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12 September 2017

To whom it may concern

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

Surface Water Delineation and Assessment Report

1. **Experience of the Peer Reviewer**

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

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

The terms of reference are provided within the introduction as:

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

3. **Methodology**

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

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

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

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

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

4. Validity of the Findings

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

5. Suitability of the Mitigation Measures and Recommendations

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

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

6. Appropriateness of Reference Literature

The references applied are appropriate.

7. Additional Comments

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

CURRICULUM VITAE

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

Education

University of Johannesburg

2011 **M. Sc (Environmental Management)**
This is a lectured Masters degree focussing on the concepts and principles of environmental management. The MSc. includes three modules: (1) Environmental management, biosphere and the environment. (2) Environmental management skills and (3) A mini dissertation in related field works.

2009 **M.Sc (Aquatic Health)** ***cum laude***
This Masters study has an ecotoxicological basis. It deals with the effects of androgenic and estrogenic growth-promoting hormones, used in cattle feeding lots, on aquatic freshwater ecosystems. It aims to incorporate biomarkers in fish (metabolomics and cellular energy allocation) as well as studies of general water quality, sediment composition and invertebrate community structures

2006 **B.Sc Honours (Zoology)** ***cum laude***
Related course work**:** Laboratory and field skills, Philosophy and research methodology, population genetics, project management, mammal diversity, eco-physiology, parasite ecology, ichthyology, research project, biological systems integrity, terrestrial ecology, nature conservation.

2005 **B.Sc (Natural and Environmental Sciences)**
Majors: Geography and Zoology
Minors: Environmental management, botany, chemistry, environmental chemistry, biogeochemistry, statistics, information science
Related course work: Cartography, biogeography, soil science, climatology and geomorphology, economic and urban geography, GIS, Geography of Africa and South Africa, invertebrate and vertebrate diversity, parasitology, ecotoxicology, terrestrial ecology and limnology, animal physiology, economic and ethno-botany, plant diversity, plant-water relations, organic and physical chemistry.

Employment and Work Experience

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

Recent projects:

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

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

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

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

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

Feb 07 – Jan 08 **EnviRoss Environmental Scientific Consultants Cc**
Consultant

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

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

Workshops and Courses

2011 **Tools for Wetland Assessment Short Course**
Department of Environmental Science Rhodes University;
Grahamstown Port Elizabeth

2009 **Environmental Management Systems –WTH Management and Training**
ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg

2008 **Wetland and Riparian Delineation Course**
Accredited wetland delineator
Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF)
Pretoria, South Africa.

2008 **Skippers Course**
License Holder of a Category "R" skippers license

2007 **SASS5 Accredited Practitioner**
Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux
(North West Nature Conservation).

2007 **Multivariate Statistics Training**
Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam

2006 **Advanced 4x4 driving course**

Societies and Accreditations

2009 **The South African Council for Natural Scientific Professions (SACNASP)**
Professional Natural Scientist
Pr. Sci. Nat. (Aquatic Health, Zoological & Ecological Sciences)

Registration number: 400275/12

2009 **Member of the International Association of Impact Assessment-SA (IAIA SA).**

2006 **Member of the Zoological Society of Southern Africa (ZSSA)**

2006 **Member of the Southern African Society of Aquatic Scientists (SASAqS)**

Presentations

Jun 2010 **South African Society of Aquatic Scientists (SASAqS) Congress**
MN Jonker, G. Walsh & JHJ van Vuren
Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.

Oct 2009 **Department of Geography and Energy studies, University of Johannesburg**
MN Jonker, M Sherwood and R Rowles. 2009.
Historical overview of water quality associated with the Blesbokspruit RAMSAR site. Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).

Jul 2007 **Zoological Society of Southern Africa Conference, Potchefstroom.**
MN Jonker
Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.

Publications

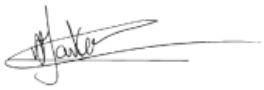
1. Van der Zee, J., Walsh., G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occuring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa.*

2. Walsh, G., Jonker. M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noumbi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.
Checklist Journal **10 (4):** 900 - 912.

3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3).**

4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

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



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SOUTH AFRICA MAINSTREAM RENEWABLE POWER DEVELOPMENTS PTY (LTD)

Proposed Construction of the Xha! Boom Substation, Linking Station and associated 132kV Grid Line near Loeriesfontein, Northern Cape Province

Surface Water Impact Assessment Report

Issue Date: 12th December 2017
Revision No.: 3
Project No.: 13622

Date:	12th December 2017
Document Title:	Proposed Construction of the Xha! Boom Substation, Linking Station and associated 132kV Grid Line near Loeriesfontein, Northern Cape Province – Surface Water Impact Assessment Report
Author:	Shaun Taylor
Revision Number:	3
Externally Reviewed by:	Michiel Jonker (Pr. Sci. Nat) Registration Number: 400275/12
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 Xha! Boom Substation, Linking Station and 132kV Grid Line near Loeriesfontein, Northern Cape Province – Surface Water Impact Assessment Report

Specialist:	SiVEST South Africa (Pty) Ltd		
Contact person:	Shaun Taylor		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	0727794899
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E-mail:	shaunt@sivest.co.za		
Professional affiliation(s) (if any)	South African Wetland Society		
Project Consultant:	SiVEST South Africa (Pty) Ltd		
Contact person:	Andrea Gibb		
Postal address:	PO Box 2921, Rivonia		
Postal code:	2128	Cell:	0725876525
Telephone:	0117980691	Fax:	0118037272
E-mail:	andreag@sivest.co.za		

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)

12th December 2017

Date

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

Section in EIA Regulations (2017)		Clause	Page in Report
Appendix 6 – Section 1	(1)	A specialist report prepared in terms of these Regulations must contain —	N/a
	(a)	details of –	N/a
		(i) the specialist who prepared the report; and	Page 7, Appendix A
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Page 7, Appendix A
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Page ii-iii
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Page 1
	(cA)	An indication of the quality and age of base data used for the specialist report;	Page 12-13 & 21-22
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Page 21-61
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Page 6 & 22
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Page 12-17
	(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Page 22-42
	(g)	An indication of any areas to be avoided, including buffers;	Page 22-42
	(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Page 22-42
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Page 6-7
	(j)	A description of the findings and potential implications of such findings on the impact of the	Page 22-42

		proposed activity, including identified alternatives on the environment or activities;	
	(k)	Any mitigation measures for inclusion in the EMPr;	Page 42-61
	(l)	Any conditions for inclusion in the environmental authorization;	Page 63-64
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Page 42-64
	(n)	A reasoned opinion –	N/a
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Page 63-64
		(iA) regarding the acceptability of the proposed activity or activities; and	Page 63-64
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Page 42-61 & 63-64
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Included in Environmental Impact Report
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Included in Environmental Impact Report
	(q)	Any other information requested by the authority.	Included in Environmental Impact Report
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/a

MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE XHA! BOOM SUBSTATION, LINKING STATION AND ASSOCIATED 132KV GRID LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

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MAINSTREAM RENEWABLE POWER DEVELOPMENTS (PTY) LTD

PROPOSED CONSTRUCTION OF THE XHA! BOOM SUBSTATION, LINKING STATION AND ASSOCIATED 132KV GRID LINE NEAR LOERIESFONTEIN, NORTHERN CAPE PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, namely the Xha! Boom substation, linking station and an associated 132kV grid line near Loeriesfontein in the Northern Cape Province (hereafter referred to as the 'proposed development'). The proposed development is aimed at feeding electricity generated by Mainstream's proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

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

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 (where applicable) as well as findings from the infield groundtruthing, verification and delineation exercise. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), the anticipated legislative implications and requirements, identification of the potential environmental impacts that could be associated with the proposed development, potential cumulative impacts of other surrounding proposed developments, proposed mitigation measures to minimize any potential impacts, a comparative assessment of alternatives and finally, specialist recommendations based on the proposed alternative layouts.

1.1 Legislative Context

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the EIA Regulations (2006, 2010, 2014 and 2017 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 BA or EIA process is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

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

1.2 Definition of Surface Water Resources as Assessed in this Study

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

1.2.1 Wetlands

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

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

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

- Channel (river, including the banks): a linear landform with clearly discernable bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a "river".
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a "river".
- Depression: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
- Flat: a Level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat.
- Hillslope seep: a wetland area 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 timing and short term, once-off nature of the assessment, the assessment should not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence within the surface water resources.

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

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

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

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

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

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

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

1.4 Specialist Credentials

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

2 PROJECT NEED AND DESIRABILITY

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

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

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

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

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

3 PROJECT TECHNICAL DESCRIPTION

The proposed Xha! Boom Substation is located approximately 70km north of Loeriesfontein in the Northern Cape Province and straddles the boundary between the Hantam and Khai-Ma Local Municipalities (**Figure 1**). The application site as shown on the locality map below (**Figure 2**). The key components of the project are detailed below.

3.1 Project Technical Details

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely Xha! Boom Substation), as well as a 132kV Linking Substation and a 132kV grid line. The aim of this development is to feed electricity generated by the proposed Xha! Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the "proposed Xha! Boom Substation")
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV grid line from the proposed Xha! Boom Substation, via the proposed Linking Substation to Helios substation, approximately 33km south-east of the proposed Xha! Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A grid line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed grid line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

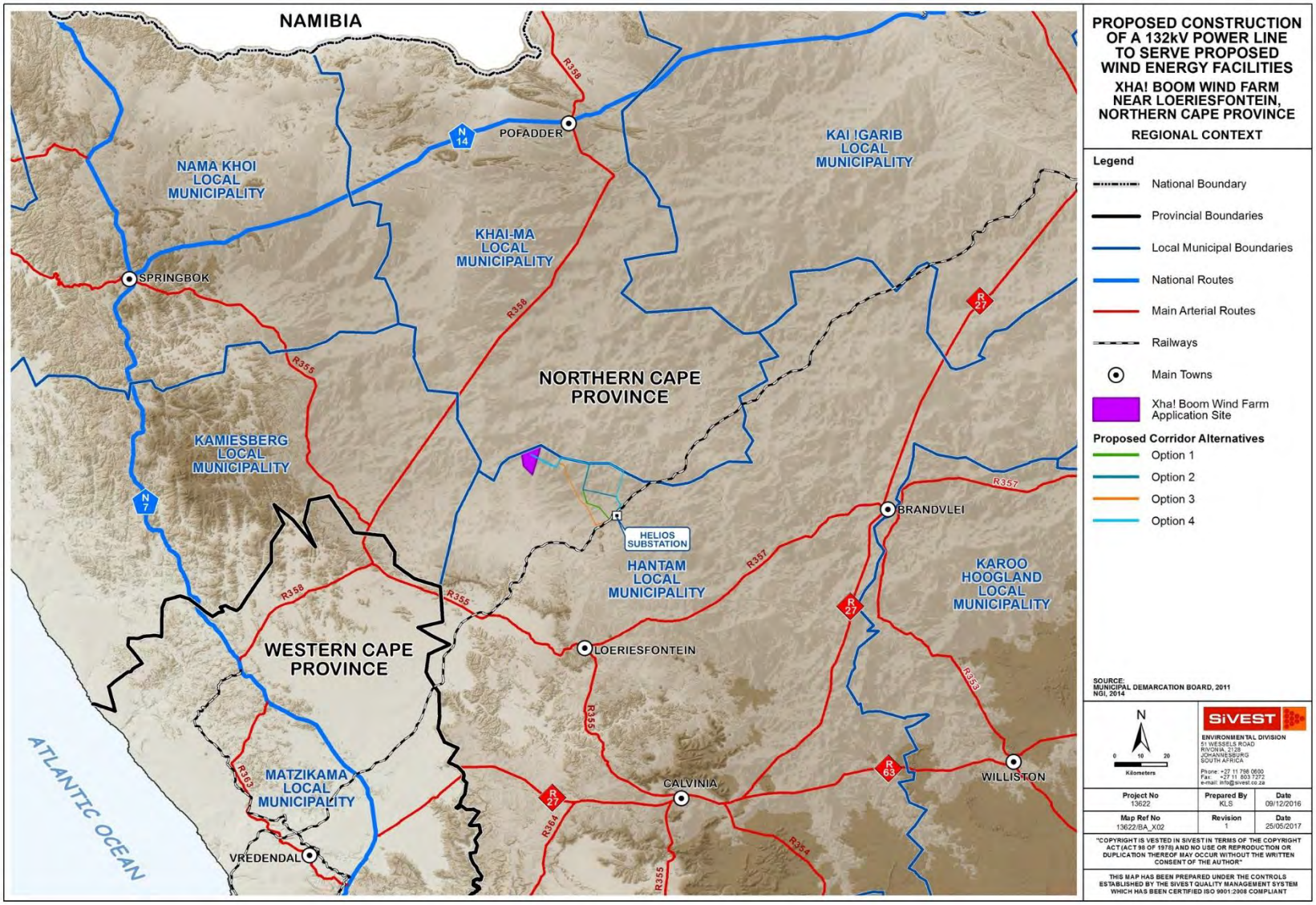


Figure 1. Regional Context Map

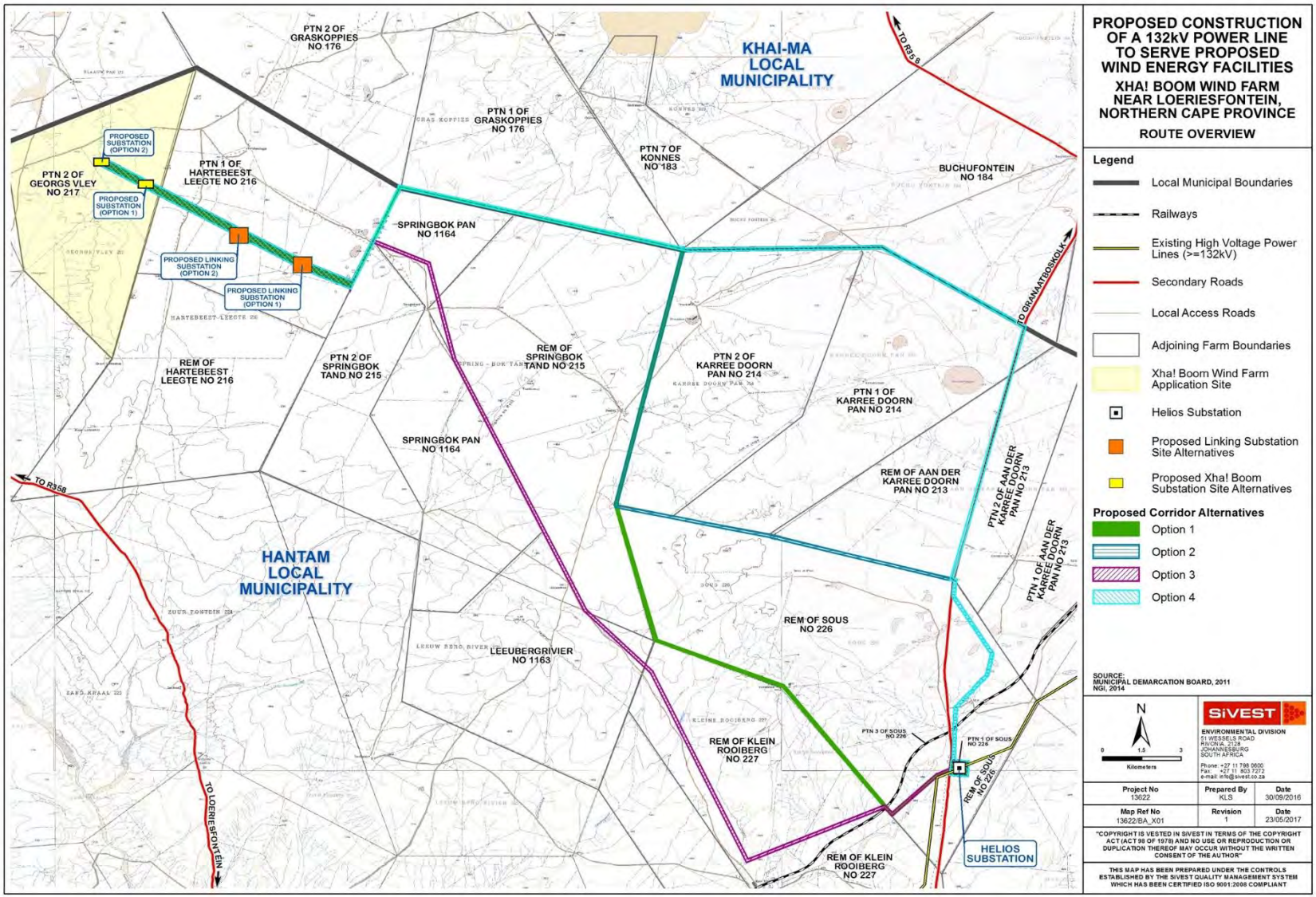


Figure 2. Locality Map

It should be noted that two (2) alternative sites for the proposed on-site Xha! Boom Substation as well as the proposed Linking Substation that have been assessed during the BA, in conjunction with four (4) grid line corridor alternatives.

The proposed grid line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures (**Figure 3**) for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the grid line.

Figure 3. Tower Type

3.2 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 proposed Xha! Boom Wind Farm (part of a separate on-going EIA process) application site, proposed Xha! Boom Substation site and associated 132kV grid line corridor route alternatives are shown in the locality map above (**Figure 2**). The following alternatives will therefore be considered and investigated as part of this assessment:

- Two (2) alternative on-site locations for the proposed on-site 132kV Xha! Boom Substation options;
- Two (2) alternative locations for the proposed linking substation options;
- Four (4) alternative grid line options for the proposed 132kV grid line;
- The "No-go" Alternative.

3.2.1 No-go Alternative

The 'no-go' alternative is the option of not establishing the proposed development. 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 and the associated substation, linking station and grid line 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 proposed development 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 Database Identification and Desktop Delineations of Surface Water Resources

The first step in the surface water assessment was to undertake a desktop assessment of any surface water features from available databases. 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.

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 Fe3+ ions which are characterised by "grey" colours of the soil matrix;
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles).
- These can occur as:
    - Concretions - harder, regular shaped bodies;
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
    - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site were assessed according to the **DWAF (2005; 2008)** guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". According to the **DWAF (2005 & 2008)** guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric

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

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

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

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

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

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

4.2.2 Riparian Habitat

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

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

The topography associated with a watercourse can comprise (but not always limited to) the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat. However, the riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the species from the adjacent terrestrial area (**DWAF, 2005**).

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

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

4.2.3 Drainage Lines

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

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

- Perennial – flows continuously throughout the year in most years;
- Non-perennial – does not flow continuously throughout the year, although pools may persist. Can be subdivided as follows:
    - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;
    - Intermittent – water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;

    - Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.
- Unknown – for rivers where the flow type is not known.

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

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

4.3 Surface Water Buffer Zones

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

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

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

- The ability of the proposed buffer to capture sediment and/or remove and filter pollutants before reaching the wetland; and
- The ability of the proposed buffer to dissipate and infiltrate the surface runoff before reaching the wetland.

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

4.4 Impact Assessment Method

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

5 GENERAL STUDY AREA

The proposed development is generally accessible via a dirt road off Granaatboskolk which can be accessed via the R357 which leads to Loeriesfontein. Land cover in the area is mainly vacant land used for grazing purposes but also includes salt mining, railways and various renewable energy developments (both solar and wind). A map indicating the land cover classes of the general area for the proposed development are provided in **Figure 4** below.

According to **Mucina and Rutherford (2006)**, the proposed development site falls within the Nama-Karoo Biome. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas. The development site can be found within the Bushmanland bioregion. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed development can therefore be found within the Bushmanland Basin Shrubland and Western Bushmanland Klipveld vegetation units (**Figure 5**). 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.

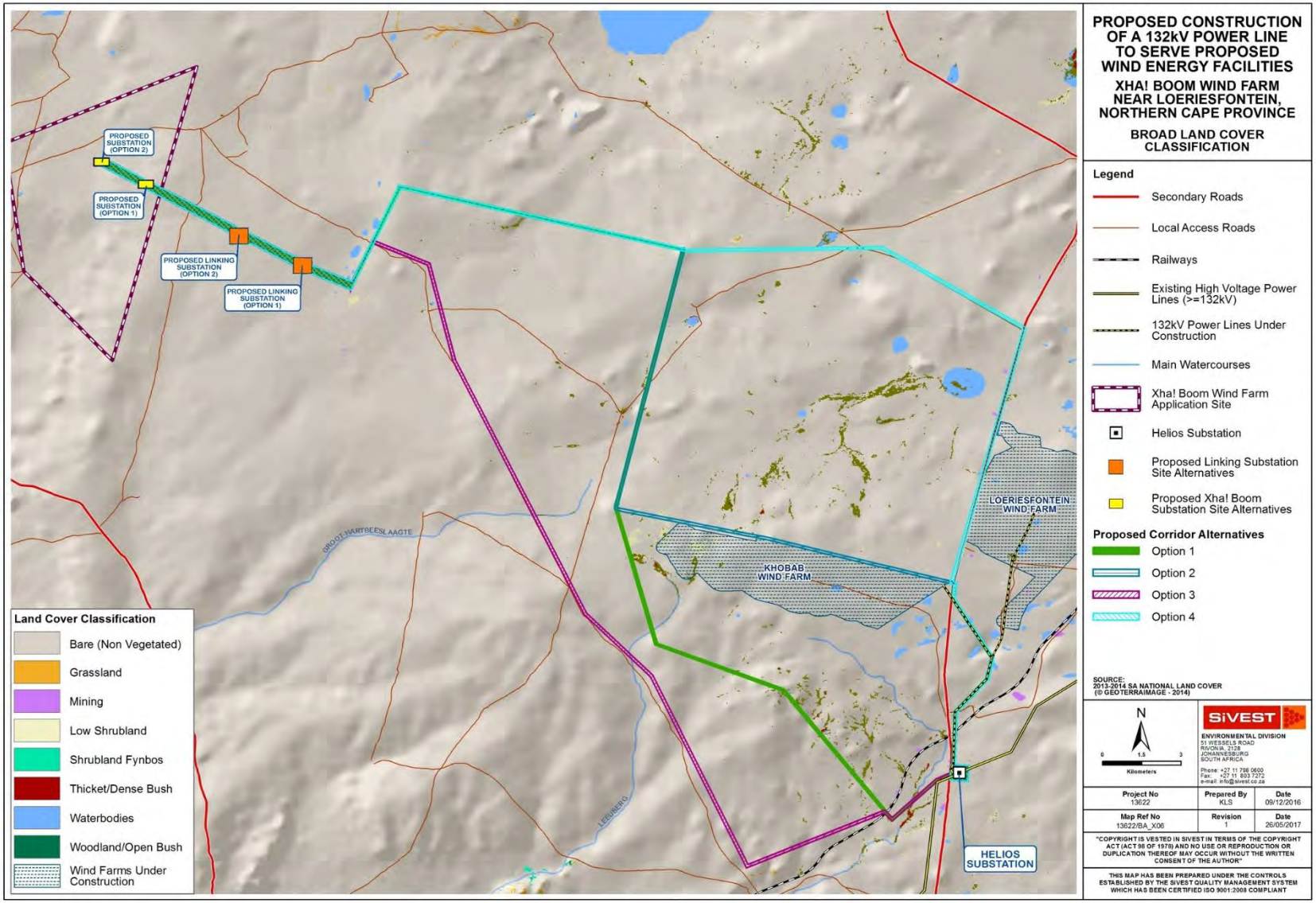


Figure 4: Land Cover Map

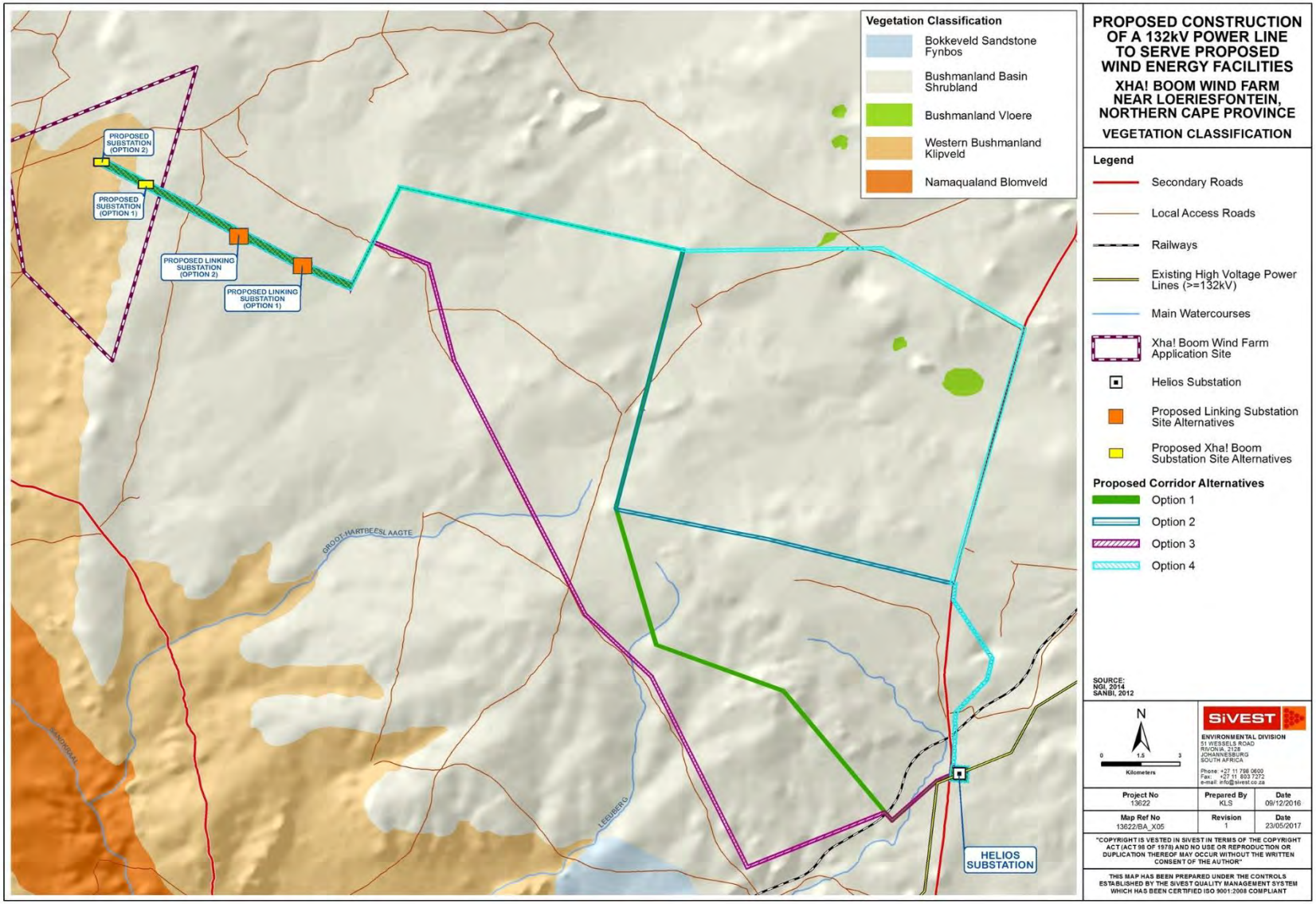


Figure 5: Vegetation Unit Map

5.1 Bushmanland Basin Shrubland Vegetation Unit

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

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

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

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

5.2 Western Bushmanland Klipveld

The vegetation and landscape features are characterised by very sparsely populated plains with a desert appearance (rocky pavements built of rounded, dark-coloured rocks and boulders) supporting succulent dwarf shrubs (*Aridaria*, *Drosanthemum Eberlanzia*, *Phyllobolus*, *Psilocaulon*, *Rushcia*), with microphyllous non-succulent shrubs (*Aptosium*, *Pentzia*) and drought-tolerant grasses.

The geology and soils consist of Hutton and Mispah soils over Karoo Sequence sediments (mostly Dwyka diamictite and Ecca shale). The rocky pavements of rounded boudlers, which characterise this area, are palaeo-river terraces of the palaeo-Orange River, which is presumed to have flowed south through this area (approximately 22 million years ago). Fc (Glenrosa and Mispah soil forms) land type covers the entire region.

The climate of the vegetation unit is identified as a very dry region with a Mean Annual Precipitation (MAP) of only 90mm (range 70-100mm) and erratic (almost desert-like) rainfall. Slight peak in precipitation in winter, hardly any in December and January, consistent with the classification of this unit in winter-rainfall Succulent Karoo Biome. Potential evaporation exceeds 2660mm. Overall Mean Annual Temperature (MAT) 16-17º C, with clear maxima in December to January. Mean maximum and minimum monthly temperatures in Kliprand are 36º C and -2º C for January and July, respectively. Incidence of frost is relatively high (25 days, range 20-40 days) due to its land-locked position and high altitude generating effect of thermal continentality.

The conservation status of the vegetation unit is described as least threatened (Target 18%). None conserved in statutory conservation areas. No signs of large scale transformation or invasion of alien plants. Erosion is high (70%) and moderate (12%).

6 FINDINGS OF ASSESSMENT

6.1 Surface Water Database Information

In terms of the **National ENPAT (2002)** database, the proposed development study site is completely within the Berg Olifants Water Management Area (WMA) (**Figure 6**). Moreover, the proposed development is therefore also within the Olifants – Cape Primary Catchment. At a finer level of detail, the Xha! Boom Wind Farm site traverses two (2) quaternary catchments including E31A and E31C.

In terms of the **NFEPA (2011)** database, there are six (6) natural depression wetlands, one (1) natural seep wetland and one (1) natural flat wetland. Therefore, eight (8) wetlands in total were identified. None of the identified wetlands are considered to be a Wetland Freshwater Ecosystem Priority Area (WETFEPA). A WETFEPA is a wetland that is earmarked to stay in good condition in order to conserve freshwater ecosystems and protect water resources for human use. These are classified according to a number of criteria some of which include existing protected areas and focus areas for protected area expansion identified in the National Protected Expansion Strategy.

Three (3) episodic rivers / streams were identified in both the **Northern Cape ENPAT (2000)** and **NFEPA (2011)** databases. These include the Hartbeeslaagte, Leeuberg and Klein-Rooiberg. All are classified as Class B: Largely Natural systems in terms of the Present Ecological Status (PES) according to the **NFEPA (2011)** database. However, the more recent **DWA (2014)** database provides more detail for each system as follows:

- Hartbeeslaagte – PES B; Ecological Importance (EI) Moderate; Ecological Sensitivity (ES) Moderate;
- Leeuberg – PES B; EI Moderate; ES Moderate;
- Klein-Rooiberg – PES B; EI Moderate; ES High.

The **Northern Cape ENPAT (2000)** database also however identifies an additional tributary to the Leeuberg episodic stream. Furthermore, additional drainage lines were also identified on the 1:50 000 topographical maps.

6.2 Surface Water In-field Delineation Information

The in-field wetland delineation assessment took place from the 6th to the 8th of December 2016 as well as the 8th to the 9th June 2017. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the proposed development area. The refined results for the proposed development are as follows:

- Five (5) Depression Wetlands;
- Twenty six (26) Major Drainage Lines including Klein-Rooiberg, Leeuberg and Hartbeeslaagte (drainage line with a channel width >5m);
- One hundred and eighty (180) Minor Drainage Lines (drainage lines with a channel width <5m).

The refinement of the surface water resources as stated above are presented in **Figure 7** to **Figure 9** below. A more detailed description of the environmental attributes (indicators) of the surface water resources characteristics is provided in the sub-sections below.

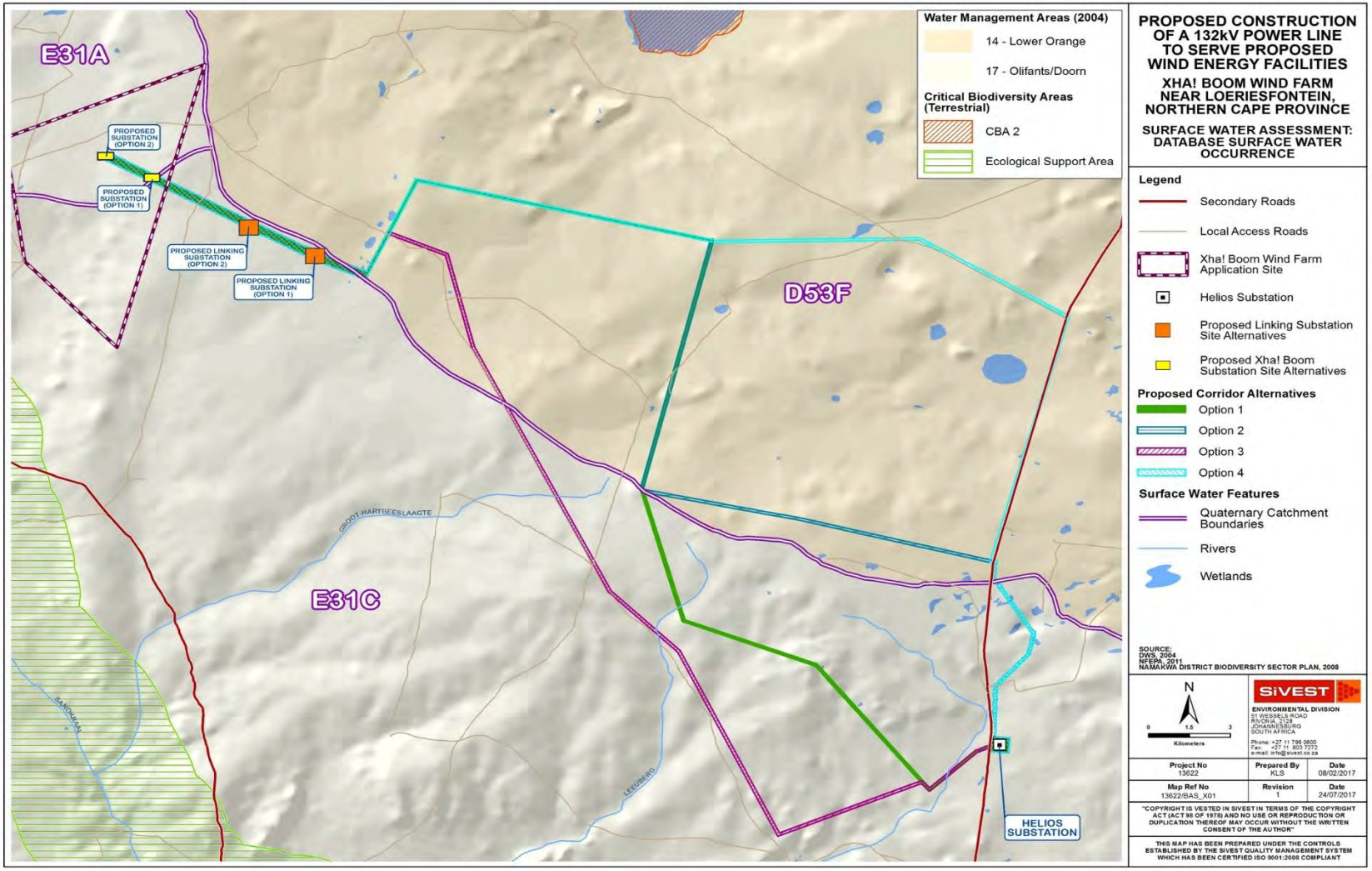


Figure 6: Database Surface Water Occurrence Map

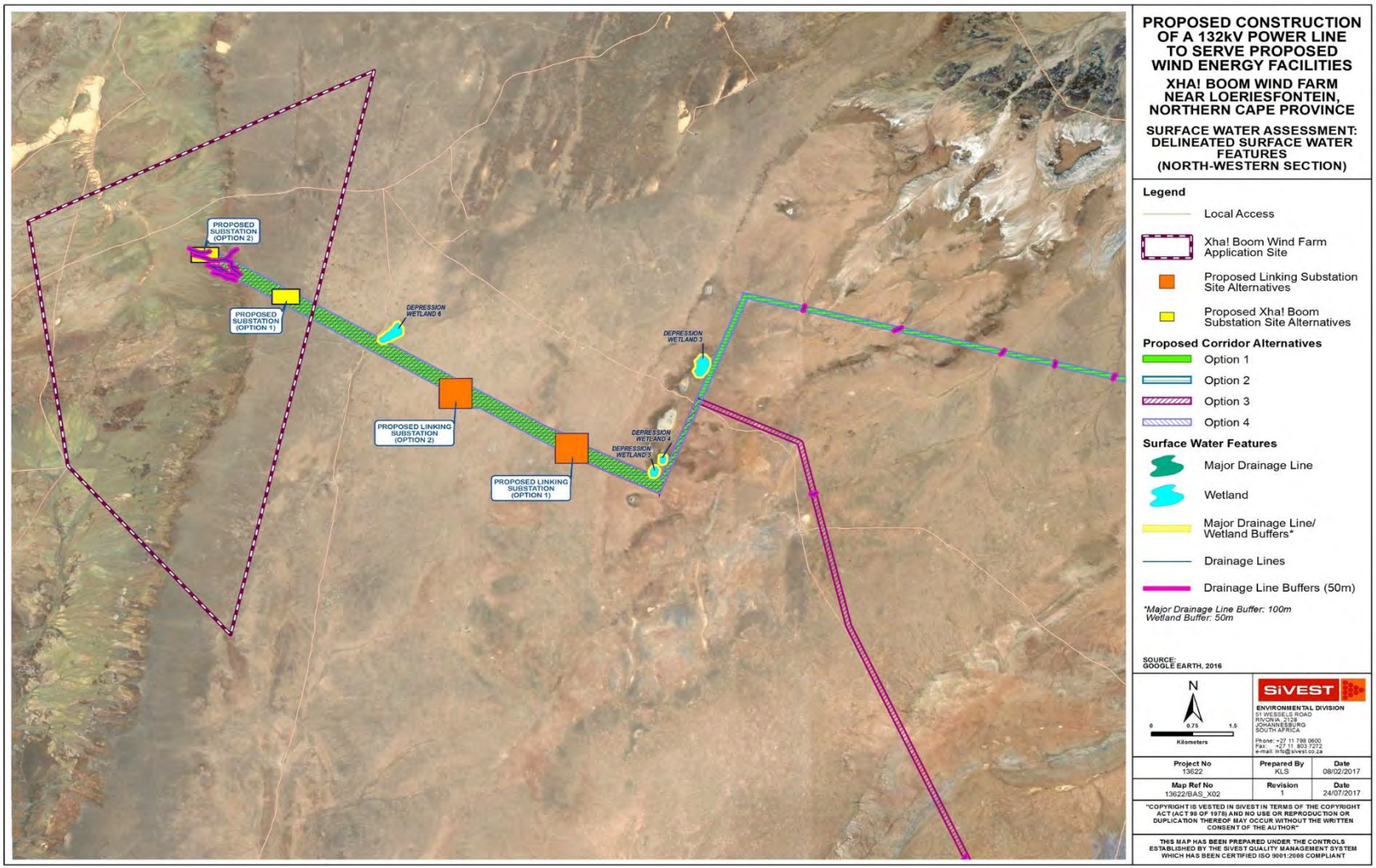


Figure 7: Surface Water Delineation Map (North-western Section)

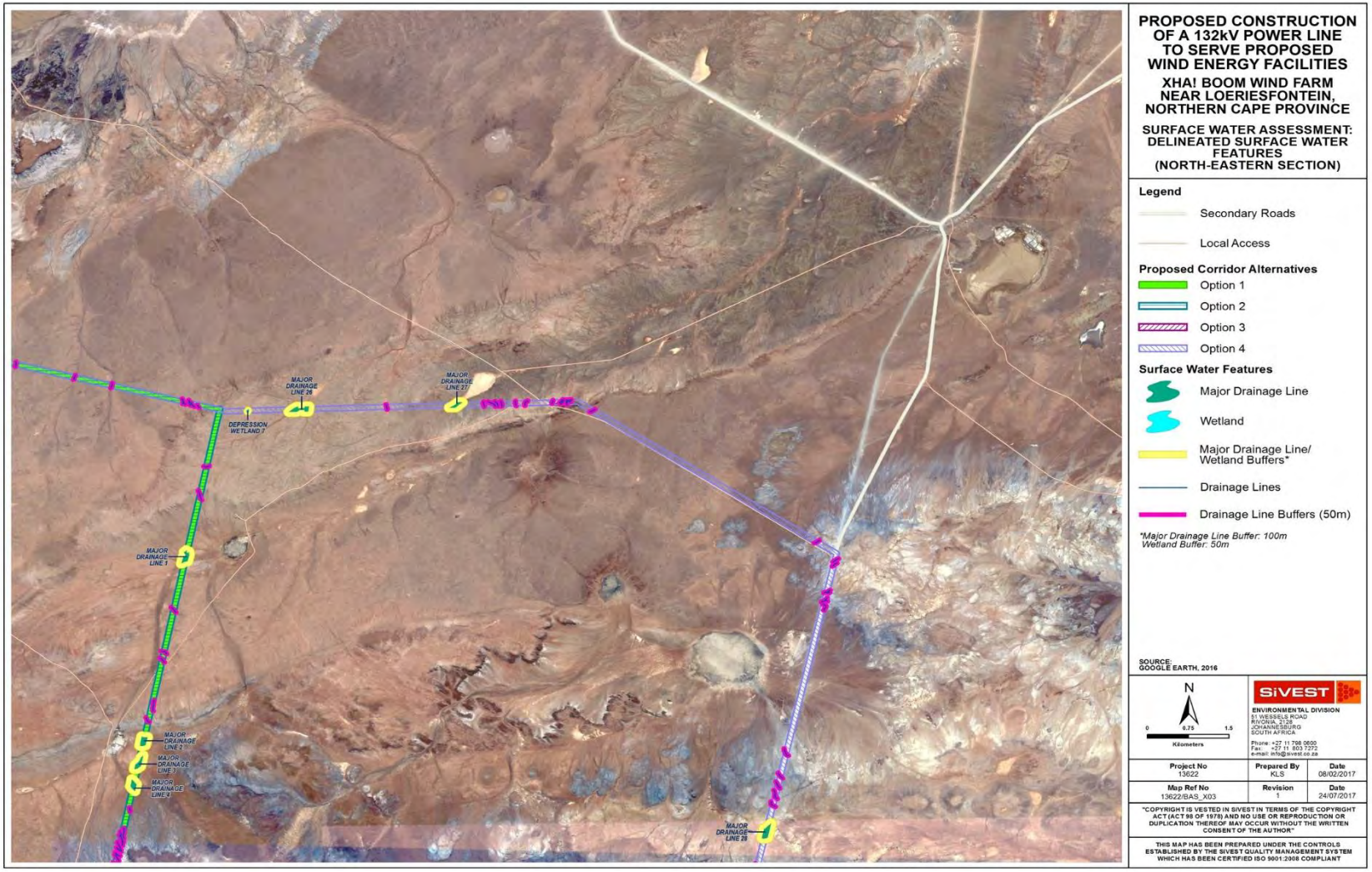


Figure 8: Surface Water Delineation Map (North-eastern Section)

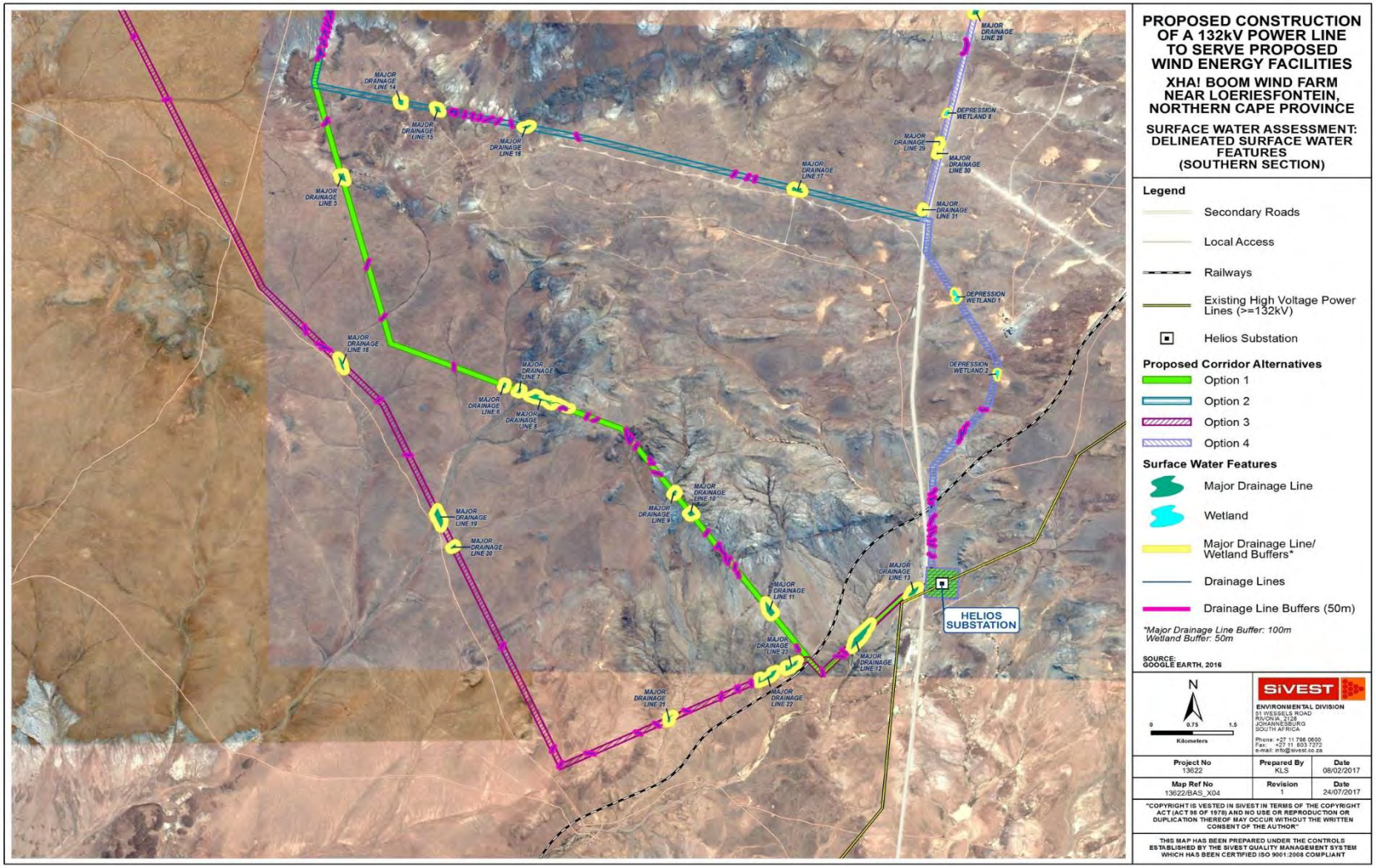


Figure 9: Surface Water Delineation Map (Southern Section)

6.2.1 Channels (Minor Drainage Lines)

6.2.1.1 Topography Associated with the Watercourses

The study region is characterized by varied topography. Linking Station 2 located on a ridgeline which runs from south to north and bisects the initial sections on the grid option alternatives. Other areas beyond this point in the north-west, are relatively flat (**Figure 10**) to gently undulating. Low ridges and undulating terrain become more characteristic in the eastern and south eastern areas. The direction of drainage is dependent on the local topography and can flow in any direction. Drainage mainly begins as first order streams that either lead to central relatively large depression wetlands, or eventually flow and link to larger river systems downstream (i.e. Klein Rooiberg, Leeuberg and Hartbeeslaagte). The minor drainage lines therefore serve as tributaries of which many are first and second order streams or A-section reaches. The minor drainage lines are considered A-section reaches due to the lack of a saturation zone. The drainage lines are presumed to mainly flow episodically during and briefly after rainfall events. Hence, all minor drainage lines were identified as ephemeral watercourses. The minor drainage line channels have variable lengths, but are no more than 5m wide. The channels are weakly defined in the upper reaches but become more incised downstream.

Figure 10: Relatively Flat Terrain in the North Western Area of the Study Region where Minor Drainage Lines were identified.

According to **Lanz (2017)**, soils across the study area are predominantly shallow, sandy soils on underlying rock or hard-pan carbonate. As the depth of soils on the proposed development area are relatively shallow, flow is predominantly via surface run-off. Therefore, limited sub-surface flow takes place, with the exception only where the composition and depth of the soil profile permits infiltration in thicker permeable soil profiles (i.e. valley bottom areas). Soil erosion potential is therefore also limited due to shallow soil depth (**Figure 11**). Overall however, erosion was very limited. Relatively good growth of a mixture of both herbaceous and graminoid species keep soils intact. Minor erosion is restricted to the channels of the drainage lines, mainly in the south eastern areas of the study area.

Figure 11: Example of a Minor Drainage Line with Limited Channel Incision

6.2.1.2 Alluvial Soils and Deposited Materials

Generally, fine to sandy particles are found within the minor drainage lines. However, the grain size of sediments can increase to gravel sized sediments (**Figure 12**) which presumably are transported from the surrounding landscape via overland flow into the drainage lines. Following flows, driven by rainfall events, sediments are deposited along the length within the drainage lines. Deposited sediments were therefore evident at the time of the assessment. All drainage lines were however dry during the site investigation, indicating the ephemeral nature of the drainage lines.

Figure 12: Example of Gravel Sized Alluvial Sediments within a Minor Drainage Line

6.2.1.3 Vegetation

According to **Todd (2017)**, the main driver of vegetation pattern in the study area is the substrate. **Todd (2017)** elaborates that on the gravel and stony soils, the vegetation consists of open shrub-dominated vegetation typical of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by *Stipagrostis* species characteristic of Bushmanland Arid Grassland. As such, large parts of the site including the Ithemba study area is dominated by so called "white grasses" and is clearly representative of the Bushmanland Arid Grassland vegetation type. However, the Bushmanland Basin Shrubland is considered the dominant habitat type along large sections of the grid line corridors. In consideration of the above, the drainage lines in the northern areas of the study site were found to be dominated by shrubland vegetation species including a mixture of low sturdy and spiny (and sometimes also succulent) shrubs. **Todd (2017)** states that taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. Graminoid species were also present directly within and along the banks of the drainage lines. The most notable grasses found in the northern drainage lines were that of the *Stipagrostis* family. Conclusively, **Todd (2017)** states that, although the drainage lines are not well developed (which can be ascribed to aridity of the area), they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events.

Figure 13: Example of Low and Sturdy Spinescent Vegetation Species typical of the Bushmanland Basin Shrubland Vegetation Type inhabiting a Minor Drainage Line

6.2.1.4 Comment on Ecological Condition of the Minor Drainage Lines

Overall, the drainage lines appeared to be in a largely natural condition. Existing impacts affecting the drainage lines are mainly due to grazing and anthropogenic (dirt road and fencing) impacts. Minor signs of erosion were evident. Drainage lines were also generally well vegetated along the channel banks as well as instream in some instances.

6.2.2 Channel (Major Drainage Lines)

6.2.2.1 Topography Associated with the Watercourse

The major drainage lines were found toward the mid-way to end sections of the grid line corridors. As such, the topography associated with the major drainage lines are generally characterised by low ridges and undulating terrain in the eastern and south eastern areas. Again, the direction of drainage is dependent on the local topography and can flow in any direction. The major drainage lines were found to be more well-developed reaches (particularly the Klein Rooiberg, Leeuberg and Hartbeeslaagte) downstream of numerous first order streams found higher in the drainage network. The major drainage lines were not in flow during both assessment periods and are therefore also considered to be ephemeral, only flowing temporarily during and briefly after heavy rainfall events.

The major drainage lines are relatively broad in extent, reaching a channel width of typically 100-200m. The widest drainage line crossing a grid line corridor however reached approximately 450m. Some major drainage lines are characterized by broad valley bottoms which open up into bare and exposed plains where overland flows wash through into more densely vegetated areas further downstream. The major drainage lines with open wash areas tend to however lack clearly defined channels. As such, the reaches of the delineated major drainage lines are considered an A-section reach due to the lack of a distinct channel and visible saturation zone (**Figure 14**). However, despite the more defined channels associated with incised macro channel banks, these systems are located relatively high up in the respective catchments and also lack a visible saturation zone. Therefore, the Klein Rooiberg, Leeuberg and Hartbeeslaagte as well as all other identified major drainage lines are also a representative of A-section reaches.

Figure 14: Image of the Major Drainage Line with Poorly Developed Channel

6.2.2.2 Alluvial Soils and Deposited Materials

The alluvial soils and deposited materials are highly similar to the sediments found in the minor drainage lines consisting of a mixture of fine-sandy-gravel sized grains that are deposited following flows driven by rainfall events.

6.2.2.3 Vegetation

The vegetation in the major drainage lines were found to be highly similar to that found in the minor drainage lines. As previously mentioned, the drainage lines in the northern areas of the study site were found to be dominated by shrubland vegetation species including a mixture of low sturdy and spiny (and sometimes also succulent) shrubs. As such, the vegetation consisted of a mixture of taller spinescent shrubs (*Lycium pilifolium* and *Rhigozum trichotomum*) and *Stipagrotis* (particularly *Stipagrostis namaquensis*) species. Once again, the importance of the drainage lines are reiterated in terms of the higher cover and productivity of these areas which are important for fauna forage and habitat availability, as well as performing an important hydrological role through regulating flow following occasional strong rainfall events **(Todd, 2017)**.

6.2.2.4 Comment on Ecological Condition of the Major Drainage Line

Overall, the major drainage lines appeared to be in a largely natural condition. Similar existing impacts affecting the minor drainage lines were found to also affect the major drainage line. The existing impacts included mainly grazing impacts and anthropogenic impacts (dirt roads and fences). The major drainage lines were also generally well vegetated along the channel banks as well as instream in some instances.

6.2.3 Depression (Pan) Wetlands

6.2.3.1 Terrain and Wetland Soil Characteristics

The depression wetlands identified can be divided into two sub-groups, namely saline and non-saline depression wetlands. The first sub-group includes a cluster of depression wetlands which can be found within 2km of Linking Substation Option 1. Only one (1) of the depression wetlands belonging to the cluster of wetlands is in the common grid line corridor shared by all alternative options. This depression wetland was found to be linked geologically to a ridgeline west of the wetlands. The wetlands are therefore wedged on the eastern side of the ridgeline (**Figure 15**).

Figure 15. Saline Depression Wetland Wedged alongside a Ridgeline

The second sub-group of wetlands includes the non-saline depression wetlands. A total of four (4) non-saline depression wetlands were identified mainly on relatively flat to gently undulating terrain. Two wetlands (2) are located in grid line option 2 which is also common to grid line option 4, whilst the remaining two (2) depression wetlands can be found within grid corridor option 4. In general, climate and landscape characteristics create favorable drainage conditions resulting in depression formations. The depression wetlands did not appear to be saline as no salt precipitation was evident at the surface (**Figure 16**).

Figure 16: Non-saline Depression Wetland

Aside from salt precipitation at the surface, soil samples drawn from the saline depression wetland revealed that the topsoil could be attributed to an Orthic A horizon. Meanwhile, the sub-soil showed typical mottling signatures in the form of red iron oxide mottling. The presence of this sub-soil may be said to be representative of a Soft Plinthic B horizon. Black mottling signatures were also evident indicating a degree of manganese concentration in the sub-soils (**Figure 17**). It must also be stated that these soils appeared to exhibit a higher clay content. The Westleigh Soil Form could therefore be attributed to these wetlands. Soil sampling was limited by rock depth (approximately 60-80cm).

Figure 17: Salt Precipitation at the Surface (left) and Red Iron and Black Manganese Accumulations observed in the Sub-soils of a Saline Wetland

In terms of the non-saline wetlands, soil samples drawn revealed fine-grained to sandy particles within a light brown matrix. Soils were relatively shallow (>0.5m). No distinct signs of wetness could however be observed (**Figure 18**). It was therefore considered that the chemical constituency of these particular soils are not considered conducive to the formation of typical wetland hydrogeomorphic (reduction and mottling) characteristics found in the saline wetlands. It may well be that the geochemical constituency of the sediment particles, coupled with high pH and the physico-chemical characteristics of the soils may mask the formation of the typical mottling characteristics observed in wetlands in other parts of the country. This is a limitation not expressed in the **DWAF (2005 & 2008)** guideline for delineation of wetlands.

Figure 18: Sub-soils from a Soil Sample Drawn from a Non-saline Depression Wetland

Overall, the prevailing climate acts as a constraint to the time that water is available or the duration of saturation (hydroperiod) for the both the saline and non-saline wetlands. The wetlands are therefore rainfall driven and consequently temporary in nature. High temperatures, low rainfall and high evaporation rates in the region contribute to limited hydroperiod of the wetlands. For the saline depression wetland near the Option 1 Linking Substation, these factors also play a role in combination to the geology and soil composition of the area contributing to the salinity status of the wetlands. Given the prevailing climate and characteristics of the soils, the wetlands were deemed to be temporary in nature.

6.2.3.2 Wetland Vegetation

Vegetation within the wetlands varied from no vegetation in the core areas of the saline wetland, to relatively dense coverage of the non-saline wetlands consisting of mainly shrubland vegetation. It was identified that salinity could be linked to the degree of vegetation occurrence. **Todd (2017)** identifies three wetland habitat types for the depression wetlands in the region including non-saline pans with a bare center and fringed by taller woody vegetation; non-saline pans vegetated by *Athanasia minuta* (**Figure 19**) and saline pans that are not vegetated. Of these wetland vegetation types, the wetlands within the grid line corridors include two types. These being the non-saline pans vegetated by *Athanasia minuta* and saline pans that are not vegetated. **Todd (2017)** further states that the depression wetlands which are not saline and are vegetated in the centre by *Athanasia minuta* additionally may include species such as *Lycium pumilum*, *Salsola glabrescens*, *Salsola aphylla*, *Rhigozum trichotomum*, *Parkinsonia africana*, *Psilocaulon coriarium* and *Osteospermum*

armatum around the fringes. He furthermore states that, the saline pans are not vegetated on account of the salt present, but are nevertheless ecologically important as they support a variety of temporary water organisms when they contain water (**Todd, 2017**).

In this respect, the depression wetlands are important for the maintenance of biodiversity. Given that the depression wetlands are temporary in nature, these system are therefore highly variable ecosystems which undergo changes in physical and chemical characteristics regularly. As such, variations are brought about in changes in substrate, inundation cycles, local climate and physical dimension of the wetland(s). Consequently, the invertebrate fauna that inhabit these environments have various physiological, behavioural and structural adaptations, enabling their survival in a constantly changing environment. Important organisms of concern that may potentially occur in these wetlands, is that of the class *Branchiopoda* (and the order *Anostraca*). These species survive desiccation through production of an egg bank which is resistant to desiccation, hatching after lying dormant during the dry phase under favorable conditions when inundation takes place. With this in mind, impacts such as sedimentation could result in preventing hatching after rainfall.

Figure 19: Depression Wetland colonised by *Athanasia minuta*

6.2.3.3 Comment on the Ecological Condition of the Depression Wetlands

The pan wetlands were observed to be in a largely natural condition. Prevailing impacts that were found to affect the wetlands include mainly grazing impacts. Depression wetlands near to Helios Substation were found to be additionally affected by anthropogenic (dirt roads, grid lines and fences) impacts.

6.3 Surface Water Buffer Zones

When determining the buffer zones for drainage lines and wetlands, critical factors that need to be considered as a result of the proposed development include the ecological drivers of these hydrological features.

The primary threats related to the proposed substation, grid lines and service / access roads are mainly during the construction phase. Particularly, the potential impacts include increased run-off, erosion and sediment inputs. Additional potential threats include geomorphological impacts due to compaction as a result of direct physical degradation from vehicular activity, soil contamination from vehicles and machinery, as well as related water quality impacts from oil and fuel spills and / or leakages from vehicles and machinery. Given this, increased run-off will have impacts on the hydrology of the surface water resources in terms of alteration of flood peaks. Clearing of vegetation can also affect the surface roughness of the catchment thereby also contributing to accelerated surface run-off, consequent sedimentation and erosion of surface water resources. Sedimentations and erosion impacts can affect the geomorphological integrity of the surface water resources. In terms of contamination impacts, leakages and spill of hazardous substances such as fuels and oils can affect the water quality and contaminate soils of the surface water resources following transportation of these substances and liquids in surface run-off following rainfall events. Potential negative impacts to the biota and vegetation inhabiting the surface water resources may result in affecting the biodiversity and overall ecological functioning of the surface water resources.

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

Given the above, a buffer zone of 100m for the major drainage line and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the factors above so as to limit potential direct and indirect impacts on the surface water resources as far as practically possible.

7 COMPARATIVE ASSESSMENT

As previously mentioned, two (2) on-site substation and two (2) linking station alternative site locations as well as four (4) grid line corridor alternatives have been investigated for the proposed development. These alternatives have been comparatively assessed in order to determine the preferred alternative from a surface water perspective.

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 assesses 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 or may be able to span the surface water feature.

The fourth criteria assesses the number of sub-catchment areas that will be affected by the proposed development. The sub-catchments include the surface water specific local catchment areas for the endorheic systems as well as the general quaternary catchment areas containing one or more surface water features. Where more sub-catchment areas are affected (both directly / indirectly), more potential contamination pathways may be present thereby influencing the extent and severity of impact.

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

The preference ratings for the onsite substation site alternatives are provided in **Table 1** 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 1: Surface Water Comparative Assessment Table

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
On-site Substation Option 1	Preferred	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources include a several minor drainage lines located approximately 600m on the opposite side of a ridgeline (watershed). Drainage therefore does not lead from the substation alternative location towards these drainage lines. Indirect impacts are therefore negligible since the ridgeline acts as a physical barrier to the drainage lines. The potential for direct and indirect impacts is negligible considering the physical barrier and distance to these nearby (<600m) surface water resources. This option is therefore preferred.
On-site Substation Option 2	Not Preferred	Two (2) drainage lines are found directly within the footprint of this

Alternative	Preference	Reasons (incl. potential issues)
		alternative site. Moreover, six (6) additional minor drainage lines can be found within 200m of the alternative site. The potential for direct and indirect impacts is moderate to high considering the location of the proposed substation as well as the proximity to nearby (<200m) surface water resources. This option is therefore not preferred.
Linking Substation Option 1	Favourable	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources are the cluster of saline depression wetlands, of which the nearest saline depression wetland within the common grid line corridor for all alternatives is located approximately 1,1km to the east. The potential for indirect impacts is minimal to considering the distance to the depression wetland. This option is therefore favourable.
Linking Substation Option 2	Preferred	No surface water resources are found directly within the footprint of this alternative site. The nearest surface water resources are the cluster of saline depression wetlands, of which the nearest saline depression wetland within the common grid line corridor for all alternatives is located approximately 3,5km to the south east. The potential for indirect impacts is very minimal considering the distance to the depression wetland. This option is therefore preferred.
GRID LINE CORRIDOR ALTERNATIVES		

Alternative	Preference	Reasons (incl. potential issues)
Grid Line Option 1	Favourable	There is one (1) depression wetland, thirteen (13) major drainage lines and sixty five (65) drainage lines within grid line option 1. A total of seventy nine (79) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.
Grid Line Option 2	Favourable	There are three (3) depression wetlands, eight (8) major drainage lines and sixty nine (69) drainage lines within grid line option 2. A total of eighty (80) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.
Grid Line Option 3	Preferred	There is one (1) depression wetland, eight (8) major drainage lines and twenty eight (28) drainage lines within grid line option 3. A total of thirty seven (37) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the

Alternative	Preference	Reasons (incl. potential issues)
		number and types of surface water resources that may potentially be affected, this option is considered to be preferred.
Grid Line Option 4	Favourable	There are five (5) depression wetlands, six (6) major drainage lines and sixty one (61) drainage lines within grid line option 4. A total of seventy two (72) surface water resources may potentially be affected by the proposed development for the option. The grid line however, can be routed to avoid, and span any features where avoidance is not possible. Given the number and types of surface water resources that may potentially be affected, this option is considered to be favourable.

Based on the above assessment, the preferred options include the following:

- **On-site Substation Option 1**
- **Linking Substation Option 2**
- **Grid Line Option 3**

The above preferred options were chosen given the fewer amount of surface water resources to be directly and indirectly affected as well as to ability of the grid line to avoid / span potentially affected surface water resources.

8 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

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

8.1 Construction Phase Potential Impacts

8.1.1 Loss of Wetland and Riparian Habitat

There are a number of direct impacts during the construction phase that can potentially have an adverse effect on the identified and delineated surface water resources habitat. These include construction of the substation, lay-down area and grid line pylons directly or in close proximity to surface water resources and the associated buffer zones (<50m of wetland and drainage lines buffer zones and within 100m of major drainage lines), clearing of drainage line or wetland vegetation, human degradation to surface water resources habitat during construction activities, and vehicle degradation by compaction during movement.

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

The substation and construction lay-down area particularly will need to be cleared of all vegetation and ideally flattened to establish the electrical infrastructure, temporary site offices, and storage areas for waste (temporary), vehicles, materials and machinery, respectively. Here removal of vegetation and edge impacts will degrade the state of vegetation associated with the surface water resources. With regards to clearing vegetation in general for the grid line pylons and access / future service roads, the areas where the pylons will need to be placed will need to be cleared of vegetation in order for the foundations to be established. Additionally, vegetation clearing will need to take place where roads are to be established for transport of workers and materials and may potentially be used as future service roads for maintenance in the future.

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

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

Table 2. Rating for Potential Construction Impacts to Surface Water Resources Habitat

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of drainage line and wetland habitat	
Extent	*Site*	
Probability	*Probable*	
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 level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**Designation of Highly Sensitive Areas** The wetlands and drainage lines must be designated as "highly sensitive" and any impact must be limited to the minimum possible extent. All wetlands and drainage lines to be directly affected must be visibly demarcated prior to construction activities taking place. The demarcation of wetlands and drainage lines must be visible and last for the duration of the construction activities. **Avoidance of Direct Impacts to Surface Water Resources** The construction lay-down area must not be situated directly within or within a proximity of 500m from any wetlands and / or drainage lines or within a 100m from any major drainage lines adhering to the stipulated buffer zones.	

	The potential future access / service roads must be planned to route around and not directly through surface water resources as far as practically possible. Where this is not possible, a Right of way (RoW) will need to be established. **Establishment of Road Access Areas** For general access to erect the pylons for the grid line, existing roads are to be used as far as possible. No roads are to be routed through any wetlands and / or drainage lines (including buffer zones) as far as practically possible. Where this is not possible however, and where no other access exists to the desired construction areas, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented accordingly. A single access route or road access area is then to be established before construction takes place, if required. This should be planned to cross perpendicularly through any drainage line(s). For wetlands, the road access area must be planned for minimal impact on wetlands (i.e. shortest route, not routed through the core of the wetlands, minimal destruction of habitat etc.). The access route should follow existing routes where present. However, where new routes are to be established, temporary or permanent Ford (or low-water) crossings and / or similar design crossings using the stream / wetland bed as part of the road can be established. Temporary ford crossings and / or similar design crossings can be planned where construction vehicles need to access proposed construction areas during construction the construction phase only. Where the access route will form part of permanent access and / or service roads, permanent ford crossings and / or similar design crossings will however be required. Given the study area, and the temporary nature of surface water resources to be potentially affected, this design should be adequate since it enables hydrological continuity of the identified temporary surface water resources, maintains substrate continuity as well as allows movement of riparian and wetland bound species. To establish a temporary ford crossing and / or similar design crossings, little to no modification of the stream banks or wetland will be required where banks are low (approximately

	1,2m) for drainage lines or topography is flat for wetlands, where the grade or approach to the drainage line does not exceed 5:1 (horizontal to vertical) and lastly, where the stream bed is firm rock or gravel. Ideally, fords and / or similar design crossings should maintain the natural shape and elevation of the drainage line and / or wetland. However, where modification is required, the banks and bed will have to be reinstated after construction has finished. Modifications to the banks may include limited grading, excavation of steep slopes, establishment of clean gravel approach to drainage line and wetland banks, placement of road base, etc. Such modifications are likely to be required for crossings through surface water resources with soft substrate. To establish the temporary bed crossing, use of materials to construct temporary mats made of wood or tyres can be used. Modifications will however need to be approved from the relevant environmental and water regulatory authorities prior to construction. For permanent ford crossings and / or similar design crossings, rock or gravel may be used on weak drainage line and / or wetland beds. The weak substrate layer will need to be excavated an infilled by the rock or gravel material to the same level of the original drainage line or wetland bed. A minimum of approximately 30cm of infill should typically be used unless soil depth is limited. A geotextile can be used to separate the infill from the bed of the surface water resource thereby providing additional support. Where other designs are more appropriate and these can be implemented, this is to be on approval from the relevant environmental and water regulatory authorities prior to construction. In general, the width of the road access areas must be limited to the width of the vehicles required to move through the relevant surface water resource(s). The road access areas must be made clearly visible by means of demarcation during construction. Ideally, for temporary ford crossings, vegetation should not be totally cleared across the entire road access areas. Rather, only the vehicle tracks should be cleared. Remaining vegetation can be kept trimmed to

	below 20cm but not lower than 5cm in height. Trees or shrubs may however require removal. Permits must be obtained where sensitive or protected vegetation species are to be removed. Preferably, these should be relocated. Erosion inspections will need to be undertaken regularly (as often as environmental compliance monitoring is undertaken by a suitably qualified Environmental Compliance Officer (ECO) during the construction phase, and monthly during the operation phase) in order to manage the integrity of the temporary and permanent ford crossings and / or similar design crossings. Additionally, rehabilitation will need to take place if and where required. Overall, no wetlands and or drainage lines are to be crossed during or directly after a rainfall event. Use of internal road access areas are only permissible after rainfall events once flows have ceased. Preferably light vehicles are to be utilised where possible and the usage of heavy vehicles must be avoided as far as possible. Where heavy vehicles (such as TLB's) must be used, extreme caution is to be exercised when entering the road access areas of the wetland and drainage lines due soil instability factors. Construction workers are only allowed in the designated road access areas. Any personnel traversing through the wetlands and / or drainage lines must be instructed not to light any fires, and / or remove any vegetation. **Control of Alien and Invasive Vegetation in Surface Water Resources** Control of alien and invasive vegetation within surface water resources will be required. Where alien and invasive vegetation encroachment / colonization takes place, these areas are to be cleared as soon as practically possible. Clearing should take place by means of mechanical removal, either by physically pulling or slashing and clearing of unwanted alien and invasive vegetation near or within the surface water resources. Monitoring of alien and invasive vegetation should be undertaken in accordance with the

	environmental compliance monitoring during the construction phase. **Emergency Measures** Operational fire extinguishers are to be available in the case of a fire emergency. Given the dry seasons and variable winds that the region experiences, it is recommended that a fire management and emergency plan is compiled. A suitably qualified health and safety officer must compile the fire management and emergency plan for the operation and maintenance phase of the project. **Post-construction Rehabilitation** Rehabilitation of the road access areas that will not be used as service roads for maintenance activities following the construction period will be required post-construction. Ideally, the affected areas must be levelled, or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish. However, given the aridity of the study area, it is likely that vegetation recovery will be slow. Rehabilitation areas will need to be monitored for erosion until vegetation has re-established where prevalent. If affected areas are dry and no vegetation is present, the soil is to be re-instated and sloped to the pre-existing natural state. **Buffer Zone Specific Mitigation Measures** During construction activities, the outer extent of the buffer zones of the wetlands and drainage lines must be designated as “sensitive” and any impact must be limited to the minimum possible extent. The buffer zone extent must be visibly demarcated prior to construction activities taking place where construction is directly within the buffer zone. The demarcation of the buffer zones must be visible and last for the duration of the construction activities. See above for same access (road access area) mitigation measures to be implemented within buffer zones.

8.1.2 Impacts to the Geomorphology of Surface Water Resources

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the surface water resources and the 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) soil erosion, as a consequence of the proposed development, is a possibility. A further impact due to erosion and potential storm water run-off impacts is increased run-off and sedimentation to surface water resources. Increased run-off can erode channels more easily, whilst an increased load of deposited sediments can smother vegetation and change flow paths / dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

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

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

Table 3. Rating for Potential Construction Impacts to the Geomorphology of the Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the degradation of the soils associated with the drainage lines and wetlands	
Extent	*Site*	
Probability	*Probable*	
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 level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2

Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**General Mitigation Measures** Apply same mitigation measures stipulated in **Section 7.1.1** above in terms of the following: ▪ Designation of Highly Sensitive Areas ▪ Establishment of Access Road Areas ▪ Avoidance of Direct Impact to Surface Water Resources ▪ Emergency Measures ▪ Post-construction Rehabilitation ▪ Buffer Zone Specific Mitigation Measures **Preventing Increased Run-off, Erosion and Sedimentation Impacts** – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future. 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. Erosion control management will need to be undertaken at the onset of construction. Regular monitoring and adequate erosion preventative measures (such as run-off protection as stipulated above) are to be implemented as and where required.	

8.1.3 Impacts to Soil and Water in Surface Water Resources

With the movement of vehicles and personnel potentially in surface water resources, there is the possibility of soil and water contamination. Soil contamination may take place as a result of oil, fuel leakages and / or cement spills from the vehicles passing in close proximity or directly within surface water resources. Similarly, where and when surface water is present, water contamination from the

same source may result. In addition, other amenities and / or storage of substances may also lead to both soil and water contamination either directly or indirectly. Where temporary toilets for workers are placed within the buffer zones, indirect contamination may result where leakages from temporary toilet units drain into surface water resources. Moreover, direct soil and water contamination can take place where temporary toilets are placed directly in surface water resources and where leakage takes place.

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

Altering the chemical composition of the soil and water disrupts the natural baseline condition to which organisms and vegetation have adapted to in order to survive. Contamination of water and soil may affect the functionality of organisms and vegetation, even potentially leading to death. Importantly, altering the chemical composition of water is considered pollution and must be prevented in terms of the NWA.

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

Table 4. Rating for Potential Construction Impacts to the Soil and Water Contamination Impacts to Surface Water Resources

IMPACT TABLE		
Environmental Parameter	Major / Minor Drainage Lines and Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the contamination of the soils and water associated with the drainage lines and wetlands	
Extent	*Site*	
Probability	*Probable*	
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 level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1

Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 26 (low negative)
Mitigation measures	**General Mitigation Measures** Apply same mitigation measures stipulated in **Section 7.1.1** above in terms of the following: ▪ Designation of Highly Sensitive Areas ▪ Establishment of Road Access Areas ▪ Avoidance of Direct Impact to Surface Water Resources ▪ Emergency Measures ▪ Post-construction Rehabilitation ▪ Buffer Zone Specific Mitigation Measures **Preventing Soil and Water Contamination** No vehicles are to be allowed in the highly sensitive and sensitive areas unless authorised. Should vehicles be authorized in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. Should there be any oil, fuel or any other fluid leaks, vehicles and machinery are not to be allowed into any drainage sensitive and highly sensitive areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive and sensitive areas. Sufficient spill contingency measures must be available throughout the construction process. These include, but are not limited to, oil spill kits to be available and fire extinguishers. Storage areas for fuel, oil, paints and other hazardous substance are not to be stored directly within surface water resources or the associated buffer zones. These substances	

	must also be contained in bunded areas with a capacity of at least 110%. No “long drop” toilets are allowed on the construction site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must not be placed directly within any surface water resource(s) or the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. No cement mixing is to take place in any surface water resource. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive and sensitive areas.

8.1.4 Impacts to Fauna associated with Surface Water Resources

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

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

Table 5. Rating for Potential Construction Impacts to the Fauna associated with Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Major / Minor Drainage Lines and Wetlands
Issue/Impact/Environmental Effect/Nature	Impacts to fauna associated with drainage lines and wetlands
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 impact can be reduced to an even lower level.*	
	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	**Preventing Impacts to Fauna Associated with Drainage lines and Wetlands** No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten by construction workers or any other project team members. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed Environmental Control Officer (ECO) or suitably qualified individual may only remove animals, where such animals (including snakes, scorpions, spiders etc.) are a threat to construction workers. The ECO or appointed individual is to be contacted should removal of any fauna be required during the construction phase. Animals that cause a threat and need to be removed, may not be killed. Additionally, these animals are to be relocated outside the road access or construction areas, within relative close proximity where they were found.	

8.2 Operation Phase Potential Impacts

8.2.1 Impacts to the Geomorphology and Hydrology of Surface Water Resources

Vehicle access to the substation/linking station sites and infrastructure (such as roads, cables and grid lines etc.) in and / or through and / or over (grid lines spanning) surface water resources. It is therefore important that access routes / future service roads 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.

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

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

Table 6. Impacts to the Geomorphology of Surface Water Resources

IMPACT TABLE	
Environmental Parameter	Major / Minor Drainage Lines and Wetlands
Issue/Impact/Environmental Effect/Nature	Impacts associated with the geomorphological and hydrological impacts associated with the drainage lines and wetlands
Extent	*Site*
Probability	*Probable*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Significant 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 level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 45 (medium negative)	- 24 (low negative)
Mitigation measures	**Minimising Vehicle Damage to the Surface Water Resources** Potential impacts can be avoided by planning and routing of access / service roads outside of and away from all surface water resources and the associated buffer zones. Where access through surface water resources are unavoidable and are absolutely required, it is recommended that any road plan and associated structures (such as ford crossings, 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 / aquatic specialist must be obtained in this respect should this be required. Control of erosion on the construction site in general must be managed through implementation of an erosion management plan. Erosion and subsequent sedimentation of surface water resources are considered significant impacts in terms of the proposed development that must be managed adequately throughout the operation of the proposed development.

8.3 Decommissioning Phase Potential Impacts

8.3.1 Decommissioning Impacts

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

8.4 Potential Cumulative Impacts

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

The proposed renewable energy developments in the surrounding area (55km radius) outside of the study site are identified in **Table 7** and shown in **Figure 20** below.

It must be noted that surface water resources change from one site to another and can range from a number of surface water resources in one area to very few on a neighbouring property depending on factors such as topography, geology, local rainfall and other environmental factors. Additionally, the characteristics of surface water resources can change along its course where longitudinal hydrological systems are involved. Nonetheless, the most important factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur, these are likely to have an impact downstream to some degree.

Table 7. Renewable Energy Developments Proposed within a 55km Radius of the Graskoppies Substation and Grid Line Study Site

Development	Current status of EIA/development	Proponent	Capacity	Farm details
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de

				Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Aan De Karree Doorn Pan No. 213; Portion 1 of the Farm Karree Doorn Pan No. 214; and Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

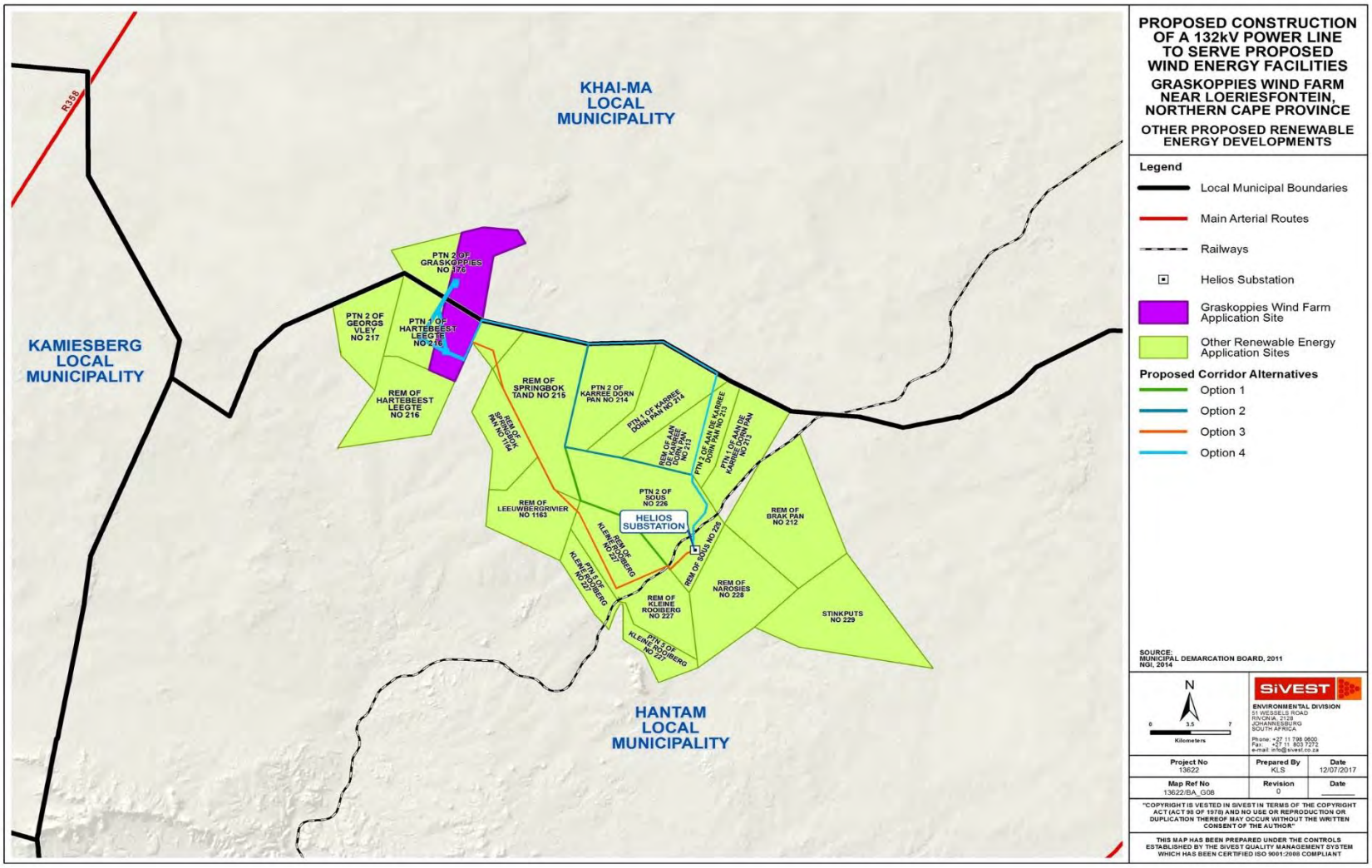


Figure 20. Renewable Energy Facilities Proposed within a 55km Radius of the Xha! Boom Substation, Linking Station and Grid Lines

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

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

The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a northern direction, whilst drainage for the Kokerbook 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely.

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

9 LEGISLATIVE IMPLICATIONS

9.1 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 (2017), based on the current layout, it is identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 will be triggered due to access / service roads and power lines through surface water resources, thereby requiring Environmental Authorization. The aforementioned potentially applicable activities are elaborated on in more detail below.

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

The development of-

(x) buildings exceeding 100 m² in size;

(xii) infrastructure or structures with a physical footprint of 100 m² or more;

where such development occurs-

a) within a watercourse (wetland);

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

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

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

The infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from-

(I) a watercourse;

Where access / service roads will route directly through any of the identified surface water resources and will be associated with the infilling or depositing of any material of more than 10 m³ into, or the dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than 10 m³ from surface water resources, this activity will be triggered.

9.2 National Water Act, 1998 (Act No. 36 of 1998)

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

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

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

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

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

In this context, a water use license will be required where any of the above water uses are required for a development. As such, for the proposed development, it has been identified based on the current layout that surface water resources will be affected by construction of access / service roads and power lines. Therefore, water uses (c) and (i) are applicable.

However, once a final layout (including a road plan and grid line, showing tower positions) is available, it is recommended that an assessment using the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229) is undertaken to potentially determine whether a General Authorisation (GA) can be issued in this regard for water uses (c) and (i) instead of undertaking a full water use license application. Should it be identified that the proposed development falls within the Low risk category, a GA registration process may be applicable as opposed to a full water use license application.

10 SPECIALIST RECOMMENDATIONS

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

- All surface water resources and buffer zones must be avoided as far as practically possible in the final layouts (including access / service roads and power lines, including tower positions) to be designed in order to minimise and potentially avoid potential impacts as far as possible.

- Where it is not possible to avoid impacts to surface water resources as a result of roads and power lines, the necessary water use license / general authorisation and environmental authorisations as relevant will be required prior to construction.
- All stipulated mitigation measures are to be adhered to in order to minimise potential impacts to surface water resources.
- With the implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding final access / service road layouts, final grid line routes and tower positions) and therefore, may by environmentally authorised.

11 CONCLUSION

SiVEST has been appointed by Mainstream to undertake a BA and Environmental management Programme (EMPr) for the proposed construction of the Xha! Boom substation, linking station and associated 132kV grid line, near Loeriesfontein in the Northern Cape Province. As part of the BA study, the need to undertake a surface water impact assessment was identified. In this study, a delineation and impact assessment of surface water resources is provided.

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

- Five (5) Depression Wetlands;
- Twenty six (26) Major Drainage Lines including Klein-Rooiberg, Leeuberg and Hartbeeslaagte (drainage line with a channel width >5m);
- One hundred and eighty (180) Minor Drainage Lines (drainage lines with a channel width <5m).

An ecological buffer zone of 100m for the major drainage line and a buffer of 50m for minor drainage lines and the natural depression wetlands have been applied in consideration of the potential direct and indirect impacts which may occur, so as to limit these impacts on the surface water resources as far as practically possible.

A comparative assessment was undertaken to determine the environmentally preferred options include the following:

- **On-site Substation Option 1**
- **Linking Substation Option 2**
- **Grid Line Option 3**

The above preferred options were chosen given the fewer amount of surface water resources to be directly and indirectly affected as well as to ability of the grid line to avoid / span potentially affected surface water resources.

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

CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Loss of Wetland and Riparian Habitat	- 42 (medium negative)	- 26 (low negative)
Impacts to the Geomorphology of Surface Water Resources	- 42 (medium negative)	- 26 (low negative)
Impacts to Soil and Water in Surface Water Resources	- 42 (medium negative)	- 26 (low negative)
Impacts to the Fauna associated with Surface Water Resources	- 22 (low negative)	- 6 (low negative)
OPERATION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Impacts to the Geomorphology of Surface Water Resources	- 42 (medium negative)	- 24 (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.

From a direct cumulative potential impact perspective, where there is no direct impact to surface water resources on the proposed project site, there will be no direct cumulative impact to surface water resources from a project site specific level. The nearest surrounding development that could potentially be impacted as a result of the proposed development from an indirect perspective is the Kokerboom 2 Wind Farm. This wind farm is located approximately 9km from the proposed development site. Therefore, there is a fair distance between the proposed development and the nearest surrounding development. The two sites are also separated by a watershed and occupy separate local catchments. Drainage from the proposed development is in a northern direction, whilst drainage for the Kokerbook 2 Wind Farm is in a south eastern direction. As a result, it is therefore highly unlikely that the proposed development will affect the Kokerboom 2 Wind Farm should this development proceed to construction. Indirect impacts such as increased run-off, consequent sedimentation and erosion are highly unlikely. Over and above the negligible potential cumulative impact to Kokerboom 2 Wind Farm, the potential cumulative impact on the remaining surrounding renewable energy developments is negligible for the same reasons, as stated above. The negligible cumulative impact is compounded by the fact that there is an increased distance to the remaining surrounding proposed renewable energy developments.

In terms of potential applicable legislation from a surface water perspective, potentially triggered environmental activities and water uses were evaluated. As such, in terms of NEMA (1998) and the EIA Regulations (2017), based on the current layout, it has been identified that Activities 12 and 19 of Government Notice 327 Listing Notice 1 may be triggered due to potential direct impacts due to access / service roads and power lines, thereby requiring Environmental Authorization. In terms of the NWA (1998), it has been identified that based on the current layout, there are a number of surface water resources which may be affected by access / service roads and power lines. Water uses (c) and (i) will therefore be applicable. However, once a final layout (including a road plan and grid line, showing tower positions) is available, it is recommended that an assessment using the risk assessment protocol in terms of Government Notice 509 of 2016 (No. 40229) is undertaken to potentially determine whether a General Authorisation (GA) can be issued in this regard for water uses (c) and (i) instead of undertaking a full water use license application. Should it be identified that the proposed development falls within the Low risk category, a GA registration process may be applicable as opposed to a full water use license application.

Finally, specialist recommendations include the following:

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

  With the implementation of mitigation measures, it is the opinion of this specialist that the proposed development components as per the layout are acceptable (notwithstanding final access / service road layouts, final grid line routes and tower positions) and therefore, may by environmentally authorised.

12 REFERENCES

1. Collins, N.B., 2005: Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.
2. Department of Water Affairs and Forestry (DWAF), 2005: A practical field procedure for identification and delineation of wetlands and riparian areas (edition 1). DWAF, Pretoria.
3. Lanz, J., 2017: Agricultural and Soils Impact Assessment for Proposed Construction of the Xha! Boom Substations and associated 132kV Power Line near Loeriesfontein, Northern Cape Province.
4. Mucina, L & Rutherford, M. C., 2006: The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
5. Ollis, D. J., Snaddon, C. D., Job, N. M & Mbona, M., 2013: Classification System for Wetlands and other Aquatic Ecosystems in South Africa, User Manual: Inland Systems.
6. Todd, S., 2017: Xha! Boom Wind Farm near Loeriesfontein: Fauna and Flora Specialist EIA Report.

Appendix A:

Specialist Credentials

CURRICULUM VITAE

Name	Shaun Taylor
Profession	Environmental Scientist
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Environmental Scientist: Environmental Division
Date of Birth	02 February 1984
ID Number	8402025020082
Nationality	South African

Education

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

Professional Qualifications

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

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

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

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

Language Proficiency

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

Employment Record

Oct 2010 – Present (Full-time)	SiVEST SA (Pty) Ltd Environmental Division – Environmental Scientist
Oct 2009 – Mar 2010 (Part-time)	Envirokey cc – Junior Environmental Consultant and GIS support
Aug 2007 – Sep 2009 (Part-time)	Holgate, Meyer and Associates Environmental Management Services – Junior Environmental Consultant

Key Experience

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

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

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

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

Projects Experience

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

STRATEGIC ENVIRONMENTAL ASSESSMENTS

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

ENVIRONMENTAL IMPACT ASSESSMENTS

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

BASIC ASSESSMENTS

- Proposed Installation of a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station, Mpumalanga Province (2011/2012);
- Proposed development of a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);

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

ENVIRONMENTAL MANAGEMENT PLANS / PROGRAMMES

- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Transmission Infrastructure (2011);
- Eskom Thyspunt Nuclear Integration Project Environmental Management Plan – Substations (2011);
- Mookodi Integration Project Environmental Management Plan – Transmission Infrastructure and Substations (2011/12);
- Noupoort Wind Farm Environmental Management Programme (2012);
- Environmental Management Programme for a 500m³ Bulk Storage Fuel Oil Tank at Grootvlei Power Station (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Kimberley, Northern Cape Province (2012);
- Environmental Management Programme for a 19MW Photovoltaic Solar Power Plant near Danielskuil, Northern Cape Province (2012);
- Karowe Diamond Mine Environmental Management Plan Review and Update, Boteti District, Botswana (2012);
- Environmental Management Programme for the Frankfort Strengthening Project: 88kV power line from Heilbron (via Frankfort) to Villiers, Free State Province (2013);
- Environmental Management Programme for the Wilger Photovoltaic 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 1 Photovoltaic – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Environmental Management Programme for the Limestone 2 Concentrated Solar Power – 132kV Overhead Distribution Power Line, Northern Cape Province (2013);
- Final Environmental Management Programme for the Khobab 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Loeriesfontein 140MW Wind Farm, Northern Cape Province (2014);
- Final Environmental Management Programme for the Noupoort 80MW Wind Farm, Northern Cape Province (2014);
- Environmental Management Programme for the Tweespruit to Welroux 132kV Power Line and Substations, Free State Province (2014/2015);
- Environmental Management Programme for the Loeriesfontein 70MW Photovoltaic and 132kV Power Line, Northern Cape Province (2015/2016).

AMENDMENT APPLICATIONS

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

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

ENVIRONMENTAL CONSTRAINTS\FATAL FLAWS

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

ENVIRONMENTAL AND WATER USE LICENSE COMPLIANCE AUDITING

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

WATER USE LICENSES

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

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

WETLAND AND RIPARIAN DELINEATION AND FUNCTIONAL ASSESSMENTS

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

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

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

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

WETLAND AND RIPARIAN REHABILIATION / POST-REHABILITATION / AUDITING ASSESSMENTS

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

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

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

JUNIOR ENVIRONMENTAL CONSULTANT AUG 2007 – SEP 2009

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

Conferences and Publications

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

Academic and Work Related Achievements

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

University of Pretoria

Faculty of Natural and Agricultural Sciences

Department of Botany

This is to certify that

SR Taylor

has successfully completed the

Wetland Training Course on
Delineation, Legislation and Rehabilitation

26 to 30 May 2008

This certificate is awarded with distinction

Course Leader

Operations Manager: CE at UP

90306 2008/08/05 ID: 8402025020082 P000828-01-2008

UNIVERSITY OF JOHANNESBURG

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

MAGISTER SCIENTIAE

with field of study

Aquatic Health

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

SHAUN TAYLOR

at a congregation of the University

Vice-Chancellor

Registrar

04 OCTOBER 2011
Johannesburg
ID 8402025020082

58185

Curriculum Vitae: Michiel Jonker

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

Education

University of Johannesburg

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

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

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

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

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

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

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

Majors: Geography and Zoology

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

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

Employment and Work Experience

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

Recent projects:

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

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

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

Feb 07 – Jan 08 **EnviRoss Environmental Scientific Consultants Cc**
Consultant

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

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

Workshops and Courses

2011 **Tools for Wetland Assessment Short Course**
Department of Environmental Science Rhodes University;
Grahamstown Port Elizabeth

2009 **Environmental Management Systems –WTH Management and Training**
ISO 14001, OHSAS 18001 and development of Environmental Management Systems, University of Johannesburg, Auckland Park, Johannesburg

2008 **Wetland and Riparian Delineation Course**
Accredited wetland delineator
Wetland Consulting Services and Department of Water Affairs and Forestry (DWAF)
Pretoria, South Africa.

2008 **Skippers Course**
License Holder of a Category "R" skippers license

2007 **SASS5 Accredited Practitioner**
Auditors: Christa Thirion (DWAF, RQS), Colleen Todd (DWAF, RQS) and Hermien Roux
(North West Nature Conservation).

2007 **Multivariate Statistics Training**
Collaboration between Wageningen University (Holland) and University of Johannesburg, UJ Eiland, Vaal Dam

2006 **Advanced 4x4 driving course**

Societies and Accreditations

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

2009 **Member of the International Association of Impact Assessment-SA (IAIA SA).**

2006 **Member of the Zoological Society of Southern Africa (ZSSA)**

2006 **Member of the Southern African Society of Aquatic Scientists (SASAqS)**

Presentations

Jun 2010 **South African Society of Aquatic Scientists (SASAqS) Congress**
MN Jonker, G. Walsh & JHJ van Vuren
Creating Management Thresholds for Fish Communities Exposed to the Effects of Coal Mining in the Mpumalanga Highveld.

Oct 2009 **Department of Geography and Energy studies, University of Johannesburg**
MN Jonker, M Sherwood and R Rowles. 2009.
Historical overview of water quality associated with the Blesbokspruit RAMSAR site. Syndicate project completed in partial fulfillment of M.Sc (Environmental Management).

Jul 2007 **Zoological Society of Southern Africa Conference, Potchefstroom.**
MN Jonker
Differences in invertebrate community structures associated with pans and dams in the Mpumalanga Highveld, South Africa.

Publications

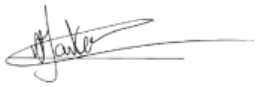
1. Van der Zee, J., Walsh., G., Sonnenberg, R., Alexandre, M. & Jonker, M.N. (*in press*). A description of three new co-occuring *Aphyosemion* species (Cyprinodontiformes: Nothobranchiidae) from Lower Guinea, with notes on habitat partitioning and allopatric speciation. *Zootaxa.*

2. Walsh, G., Jonker. M. & Mamonekene, V. (2014). A collection of fishes from tributaries of the lower Kouilou, Noumbi and smaller coastal basin systems, Republic of the Congo, Lower Guinea, west-central Africa.
Checklist Journal **10 (4):** 900 - 912.

3. Jonker, M.N., Van Vuren, J.H.J & Wepener, V. (2009). The impact of feedlot effluent on water quality and aquatic macroinvertebrate community structure in streams of the upper Vaal River catchment, South Africa. *African Journal of Aquatic Science* **34 (3).**

4. De Jager, C., Swemmer, A., Aneck-Hahn, N.H., van Zijl, C., van Wyk, S., Bornman, M.S., Barnhoorn, I.E.J., Jonker M., van Vuren, J.H.J. & Burger, A.E.C. (2010). Endocrine Disrupting Chemical (EDC) Activity and Health Affects of Identified Veterinary Growth Stimulants in Surface and Ground Water. WRC report no. K5-1686. Pretoria, South Africa.

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



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SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Mr Michiel Nell Jonker
Registration number: 400275/12

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003 (Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Zoological Science	**15 August 2012**
Ecological Science	**19 September 2012**
Aquatic Science	**30 January 2013**

SUID-AFRIKAANSE POLISIEDIENS
FLORIDA POLICE STATION
2017 -04- 12
FLORIDA
SOUTH AFRICAN POLICE SERVICES

15 August 2012

Pretoria

President

Executive Director

Appendix B:

Impact Rating Methodology

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

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 8**.

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 8. 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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