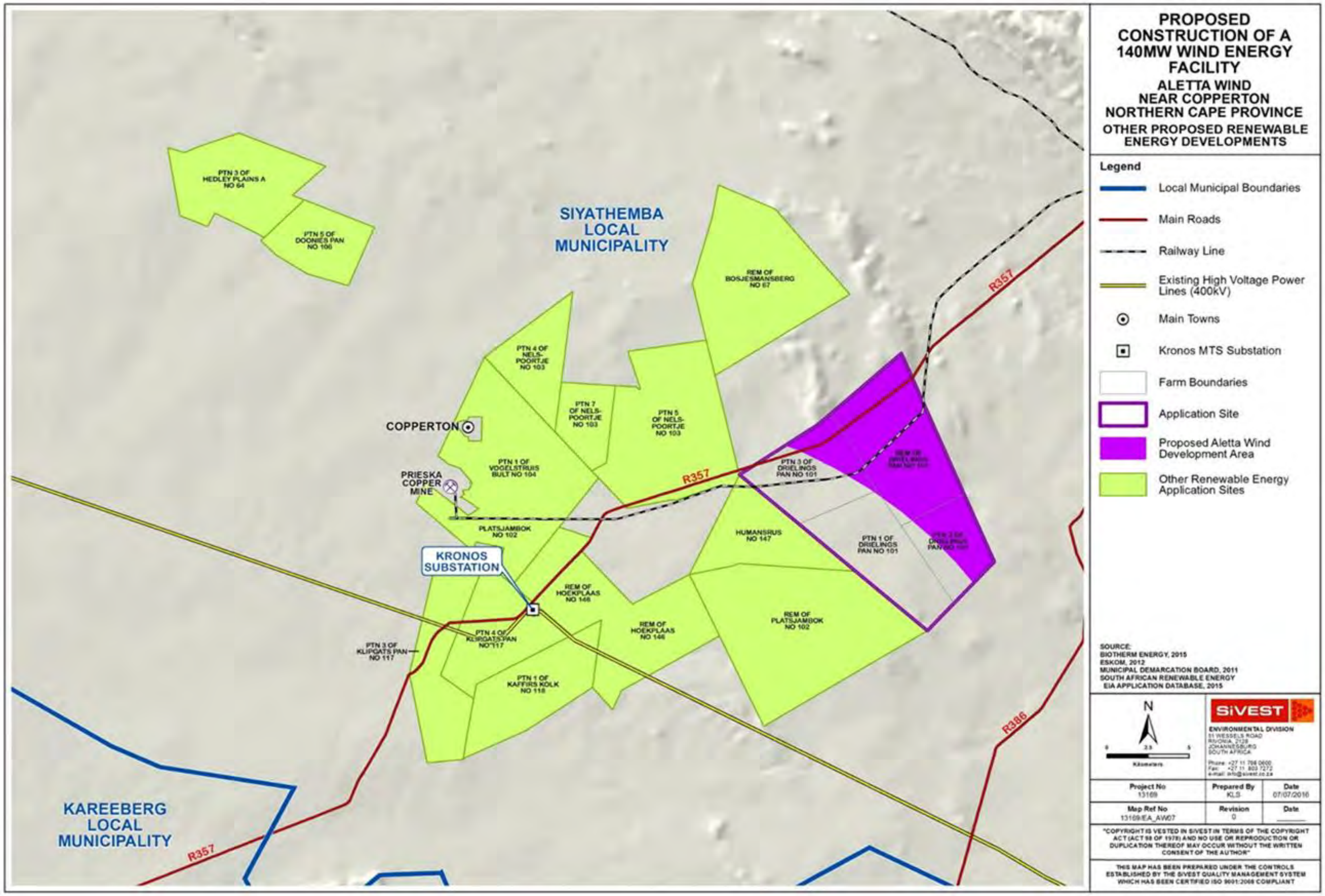

Figure 17: Renewable Energy Facilities Proposed and / or being constructed within the vicinity of the Proposed Development Area

A literature review of other surface water and / or aquatic studies on the neighbouring adjacent properties were undertaken to ascertain any additional cumulative impacts that should be taken into consideration. Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012 which are not currently publically available to download. Nonetheless, a fair amount of information was available. The information (including surface water / aquatic specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding renewable energy sites planned that were taken into account are shown in **Table 11** below.

Table 11: Literature Review of Surface Water Impacts for Surrounding Renewable Energy Developments

Project	**Relevant Impacts to be Taken into Consideration from Surface Water Perspective**	**Impacts Significance Rating after Mitigation**
Mulilo Sonnedix Prieska PV	▪ Impact on water resources (Scoping) ▪ Sediment and erosion (Scoping)	▪ None
Garob Wind Energy Facility Project	▪ Long term increased soil erosion risk ▪ Increased water run-off ▪ Siltation of watercourses and other natural resources	▪ Low ▪ Low ▪ Low
Humansrus Solar PV Energy Facility 1 and 2	▪ Loss of riparian systems ▪ Impact on dry river beds and localized drainage systems (road crossings) ▪ Impact on riparian systems through the possible increase in surface water runoff on riparian form and function (hydrological changes) ▪ Increase in sedimentation and erosion ▪ Physical disturbance by the supporting infrastructure on the riverine environment	▪ Low ▪ Low ▪ Low ▪ Low ▪ Low
Humansrus Solar PV Energy Facility 2 and 3	▪ Loss of riparian systems ▪ Impact on dry river beds and localized drainage systems (road crossings) ▪ Impact on riparian systems through the possible increase in surface water runoff on	▪ Low ▪ Low ▪ Low ▪ Low ▪ Low

	riparian form and function (hydrological changes) ▪ Increase in sedimentation and erosion ▪ Physical disturbance by the supporting infrastructure on the riverine environment	
Mierdam Solar Photovoltaic Facility	▪ Impacts related to surface water resources	▪ Low
Platsjambok East and West Solar Photovoltaic Facility	▪ Loss of habitat	▪ Low
Helena Solar 1, 2 and 3 PV Energy Facility	▪ Impact associated with the construction lay-down area ▪ Vehicle and machinery degradation ▪ Human degradation of flora and fauna associated with surface water resources ▪ Degradation and removal of soils and vegetation associated with surface water resources ▪ Increased run-off and sedimentation ▪ Stormwater run-off associated with the PV facility, buildings, substation and associated infrastructure ▪ Oil leaks from the substation	▪ Low ▪ Low ▪ Low ▪ Low ▪ Low ▪ Low ▪ Low
PV 2-11 Solar Energy Plants on the Farm Hoekplaas	▪ Impact on water resources (Scoping) ▪ Sediment and erosion (Scoping)	▪ None

In terms of the review undertaken on the above reports, the main cumulative impacts from a catchment perspective for surface water resources in the regional 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 on 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.

With these impacts in mind, the direct cumulative impact of loss of surface water resources and degradation will not be compounded by the proposed development. This is due to the wind turbines, substation and operation and maintenance buildings not being located in any surface water resources. However, provision for potential degradation of surface water resources due to associated infrastructure is noted. Should these potential impacts be avoided / reduced as per the mitigation measures stipulated in **Section 9.3** above, the cumulative impact will be negligible and not impact at a site as well as regional level.

From an indirect cumulative impact perspective, the proposed development as a whole is not expected to contribute to the cumulative impacts of increased run-off, sedimentation and erosion since the drainage lines flow in a southerly direction to be contained on the proposed development area and not into any adjacent proposed or current renewable energy developments being constructed. Additionally, there is little risk of surrounding renewable energy developments impacting on the proposed development. The nearest renewable energy development upstream of the proposed development is the Moiblox Solar Project which is approximately 4km north. The potential risk of increased run-off, sedimentation and erosion impacting on the proposed development is minimal due to the distance. It would be important however, that provision for these impacts are taken into consideration by the proposed Moiblox Solar Project. That being said, with the implementation of stipulated mitigation measures as per **Section 9.3** and **9.4**, the indirect cumulative impact for the proposed development itself is again deemed to be negligible.

10 SPECIALIST RECOMMENDATIONS

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

- All stipulated mitigation measures are to be adhered to;
- All surface water resources and buffer zones must be avoided as far as practically possible;
- Where it is not possible to avoid impacting on the identified surface water resources, the relevant environmental authorisation and water use license must be applied for.

11 CONCLUSION

SiVEST has been appointed by BioTherm Energy (Pty) Ltd. to undertake an Environmental Impact Assessment (EIA) and Environmental management Programme (EMPr) for the proposed construction of the Aletta Wind Farm, near Copperton in the Northern Cape Province. As part of the EIA study, the need to undertake a surface water impact assessment was identified. A scoping–level surface water assessment was conducted previously to initially identify all potential surface water resources at a database and desktop level. Following the scoping phase, a more detailed field assessment was undertaken to groundtruth, verify and refine delineations of the identified surface water resources.

Ultimately, it was found that there were nine (9) watercourses (drainage lines) and twenty two (22) depressions (depression wetlands). For the depression wetlands, these were sub-divided into two sub-categories for the fifteen (15) natural depression wetlands and the seven (7) artificial (man-made) depression wetlands identified. A buffer zone of 50m for watercourses and the natural depression wetlands have been applied in consideration of the factors above. No buffer zone was applied to the artificial depression wetlands as these were not identified to be of any major ecological significance. The artificial depression wetlands would however need to be avoided and should be viewed as exclusion zones.

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

PRE-CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Construction Lay-down Area	-22 (low negative)	-6 (low negative)
CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle and Machinery Degradation Impacts	-26 (low negative)	-6 (low negative)
Human Degradation of Flora and Fauna associated with Surface Water Resources	-10 (low negative)	-6 (low negative)
Degradation and Removal of Soils and Vegetation in Surface Water Resources	-42 (medium negative)	-6 (low negative)
Increased Run-off, Erosion and Sedimentation Impacts	-39 (medium negative)	-6 (low negative)
OPERATION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle Damage to Surface Water Resources	-42 (medium negative)	-8 (low negative)
Stormwater Run-off Impacts to Surface Water Resources	-28 (low negative)	-11 (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 were assessed given that numerous proposed and currently constructed renewable energy developments can be found in the surrounding area. As such, the direct cumulative impact of loss of surface water resources and degradation was found not to be compounded by the proposed development as the wind turbine, substation and operation and maintenance buildings were not located in any surface water resources. However, provision for potential degradation of surface water resources due to associated infrastructure was noted. Should these potential impacts be avoided / reduced as per the mitigation measures stipulated, the cumulative impact will be negligible. From an indirect cumulative impact perspective, the proposed development as a whole was not expected to contribute to the cumulative impacts of increased run-off, sedimentation and erosion since the drainage lines flow in a southerly direction and will be contained on the proposed development area, and not into any adjacent proposed or current renewable energy developments being constructed. That being said, with the implementation of stipulated mitigation measures, the cumulative impact was again deemed to be negligible.

Finally, specialist recommendations include the following:

- All stipulated mitigation measures are to be adhered to;
- All surface water resources and buffer zones must be avoided as far as practically possible;
- Where it is not possible to avoid impacting on the identified surface water resources, the relevant environmental authorisation and water use license must be applied for.

12 REFERENCES

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Appendix A:

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 12**.

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 12. Example of the significance impact rating table

NATURE		
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.		
GEOGRAPHICAL EXTENT		
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
PROBABILITY		
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).
REVERSIBILITY		
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.
IRREPLACEABLE LOSS OF RESOURCES		
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.
DURATION		
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).
CUMULATIVE EFFECT		
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
INTENSITY / MAGNITUDE		
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.

SIGNIFICANCE		
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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