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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE WATER USE AUTHORISATION PROCESS FOR THE PROPOSED BRANDVALLEY WIND ENERGY FACILITY (WEF), BETWEEN SUTHERLAND AND MATJIESFONTEIN IN THE NORTHERN AND WESTERN CAPE PROVINCE

Prepared for

Brandvalley Wind Farm (Pty) Ltd

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EXECUTIVE SUMMARY

FEN Consulting was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Brandvalley Wind Energy Facility (WEF) and associated infrastructure. The proposed development includes the construction of various turbines linked via underground cabling, wherever technically feasible, to an onsite 33/132 kV substation. A construction camp will be developed that will play host to the on-site batching plant for use during the construction phase as well as offices, administration and operations and maintenance (O&M) buildings during the operational phase. Groundwater abstraction by means of boreholes is proposed and the sustainable yield of the boreholes has been proven. Constructing new watercourse road crossings, upgrading existing watercourse road crossings and the upgrading of existing roads where necessary are proposed.

A large drainage network of ephemeral watercourses, associated with the Groot, Roggeveld, Muishond and Wilgebos Rivers were identified as well as various Channelled Valley Bottom Wetlands. Most of these watercourses are considered to be in a largely natural to moderately modified ecological condition and of high ecological importance and sensitivity.

Only access road crossings as well as trenching of cabling within these crossings will directly impact on the watercourses. All other proposed infrastructure will be located outside of the delineated extent of the watercourses; however, some will be located within the 100 m/500 m regulated area. The proposed overhead collector powerlines will directly traverse watercourses, however, as far as feasible, all powerline support structures will be located at least 32 m from the delineated extent.

It was determined that the proposed development will have a Negative Moderate to Low risk significance on the watercourses with implementation of mitigation measures. A direct negative risk to the watercourses is expected due to the upgrading of watercourse crossings and the upgrading of an extensive section of access road located adjacent to a channelled valley bottom wetland and the Groot River.

Based on the findings of the assessment, no fatal flaws from a freshwater resource management point of view were identified. With adherence to cogent, well-conceived and ecologically sensitive construction plans and the implementation of the mitigation measures provided in this report and provided that general good construction practice is adhered to, from a freshwater conservation perspective the proposed development is considered acceptable. Authorisation by means of a Water Use Licence Application (WULA) in terms of Sections 21 (a), (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) must be obtained from the Department of Water and Sanitation (DWS).

MANAGEMENT SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Brandvalley Wind Energy Facility (WEF) and associated infrastructure between Matjiesfontein and Sutherland in the Northern and Western Cape Province (hereafter referred to as the 'proposed development'). The development entails:

- 58 turbines and associated crane pads;
- Internal access roads, with underground cables installed along these roads as far as feasible;
- Collector overhead powerlines (3 options proposed)
- Substation
- Construction camp
- Groundwater abstraction from boreholes

The purpose of this report is to provide a description and assessment of the ecology of the watercourses associated with the proposed development including mapping of the natural watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES). The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed development and mitigatory measures were identified which aim to minimise the potential impacts.

A desktop study was conducted, in which the watercourses were identified prior to the on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 5 of this report.

During the site visit undertaken on the undertaken on the May 2021, watercourses associated with the Groot River system, Roggeveld River system, Muishond River system and Wilgebos River system were identified to be traversed by the proposed development. The Groot River are proposed to be traversed several times by access roads. Most of the watercourses to be traversed by the proposed development and those identified within the investigation area can best be described as headwater episodic[1] drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries with riparian vegetation, which ultimately flow into the larger riverine systems located outside the investigation area. Although these EDLs cannot be classified as riparian resources in the traditional sense, due to the lack of saturated soil and riparian vegetation, they do still function as waterways, through episodic conveyance of water. However, based on the definition of a watercourse water flows regularly or intermittently within these EDLs, conveying water from the upgradient catchment area into the downgradient tributaries and eventually into the larger river systems. As such, they can be considered as watercourses due to their importance for hydrological functioning as they do function as waterways and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998). Ephemeral tributaries with riparian vegetation and associated channelled valley bottom wetlands were also identified to be traversed by the proposed development. The results of the ecological assessment of the watercourses are discussed in Section 5 of this report is summarised in the table below.

Table A: Summary of results of the ecological assessment as discussed in Section 5.

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Channelled valley bottom wetland	B/C (Largely natural with few modifications)	Intermediate (1,5)	High	REC: Category B (Largely natural with few modifications) BAS: Category B RMO: B/C (Improve)
Ephemeral river (Groot River) and tributaries with riparian vegetation	C (Moderately modified)	Intermediate (1,5)	High	REC: Category C (Moderately modified) BAS: Category B RMO: B/C (Improve)
Episodic drainage line (EDL)	B (Largely natural with few modifications)	Intermediate (1,4)	High	REC: B (Largely natural with few modifications) BAS: Category B RMO: B (Improve)

Proposed new watercourse road crossings, the upgrading of existing watercourse crossings and the upgrading of roads directly adjacent to watercourses pose a direct negative impact to the watercourses. All other infrastructures are located outside the delineated extent of watercourses. Four (4) crane pads, and the construction camp are located within the 100 m GN509 Zone of Regulation (all located at least 53 m from a watercourse). Two (2) crane pads and the substation are located in the 500m GN509 Zone of Regulation (all located at least 90 m from a wetland). Although the collector overhead powerlines directly traverse the watercourses, all powerline support structures will be constructed outside of the delineated extent of the watercourses and as far as feasible, at least 32 m from its delineated extent.

The DWS Risk Assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed watercourses. A summary of the outcome of the risk assessment is provided in Table B.

Table B: Summary of the outcome of the DWS Risk Assessment for the proposed development (with the implementation of mitigation measures).

	Impact and Aspect	Risk
Construction Phase	Site preparation prior to construction activities of the proposed construction camp, substation, overhead powerline support structures as listed in Table 9 located within the 100m GN509 ZoR but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the 100m/500m GN509 ZoR but outside the delineated extent of watercourses. • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles; • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Low
	Site preparation prior to construction activities relating to the development of new watercourse road crossings - upgrading of existing roads, installation of underground cables traversing through watercourses, and upgrading of roads within close proximity (within 32 m) to watercourses. • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Moderate
	Creating new watercourse crossings, upgrading existing watercourse crossings and upgrading of existing roads within close proximity (within 32 m) to watercourses: • Excavation within the watercourse for the removal of existing infrastructure (where applicable) and for the casting of proposed concrete base • Placement of culvert structures atop concrete base.	Moderate
	Construction of surface infrastructure outside of the watercourses but still within the 100 m/500m GN509 ZoR, which includes the collector overhead powerlines, construction camp, substation and 6 crane pads: • Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes.	Low
Operational Phase	Operation and maintenance of the surface infrastructure outside the watercourses but still within the 100 m GN509 ZoR, which includes the collector overhead powerlines, construction camp, substation and 6 crane pads: • Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (with specific mention of the crane pads and construction camp area).	Low
	Operation and maintenance of roads traversing watercourses: • Concentrated runoff entering the watercourses; • Disturbance to the watercourse vegetation.	Low
Decommissioning Phase	Removal of all surface infrastructure from the project area: • Movement of construction vehicles and personnel; • Disturbance to the buffer zone surrounding the watercourses	Low

No surface infrastructure components are located within any of the delineated watercourses, with the exception of road crossings, which entails the construction of new watercourse road crossings and upgrading of existing crossings. Due to the ecological sensitivity and importance of the watercourses, the upgrading of access roads directly adjacent to watercourses and upgrading of watercourse crossings by means of installing formal through flow structure poses a moderate risk significance to the watercourses, with the application of the recommended mitigation measures. The proposed collector overhead powerlines will also traverse several watercourses; however, the powerline support structures will be constructed outside the delineated extent of the watercourses and as far as feasible, at least 32m from the delineated extent of the watercourses.

Despite direct negative impacts expected from the proposed development, with implementation and strict enforcement of cogent, well-developed mitigation measures as outlined in this report, with specific mention of ensuring all instream construction footprints are rehabilitated and the watercourses monitored for any alien and invasive species establishment, no fatal flaws in terms of freshwater ecological aspects were identified and the proposed development can be considered acceptable.

Authorisation by means of a Water Use Licence Application (WULA) in terms of Sections 21 (a), (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) must be obtained from the DWS for the proposed development prior to the commencement of any works.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environment, Forestry and Fisheries screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) as well as for the Environmental Impact Assessment (EIA) Regulations 2014 (as amended) requirements for Specialist Reports (Appendix 6).

No.	Requirements	
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Cover Page and Appendix G.
2.2	Description of the preferred development site, including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 4.1: Table 1 and Section 4.2
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 4: Table 1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 4: Table 1
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 5.3
2.3	Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	Section 6 and 7
2.4	Assessment of impacts – a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes, with implementation of the proposed mitigation measures
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.) and d. Assessment of the risks associated with water use/s and related activities.	Section 5.3

2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc).	Section 7.1 and 7.2
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 5.3
2.4.6	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 5.3
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	NA – Closest estuary is approximately 180 km south of the study area
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Appendix G
3.2	A signed statement of independence by the specialist.	Appendix G
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 3.1
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 3, Appendix C and Appendix D
3.5	A description of the assumptions made, any uncertainties or gaps in knowledge or data.	Section 1.3
3.6	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	Section 6
3.7	Additional environmental impacts expected from the proposed development.	Section 7
3.8	Any direct, indirect and cumulative impacts of the proposed development on site.	Section 7
3.9	The degree to which impacts, and risks can be mitigated.	Section 7
3.10	The degree to which impacts, and risks can be reversed.	Section 7, Appendix F
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 7
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 6
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	Section 7
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 8
3.16	Any conditions to which this statement is subjected.	Section 8

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Episodic drainage lines	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period or may flow only once in several years.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perennial:	Flows all year round.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	The outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year.
Vernal pool	Also called vernal ponds or ephemeral pools, are temporary pools of water that provise habitat for distinctive aquatic plants and animals that are adapted to the very short inundation periods of these pools (BlueScience, 2018)
Watercourse:	In terms of the definition contained within the National Water Act, 1998 (Act No. 36 of 1998) a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks.
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius
AC	Alternating Current
BA	Basic Assessment
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
DC	Direct Current
DEFF	Department of Environment, Forestry and Fisheries
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
kV	Kilovolt
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	The National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NWCS	National Wetland Classification System
O&M	Operation and Maintenance
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
REDZ	Renewable Energy Zones
REIPPPP	Renewable Energy Independent Power Producer Procurement Program (REIPPPP)
PFP	Preferential Flow Path
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SARERD	South African Renewable Energy Resource Database
SAS	Scientific Aquatic Services
SQR	Sub-quaternary catchment reach

subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WUA	Water Use Authorisation
WULA	Water Use Licence Application
WRC	Water Research Commission
ZOR	Zone of Regulation

1 INTRODUCTION

1.1 *Background*

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Water Use Authorisation (WUA) process for the proposed Brandvalley Wind Energy Facility (WEF) and associated infrastructure between Matjiesfontein and Sutherland in the Northern and Western Cape Province (hereafter referred to as the 'proposed development') (Figures 1 and 2). Please refer to Section 2 for the project description.

In order to identify all watercourses that may potentially be impacted by the proposed development, a 500 m "zone of investigation" was implemented around the proposed development, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), in order to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the proposed development - will henceforth be referred to as the 'investigation area'.

The purpose of this report is to provide a description and assessment of the ecology of the watercourses associated with the proposed development including mapping of the natural watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES). The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed development and mitigatory measures were identified which aim to minimise the potential impacts.

This study further aims to provide detailed information to guide the proposed development in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development. This report, after consideration of the above, must guide the proponent, by means of a reasoned opinion and recommendations, as to the viability of the proposed development from a watercourse management perspective.

1.2 *Structure of this report*

This report investigates the impact significance of the proposed development, as explained the National Water Act, 1998 (Act No. 36 of 1998) (NWA) by means of the DWS Risk Assessment Matrix. The following structure is applicable to this report:

Section 1: Introduction
Provides an introduction, the structure of this report, the assumptions and limitations.

Section 2: Project Description
Provides the location of the proposed development as well as a brief summary of the proposed activities associated with the proposed development.

Section 3: Assessment Approach
Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the impact assessment approach.

Section 4: Desktop Assessment Results
Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2014 database and the Western Cape Biodiversity Spatial Plan (2017), Critical Biodiversity Areas of the Northern Cape (2016) and National Biodiversity Assessment (NBA) 2018 was undertaken to aid in defining the PES and EIS of the watercourses.

Section 5: Site Based Watercourse Assessment Results (Terms of Reference)
This section reports the following:

- A description and delineation of all watercourses associated with the proposed development according to "Department of Water Affairs and Forestry (DWAF)[2] (2008)[3]: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones";
- Delineation of all watercourses (using desktop methods) within 500 m of the proposed development in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998);
- The classification of the watercourses according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The Ecological assessment of the watercourses utilised the following methodologies:
    - The EIS of the watercourses according to the method described by DWAF (1999);
    - The services provided by the watercourses associated with the proposed development were assessed according to the method of Kotze et al. (2009);
    - The PES of the watercourses was assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.* (2008) and the River Eco Classification: Index of Habitat Integrity (IHI) as advocated by the Water Research Commission (WRC) and DWAF (2008), as applicable; and
- The allocation of a suitable Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) to the watercourse based on the results obtained from the PES, Ecoservices and EIS assessments.

Section 6: Legislative Requirements
Provides the applicable legislative requirements based on the findings from Section 5 and indicates any applicable zones of regulation that may trigger various enviro-legal authorisation requirements.

Section 7: Risk Assessment
Provides the outcomes from the DWS Risk assessment which highlights all potential impacts that may affect the surrounding watercourses. Management and mitigation measures are provided which should be implemented during the various proposed development activities (planning, construction and operational phases) to assist in minimising the impact on the receiving environment.

Section 8: Conclusion
Summarises the key findings and recommendations based on the impact assessment outcomes and legislative requirements.

[2] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.
[3] Although an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas). This is still considered a draft document currently under review.

1.3 *Assumptions and Limitations*

- The ground-truthing and verification of the delineated extent of the watercourses are confined to a single site visit undertaken from the 25th to the 28th of May 2021 of the proposed development. All watercourses identified within the investigation area were delineated in fulfilment of Government Notice 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) using various desktop methods with limited field verification including the use of topographic maps, historical and current digital satellite imagery and aerial photographs;
- Due to the landscape in some areas being rugged and very undeveloped, some reaches of the identified watercourses were inaccessible. Therefore, verification points for watercourses were located at points as close to the watercourse to be verified as possible and, where necessary the conditions at the exact point required were inferred or extrapolated;
- Due to the majority of the watercourses being ephemeral within the region, very few areas were encountered that displayed more than one watercourse characteristic as defined by the DWAF (2008) method (such as containing alluvial or inundated soils, or hosts riparian vegetation adapted to saturated conditions). As a result, identification of the outer boundary of the temporary watercourse zones and marginal riparian zones proved difficult in some areas and, in particular, in the areas where watercourse conditions and riparian zones are marginal. Therefore, delineations were augmented with the use of digital satellite imagery. Nevertheless, the watercourse delineations as presented in this report are regarded as a best estimate of the watercourse boundaries based on the site conditions present at the time of assessment and the results obtained are considered sufficiently accurate to allow informed planning and decision making to take place;
- Global Positioning System (GPS) technology is inherently somewhat inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. However, the delineations as provided in this report are deemed accurate enough to fulfil the environmental authorisation requirements as well as the implementation of the mitigation measures provided;
- Watercourses and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourse boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the watercourses have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

2 PROJECT DESCRIPTION

The proposed Brandvalley Wind Energy Facility (WEF) is located in the Western Cape, approximately 15 km north of Matjiesfontein, with Laingsburg a further 30 km east of Matjiesfontein. The Brandvalley WEF will comprise of the following:

- 58 wind turbines;
- Permanent compacted hardstanding areas / crane pads for each wind turbine (70 m x 50 m);
- Internal access roads up to 12 m wide, including structures for stormwater control would be required to access each turbine location and turning circles. Where possible, existing roads will be upgraded;
    - Access to the proposed development will be obtained from the Regional (R) 354 road, east of the development. The following existing Minor Roads (MR) from the R354 will be upgraded: the MR 8041 and MR 8042 (north of proposed development) and MR 6159 (west of proposed development). Typical existing watercourse crossings that will be upgraded include large rectangular culverts and pipe culverts, where required;

- 33kV overhead powerlines linking groups of wind turbines to onsite 33/132kV substation(s) (referred to as the collector systems – three (3) options proposed)';
- Underground 33 kV cabling between turbines buried along access roads, where feasible;
- 33/132kV onsite substation location (approximately 200m x 200m);
- Construction camp (~10ha) and an on-site concrete batching plant (~1ha);
- Additionally, a maximum potential of 80,000 m^3/annum of groundwater will be required for the construction phase to support the construction activities. The construction phase is estimated to last for a maximum of 2 years. Abstraction will be from the most appropriate borehole sited across the project area. At the time of report compilation, a single borehole (BH 264) was considered feasible for pumping with little to no impact on groundwater drawdown expected based on the sustainable yield tests. This volume of water will be significantly reduced to 250 m^3/annum during the operational life of the proposed development.

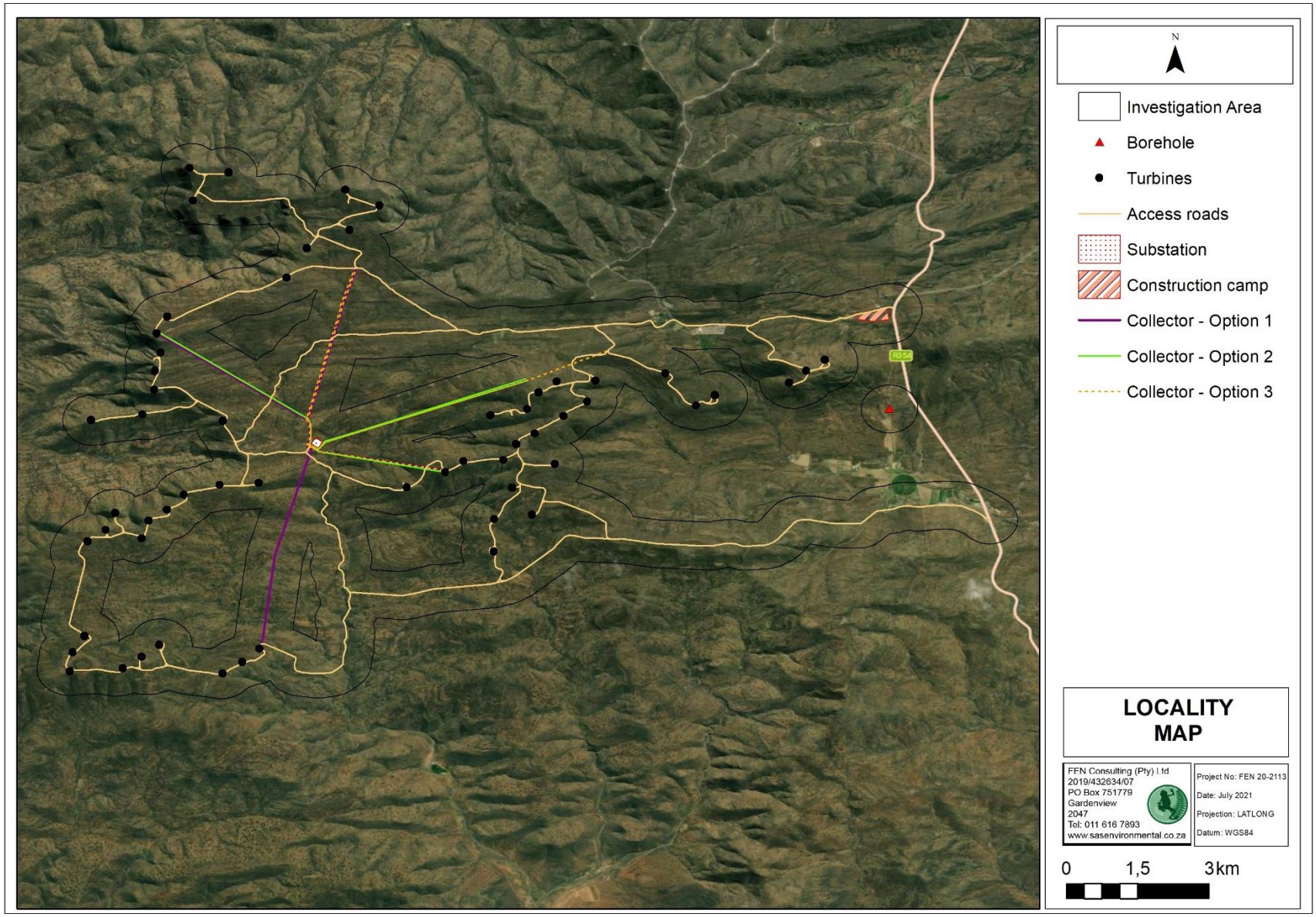

Figure 1: Digital satellite image depicting the proposed development and the associated investigation area in relation to its surroundings.

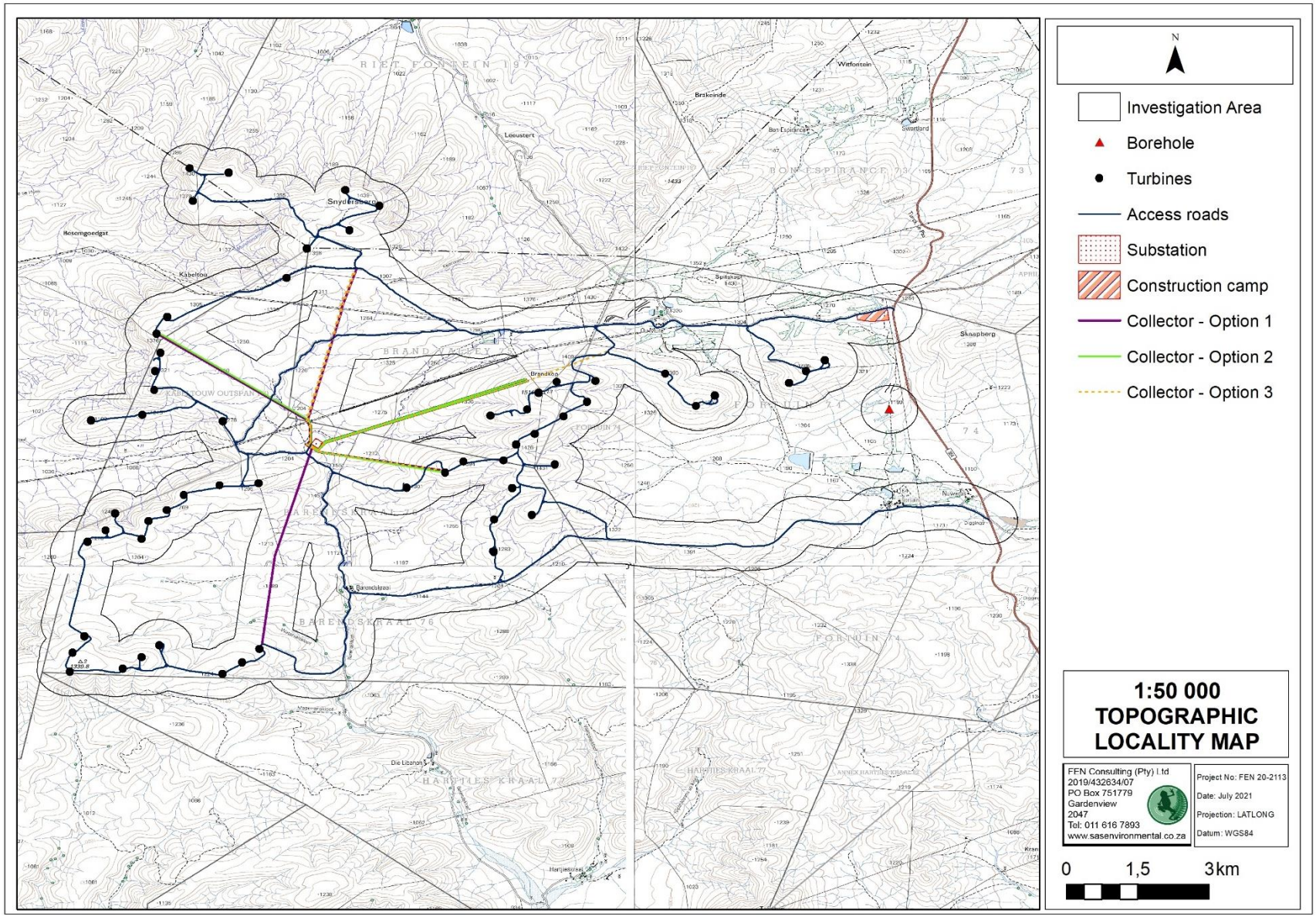

Figure 2: Location of the proposed development and the associated investigation area depicted on a 1:50 000 topographical map in relation to surrounding areas.

3 ASSESSMENT APPROACH

3.1 *Watercourse Field Verification*

As part of this assessment, the following definitions, as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance:

Watercourse means-

(a) A river or spring;
(b) A natural channel in which water flows regularly or intermittently;
(c) A wetland, lake or dam into which, or from which water flows; and
(d) Any collection of water, which the Minister may, by notice of the Gazette, declare a watercourse.

Wetland habitat is "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Riparian habitat includes the physical structure and associated vegetation of areas associated with a watercourse which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

A field verification was undertaken from the 25th to the 28th of May 2021 (early winter season[4]) during which the presence of any watercourse characteristics as defined by DWAF (2008) or wetlands as defined by the National Water Act, 1998 (Act No. 36 of 1998) were noted (please refer to Sections 5 and 6 of this report). In addition to the delineation process, detailed assessment of the delineated watercourses was undertaken, at which time factors affecting the integrity of the watercourses were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the watercourses. A detailed explanation of the methods of assessment undertaken as listed in Section 1.1 is provided in **Appendix C** of this report.

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

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

[4] Site surveys are recommended to take place during a seasonal period where the probability of detecting an identifiable life history stage of vegetation species (such as facultative vegetation species) is highest and in the rainy period to ensure optimised conditions for the identification of seasonal watercourses, which may otherwise be overlooked. Thus, the site conditions at the time of the field assessment are considered optimal as rainfall had occurred in the local area prior to the site assessment undertaken end of May 2021.

3.2 *Sensitivity Mapping*

All watercourses associated with the proposed development were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map presented in Section 6 should guide the design, layout and management of the proposed development.

3.3 *Risk and Impact Assessment and Recommendations*

Following the completion of the assessment, a risk assessment (DWS Risk Assessment) was conducted (please refer to **Appendix D** for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures, which apply to the proposed construction and operational/maintenance activities. The detailed mitigation measures are outlined in Section 7 of this report, while the general management measures which are considered best practice mitigation applicable to this project, are outlined in **Appendix F**.

4 DESKTOP ASSESSMENT RESULTS

4.1 *National and Provincial Datasets*

The following section contains data accessed as part of the desktop assessment and presented as a “dashboard-style” report below (Table 2). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation are provided.

It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics associated with the proposed development at the scale required to inform the environmental authorisation and/or water use authorisation processes. Given these limitations, this information is considered useful as background information to the study, is important in legislative contextualisation of the risks and impacts, and was thus used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the field survey. It must, however, be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process.

Table 1: Desktop data (from desktop databases only) relating to the characteristics of the proposed development and its associated investigation area.

Aquatic ecoregion and sub-regions in which the investigation area is located		Detail of the investigation area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	Great Karoo		
Catchment	Olifants – Cape and Gourits	FEPACODE	The proposed development is located in a sub-quaternary catchment classified as an upstream management catchment which is required to be managed to prevent downstream degradation of Freshwater Ecosystem Priority Areas (FEPAs) and fish support areas (FEPA CODE = UPSTREAM).
Quaternary Catchment (Figure 3)	E22A, E22B, E23A, J11E and J11D		
WMA	Olifants/Doorn and Gouritz		
subWMA	Doring and Groot		
Dominant characteristics of the Great Karoo Ecoregion Level II (21.03) (Kleynhans *et al*., 2007)		NFEPA Wetlands (Figure 4)	According to the NFEPA database (2011), several natural and artificial wetlands are located in the investigation area, of which some of the natural seep wetlands (considered to be in a moderately modified ecological condition (WETCON = C)) are proposed to be traversed by the access roads along existing crossings. Most of the natural and artificial wetland identified by this database was verified to be artificial impoundments or irrigated fields during the site assessment.
Level II Code	21.03		
Dominant primary terrain morphology	Low Mountains, Parallel Hills, Lowlands, Mountains and Lowlands.		
Dominant primary vegetation types	Great Nama Karoo, Escarpment Mountains Renosterveld, Upland Succulent Karoo, Upper Nama Karoo		
Altitude (m a.m.s.l)	500 – 1700	Wetland Vegetation Type	The majority of the investigation area is located in the Karoo Shale Renosterveld Wetland Vegetation type (least threatened), with the south central section of the investigation area located in the Rainshadow Valley Karoo (Skv) Wetland vegetation Type. The threat status of the wetland vegetation type is provided by Mbona *et al.* (2015).
MAP (mm)	100 – 300		
The coefficient of Variation (% of MAP)	30 – 40		
Rainfall concentration index	30 – 55	NFEPA Rivers (Figure 4)	As per the NFEPA database (2011), the Groot River is proposed to be traversed by the internal access road. The Roggeveld River is located in the eastern portion of the investigation area, the Muishond River in the north eastern portion and the Wilgebos River in the northern portion of the investigation area. These rivers are considered to be largely natural with only a few modifications (RIVCON = AB) but is considered to be in a moderately modified (Class C) ecological condition by the PES 1999 dataset.
Rainfall seasonality	Very late summer, Winter		
Mean annual temp. (°C)	14 – 18		
Winter temperature (July)	0 – 18		
Summer temperature (Feb)	10 – 30		
Median annual simulated runoff (mm)	<5 - 20		
Importance of the investigation area according to the Western Cape Biodiversity Spatial Plan (2017) (Figure 5)			
According to the Western Cape Biodiversity Spatial Plan (2017), the western portion of the investigation area is located in an area classified as Critical Biodiversity Areas (CBA) 1, of terrestrial ecological importance. CBAs are areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure, in this case specifically for riverine environments. CBA 1 are areas likely to be in a natural condition. The central and southern portions of the investigation area are associated with areas classified as Ecological Support Areas (ESAs) 1 and 2 (of aquatic/watercourse importance). ESAs are important in supporting the functioning of CBAs and are often vital for delivering ecosystem services. ESA 1 are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas (PAs) or CBAs, and are often vital for delivering ecosystem services. ESA 2s are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services. The central and southern portions of the investigation area are also associated with areas classified as Other Natural Areas (ONAs). ONAs are areas that have not been identified as a priority in the current systematic biodiversity plan, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.			
Importance of the investigation area according to the Critical Biodiversity Areas of the Northern Cape (2016) (Figure 5)			
According to the Critical Biodiversity Areas of the Northern Cape (2016), the northern portion of the investigation area is associated with areas classified as Ecological Support Areas (ESAs) and Other Natural Areas (ONAs). ESAs are areas that are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning in CBAs. ONAs are areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.			
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA) (Figure 6)			
According to the NBA 2018: SAIIAE seep wetlands and a large channelled valley bottom wetland are proposed to be traversed by the proposed access roads. These wetlands are considered to be in a heavily to severely/critically modified ecological condition (WETCON = D/E/F). The Ecosystem Threat Status (ETS) of the seep wetlands are considered Least Concerned, while the ETS of the channelled valley bottom wetland are considered Critical. The ecosystem protection level (EPL) of the wetlands is Not Protected. The NBA 2018:SAIIE also identified the following rivers: the Groot River is proposed to be traversed by the internal access road. The Roggeveld River is located in the eastern portion of the investigation area, the Muishond River in the north eastern portion and the Wilgebos River in the northern portion of the investigation area; which corresponds with the rivers identified by the NFEPA database. The ETS of the rivers are least threatened, and the EPL thereof is poorly protected.			

CBA = Critical Biodiversity Area; EI = Ecological Importance; EN = Endangered; EPL = Ecosystem Protection Level ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres above mean sea level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Area; OESA = Other Ecological Support Area; PA = Protected Area; PES = Present Ecological State; WMA = Water Management Area.

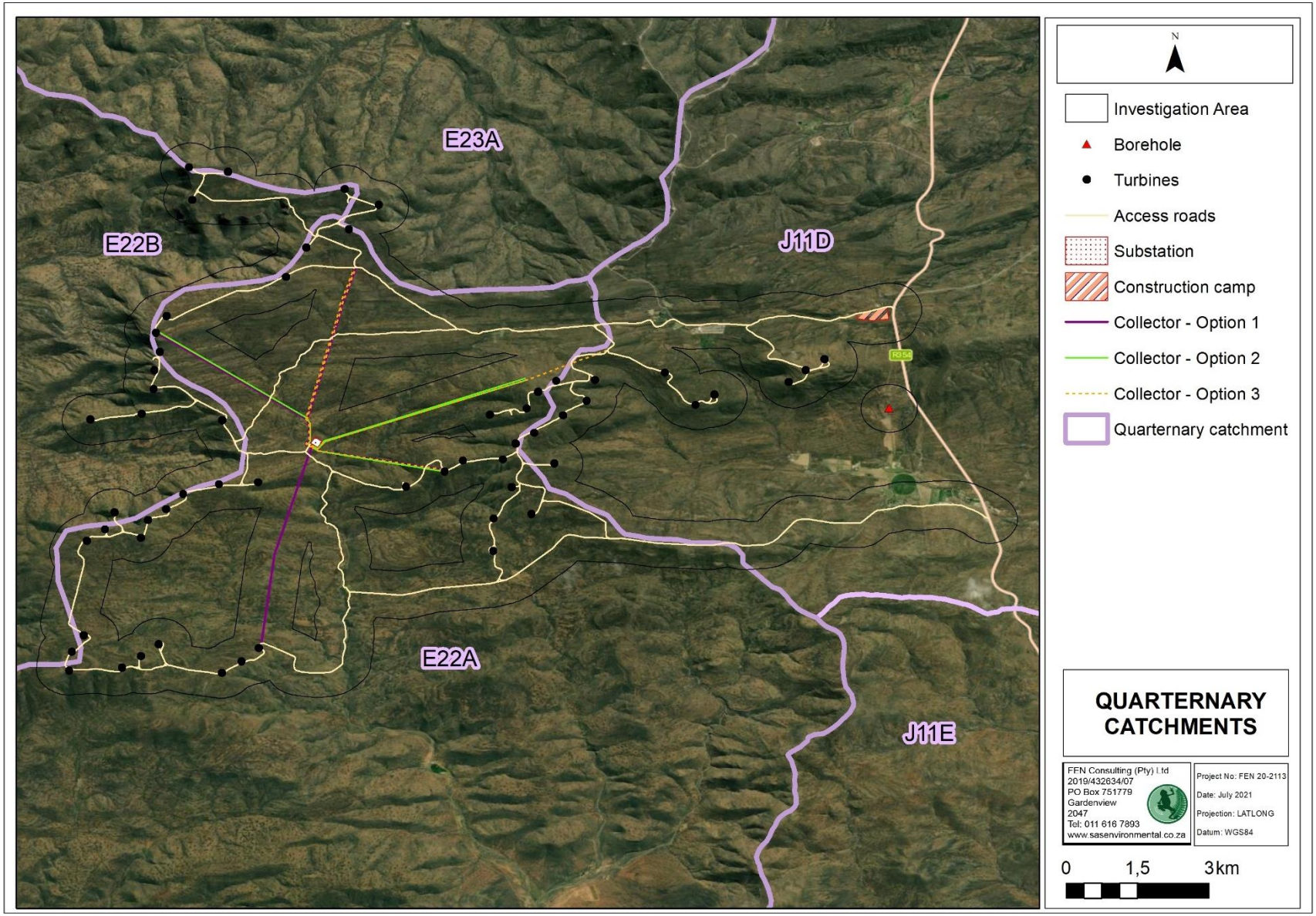

Figure 3: Quaternary catchments associated with the proposed development.

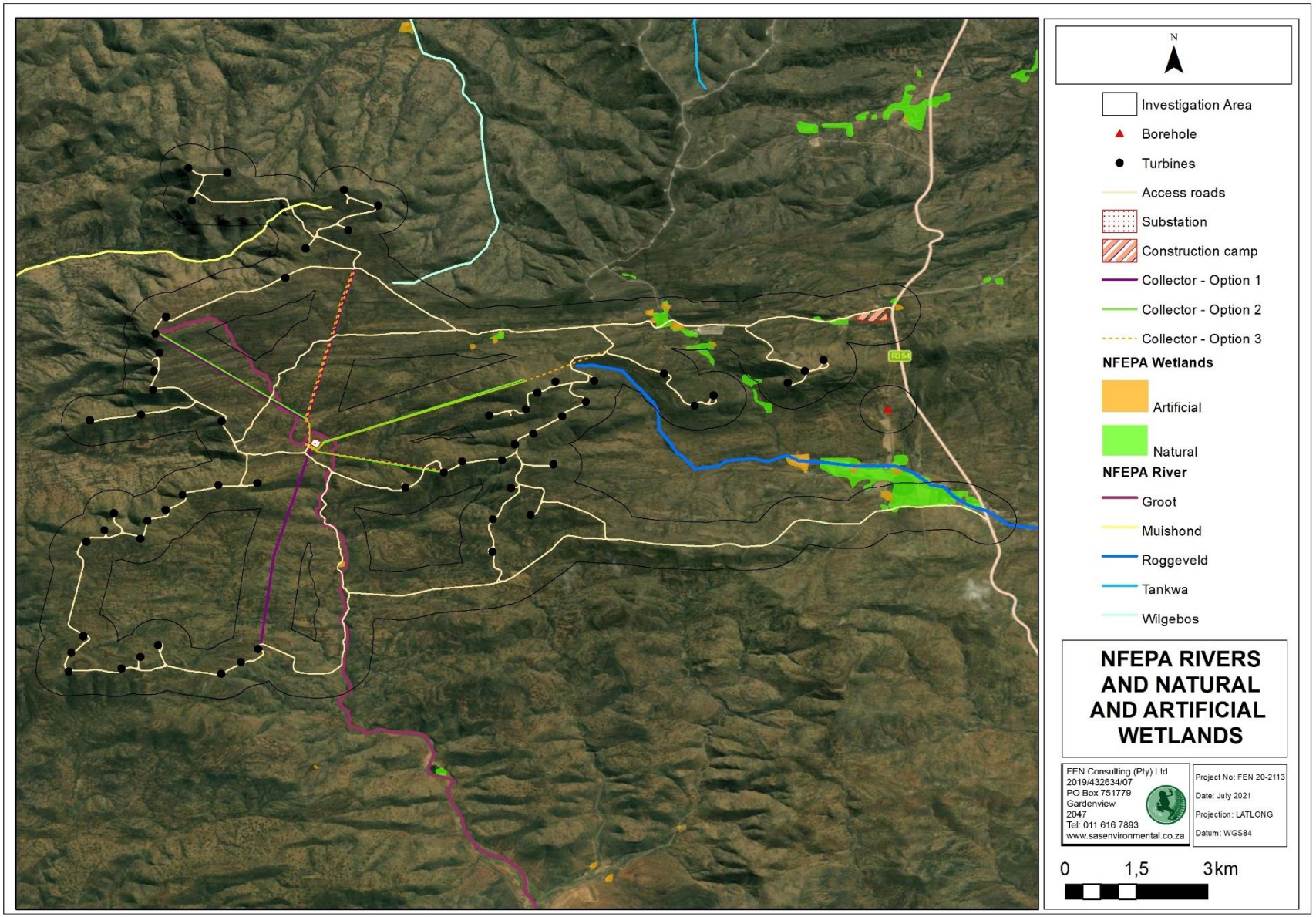

Figure 4: NFEPA listed rivers and natural and artificial wetlands associated with the proposed development and investigation area, according to the NFEPA database (2011).

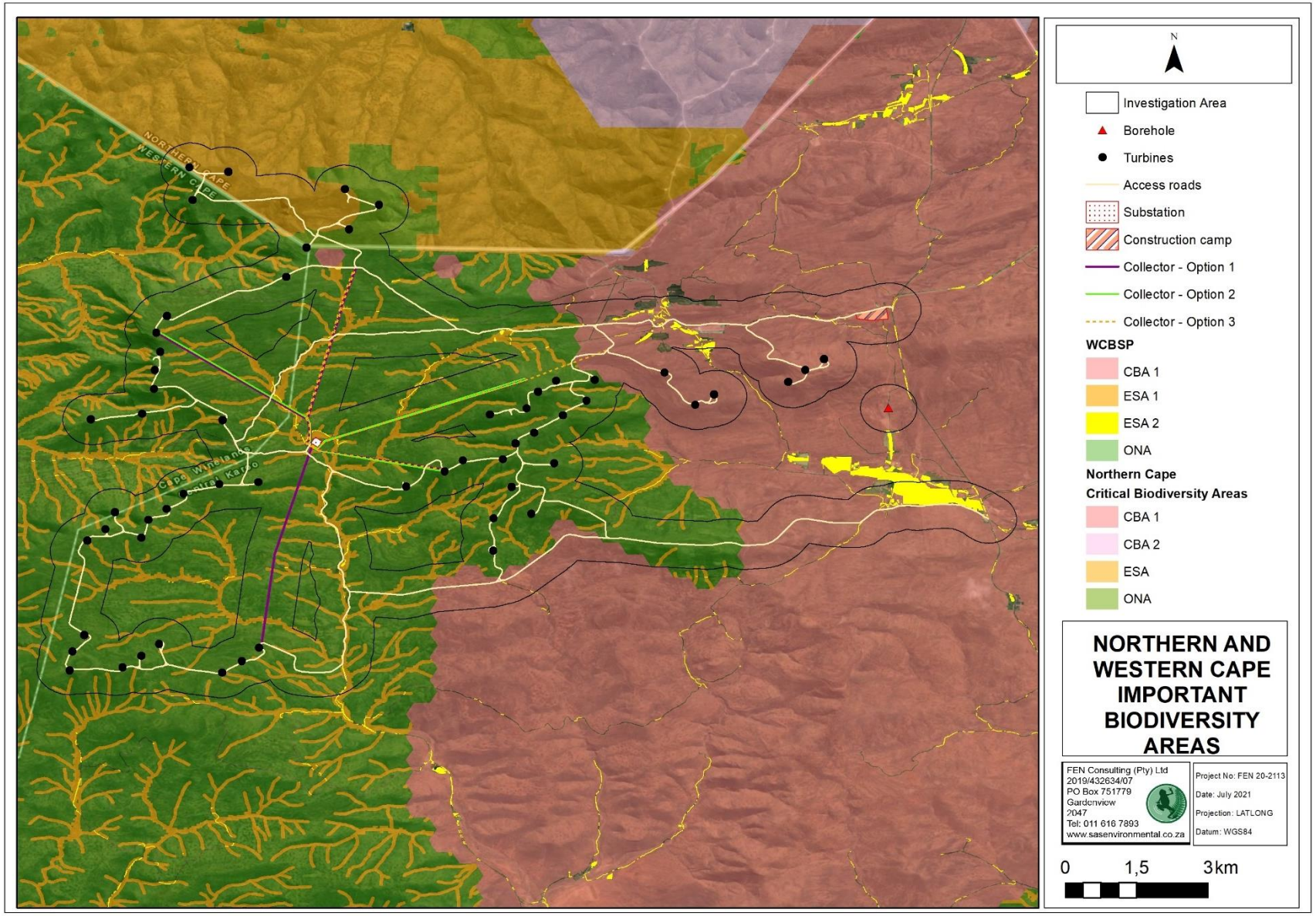

Figure 5: The areas of biodiversity importance associated with the proposed development and investigation area, according to the Western Cape Biodiversity Spatial Plan (2017) and Critical Biodiversity Areas of the Northern Cape (2016) databases.

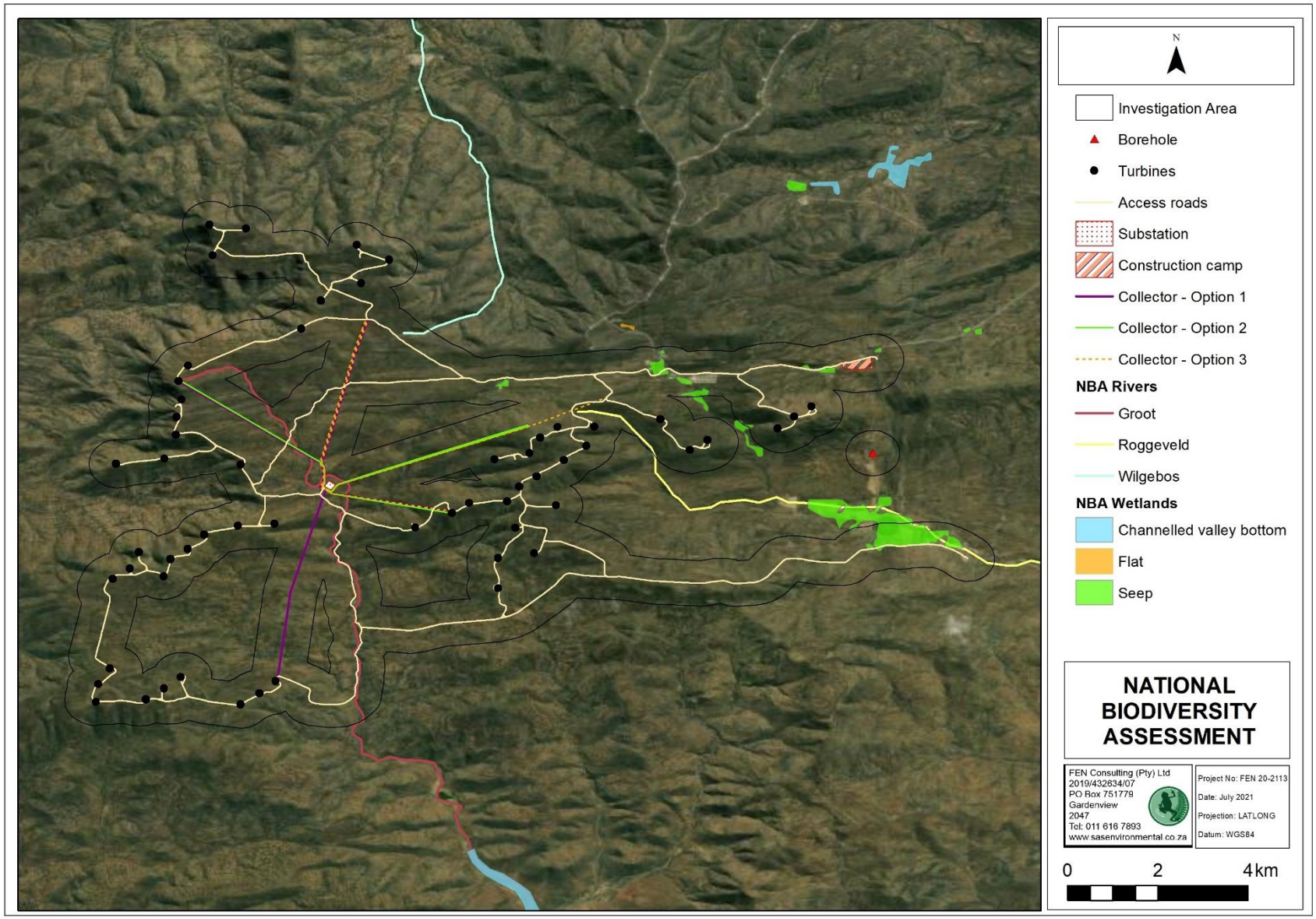

Figure 6: NBA identified wetlands and rivers associated with the proposed WEF development and investigation area, according to the NBA database (2018).

4.2 *Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS Database]*

The PES/EIS database, as developed by the DWS RQIS department was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as the South Africa River Health Programme (SA RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on invertebrates and background conditions associated with the SQRs SQRs E23A-07875 (Wilgebos River), E22A-08171 (Groot River) and J11D-08162 (Roggeveld River) as contained in this database and pertaining to the PES and EIS are tabulated in Tables 2 and 3 and visually represented in Figure 7 that follows.

Table 2: Invertebrates previously collected from or expected at the SQR monitoring points.

Macro-Invertebrates	E23A-07875 (Wilgebos River)	E22A-08171 (Groot River)	J11D-08162 (Roggeveld River)
Aeshnidae	X	X	X
Ancylidae	X		X
Baetidae 1 Sp	X		X
Baetidae 2 Sp		X	X
Belostomatidae	X		
Ceratopogonidae	X	X	X
Caenidae	X		X
Chironomidae	X	X	X
Coenagrionidae	X	X	X
Corduliidae	X	X	
Corixidae	X	X	X
Culicidae	X	X	X
Dytiscidae	X	X	X
Ecnomidae			X
Elmidae/Dryopidae		X	
Gerridae	X	X	X
Gyrinidae	X	X	X
Hirundinea		X	
Hydracarina	X	X	X
Hydropsychidae 1 Sp			X
Hydropsychidae 2 Sp		X	
Leptoceridae		X	
Leptophlebiidae			X
Lestidae	X		
Libellulidae	X	X	X
Lymnaeidae	X	X	
Muscidae	X		
Naucoridae		X	X
Notonectidae	X	X	X
Oligochaeta	X	X	X
Physidae	X		
Pleidae	X	X	X
Potamonautidae			X
Simuliidae	X	X	X
Tabanidae			X
Teloganodidae			X
Tubellaria		X	X
Veliidae/Mesoveliidae	X	X	X

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reaches associated with the proposed development based on the DWS RQS PES/EIS database.

	E23A-07875 (Wilgebos River)	E22A-08171 (Groot River)	J11D-08162 (Roggeveld River)
Synopsis			
PES Category Median	Natural/Close to natural	Natural/Close to natural	C (Moderately modified)
Mean EI class	High	High	High
Mean ES class	High	High	High
Length	31,84	35,2	37.93
Stream order	1	1	1
Default EC[4]	B (High)	A (Very High)	B (High)
PES Details			
Instream habitat continuity MOD	None	None	Moderate
RIP/wetland zone continuity MOD	Small	Small	Moderate
Potential instream habitat MOD activities	None	None	Moderate
Riparian/wetland zone MOD	None	None	Moderate
Potential flow MOD activities	Small	Small	Large
Potential physico-chemical MOD activities	None	None	Large
EI Details			
Fish spp/SQ	-	-	-
Fish average confidence	-	-	-
Fish representivity per secondary class	-	-	-
Fish rarity per secondary class	-	-	-
Invertebrate taxa/SQ	25	28	29
Invertebrate average confidence	3	1	5
Invertebrate representivity per secondary class	Moderate	Moderate	Very High
Invertebrate rarity per secondary class	High	High	Very High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Very Low	Very High
Habitat diversity class	Low	Low	Moderate
Habitat size (length) class	Moderate	High	High
Instream migration link class	Very High	Very High	High
Riparian-wetland zone migration link	Very High	Very High	High
Riparian-wetland zone habitat integrity class	Very High	Very High	High
Instream habitat integrity class	Very High	Very High	High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	Very High	Very High	High
ES Details			
Fish physical-chemical sensitivity description	-	-	-
Fish no-flow sensitivity	-	-	-
Invertebrates physical-chemical sensitivity description	Moderate	Moderate	Very High
Invertebrates velocity sensitivity	High	Very High	Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very High	Very High	Very High
Stream size sensitivity to modified flow/water level changes description	High	Very High	High
Riparian-wetland vegetation intolerance to water level changes description	Very High	Very High	High

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;

[2] EI = Ecological Importance;

[3] ES = Ecological Sensitivity

[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

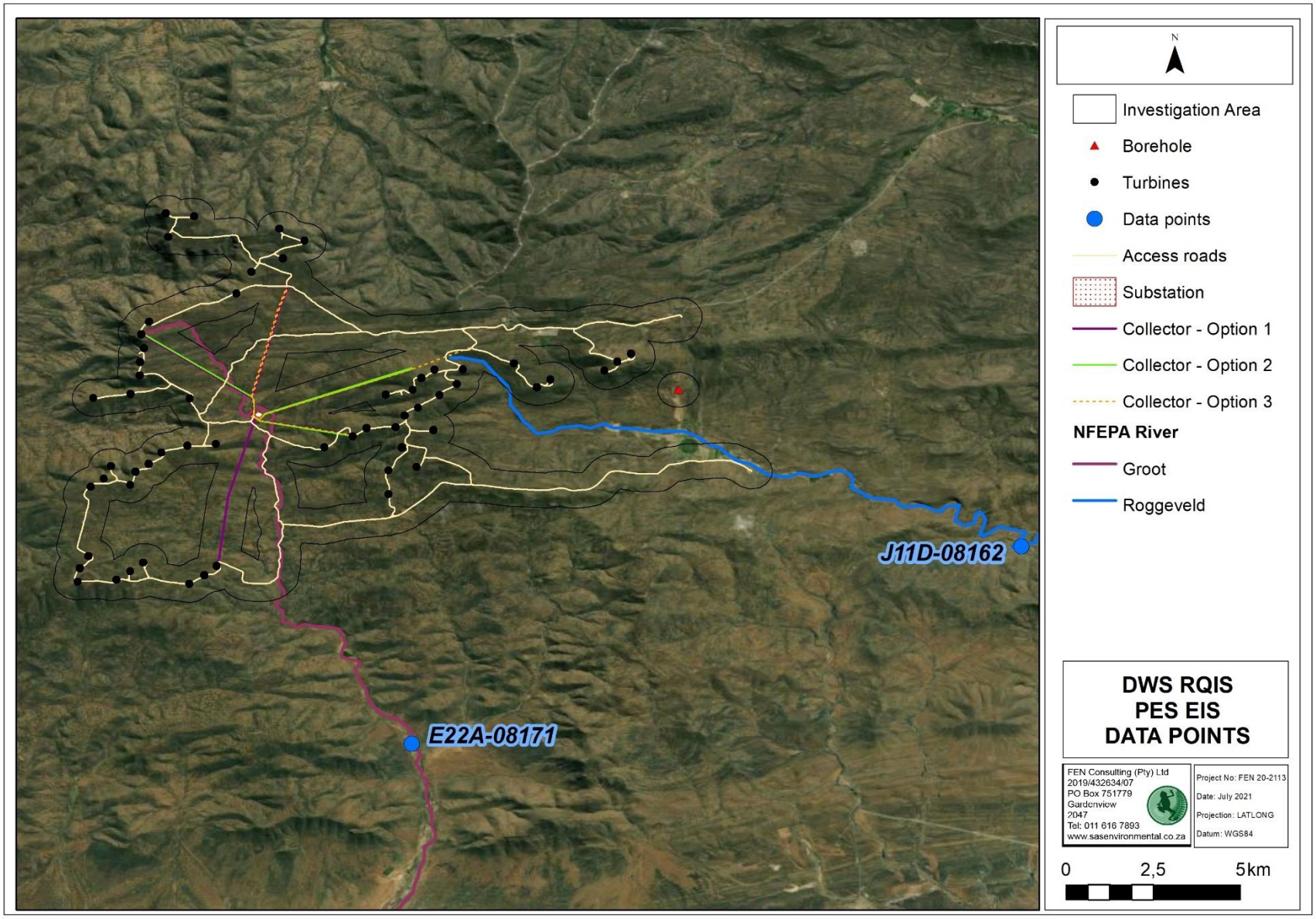

Figure 7: DWS RQIS PES/EIS sub-quaternary catchment reaches (SQRs) indicated relative to the proposed development and investigation area.

5 RESULTS: WATERCOURSE ASSESSMENT

5.1 *Field verification and delineation*

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national watercourse databases (as outlined in Section 4 of this report) were used to identify points of interest associated with the proposed development at a desktop level. In this regard, specific mention is made of the following:

- Linear features: since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with watercourses: a distinct increase in density as well as shrub size near flow paths;
- Hue: with water flow paths often showing as white/grey or black and outcrops or bare soil displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions.

These points of interest were verified during the site assessment undertaken from the 25th to the 28th of May 2021. Watercourses associated with the Groot, Muishond, Roggeveld and Wilgebos River systems were identified within the investigation area. The proposed development is located at the southern end of the greater Koedoesberg mountains and directly south of the existing Roggeveld WEF. Turbines (turbines 35, 37, 40 to 46) located on the Snydersberg associated with the most northern extent of the proposed development, located upgradient of the Wilgebos River system. Turbines 53 to 61 are located on and around Brandkop, which forms part of the catchment of the headwater systems associated with the Groot and Roggeveld River systems. The sections of existing internal roads proposed to be upgraded (MR 8041 and MR 8042 (north of proposed development) and MR 6159 (west of proposed development)) traverses watercourses associated the Groot and Roggeveld River systems. Current land uses associated with the development site includes predominantly small-scale farming activities, specifically located adjacent to watercourses and existing powerline servitudes. An irrigation furrow was identified immediately west of the R 354 road where the construction camp is proposed (Figure 8). This is a man-made feature created to collect surface water runoff from watercourses and convey it into an artificial impoundment located 3,5 km south of the proposed construction camp. Due to the anthropogenic origin of this furrow, it cannot be defined as a true watercourse and does not enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998).
+

Figure 8: (Left) digital satellite imagery depicting the locality of the furrow, which is a straightened berm and channel feature, relative to the proposed construction camp. (Right) Photograph of the furrow being traversed by the MR 8042 (access road) located along the northern boundary of the proposed construction camp.

Most of the watercourses to be traversed by the proposed development and those identified within the investigation area can best be described as headwater episodic[5] drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries with riparian vegetation, which ultimately flow into the larger riverine systems. Although these EDLs cannot be classified as riparian resources in the traditional sense, due to the lack of saturated soil and riparian vegetation, they do still function as waterways, through episodic conveyance of water. However, based on the definition of a watercourse (see Section 3.1) water flows regularly or intermittently within these EDLs, conveying water from the upgradient catchment area into the downgradient tributaries and eventually into the larger river systems. As such, they can be considered as watercourses due to their importance for hydrological functioning as they do function as waterways and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998). Ephemeral tributaries with riparian vegetation and associated channelled valley bottom wetlands were also identified to be traversed by the proposed. The Groot River are proposed to be traversed several times by access roads.

Figures 9 to 12 depicts the delineated extent of the identified watercourses relative to the proposed development.

[5] "Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period or may flow only once in several years." (Uys and O'Keeffe, 1997, in Rossouw *et. al*, 2006).

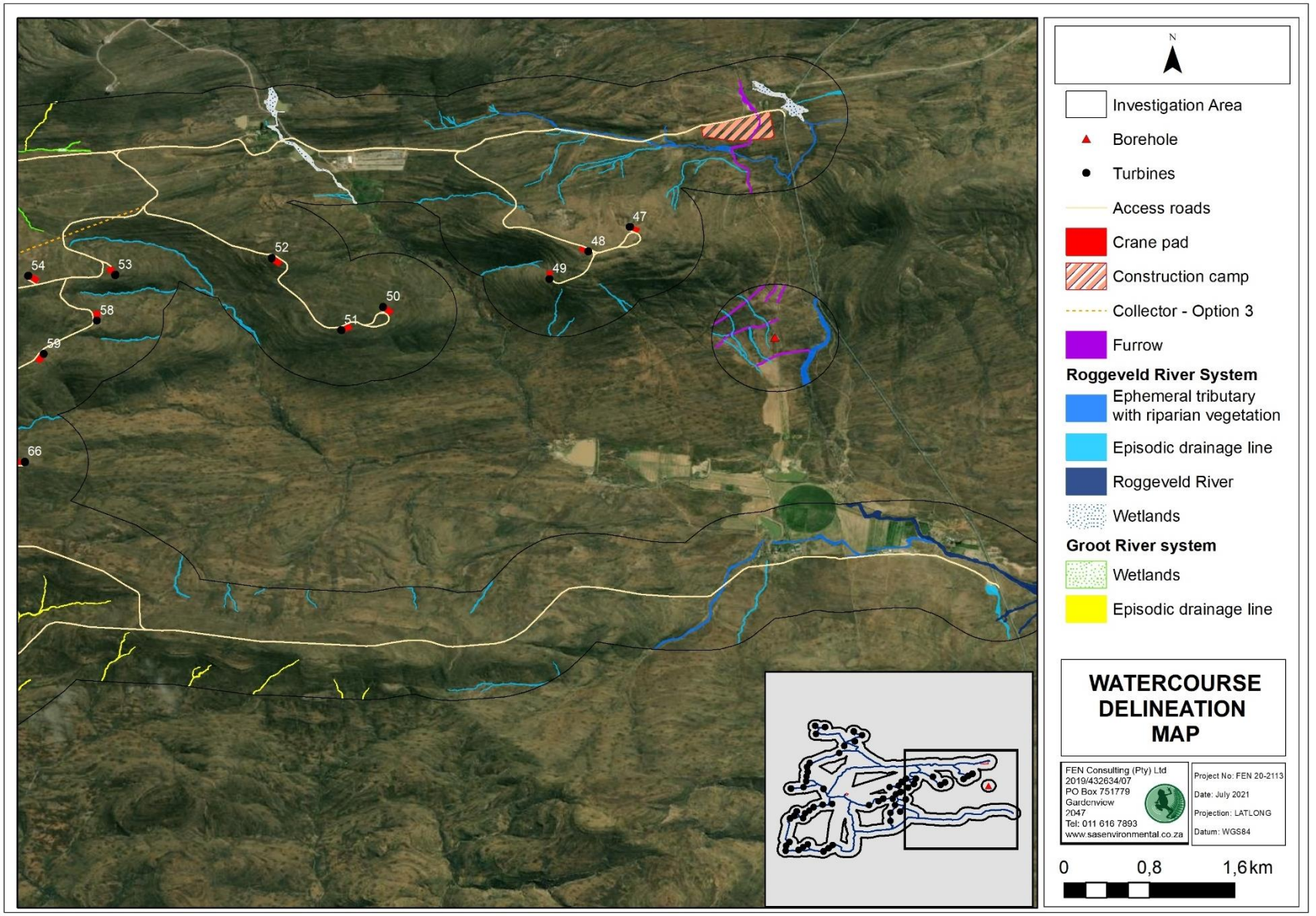

Figure 9: The locality of the delineated watercourses in the eastern portion of the investigation area.

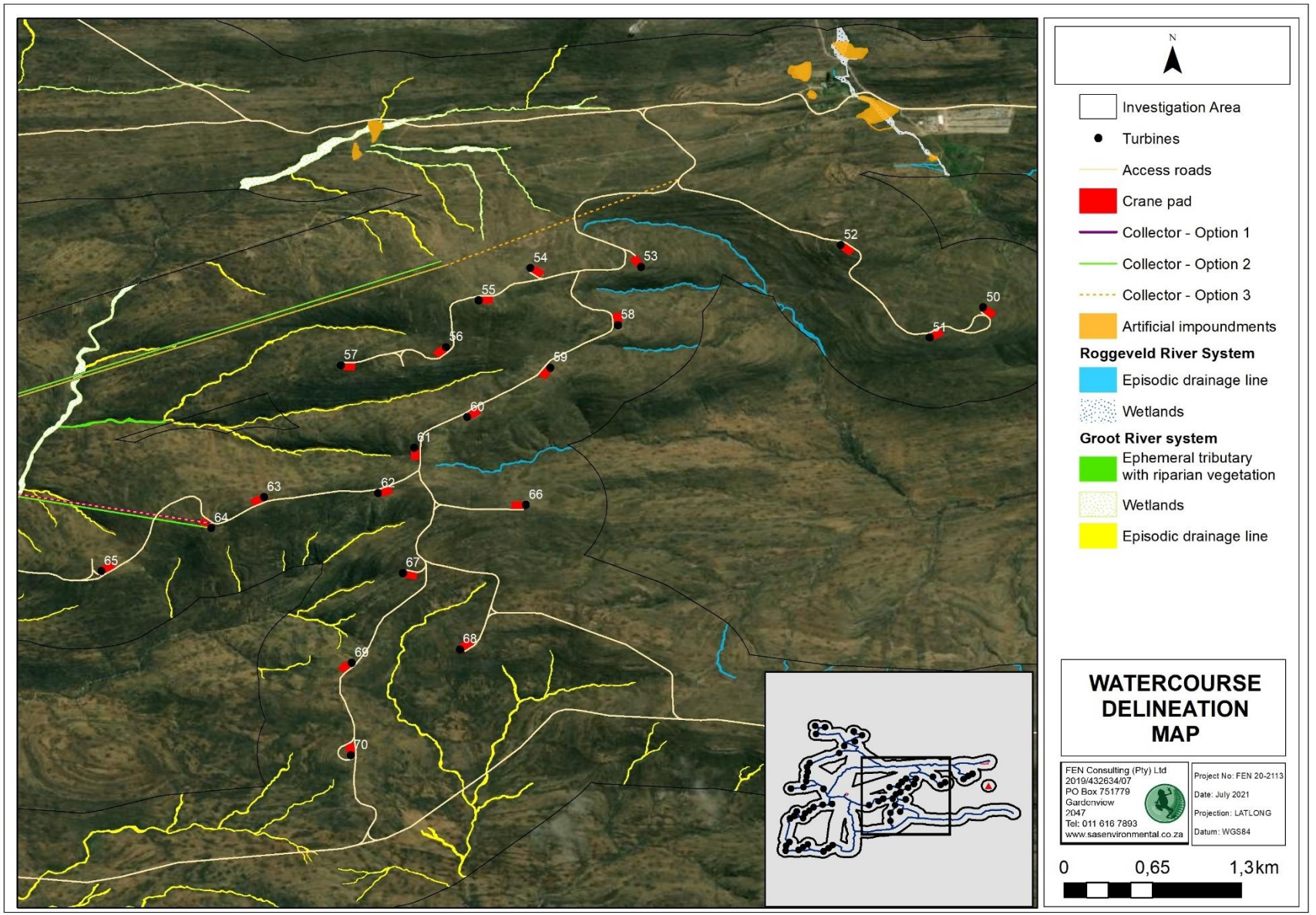

Figure 10: The locality of the delineated watercourses in the central portion of the investigation area.

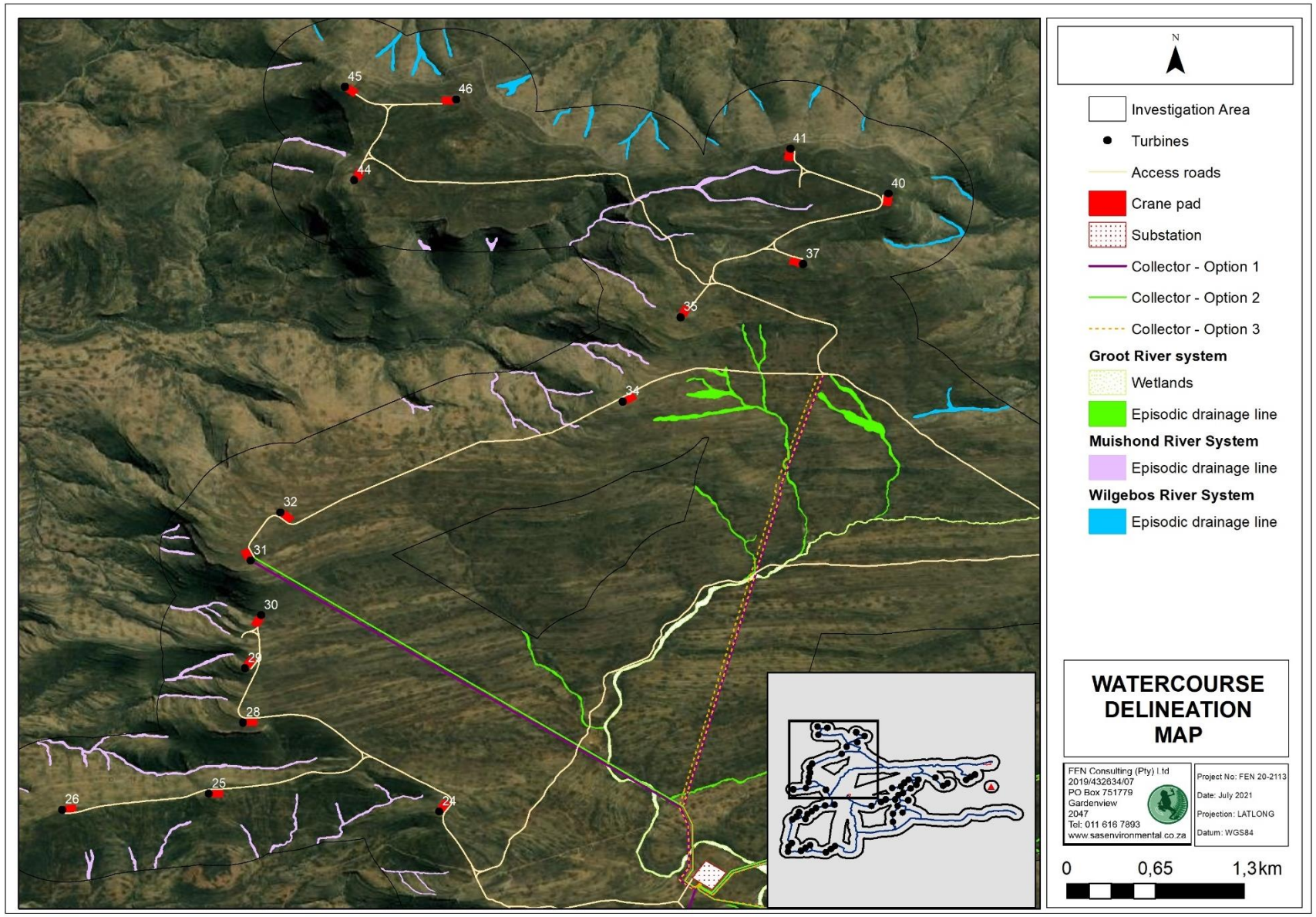

Figure 11: The locality of the delineated watercourses in the northwestern portion of the investigation area.

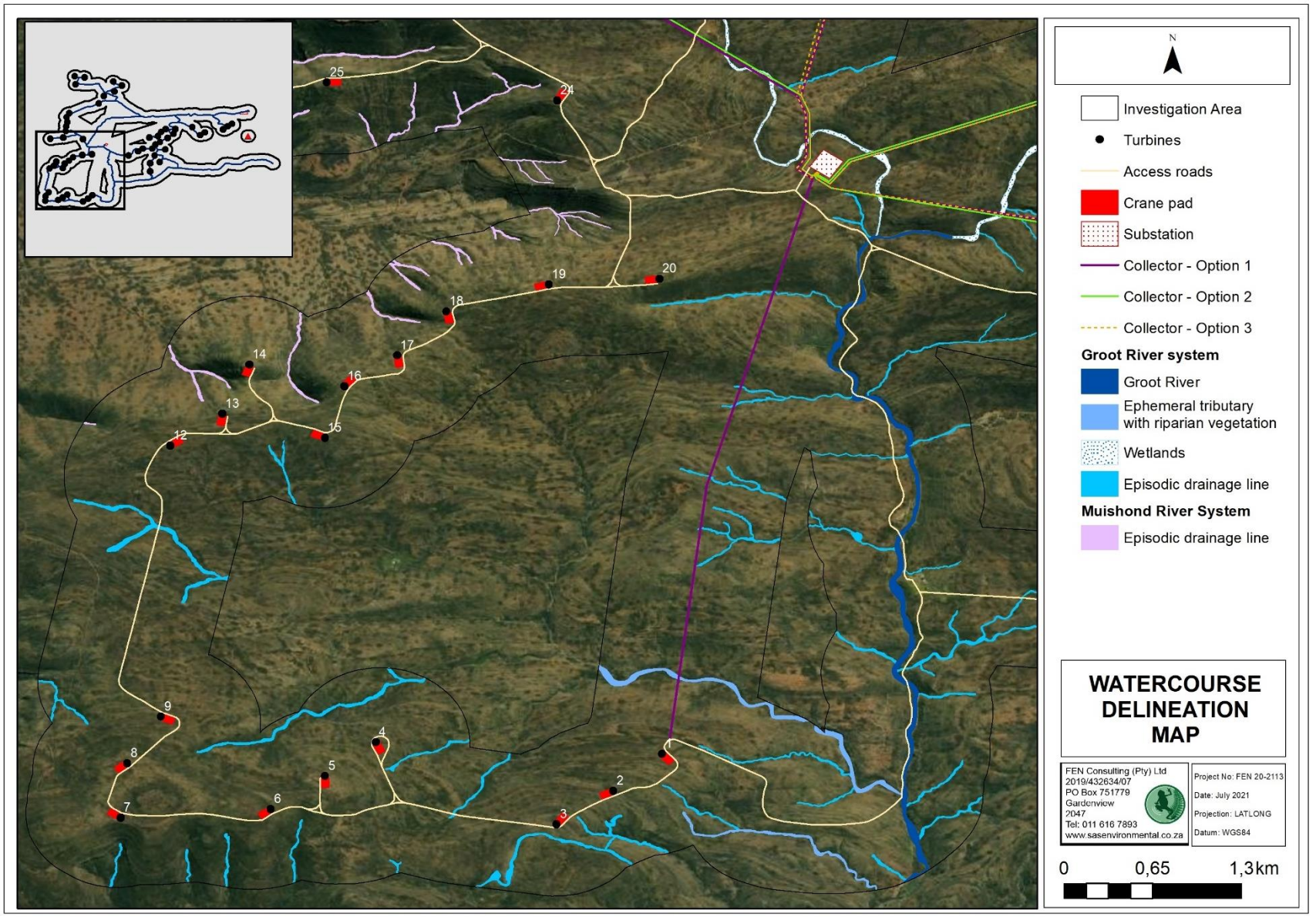

Figure 12: The locality of the delineated watercourses in the southwestern portion of the investigation area.

5.2 *Watercourse delineation*

The outer boundary of the identified watercourses were delineated according to the guidelines advocated by DWAF (2008) taking into consideration soil characteristics as defined by Job (2009). The delineations as presented in this report are regarded as a best estimate based on the site conditions present at the time of the assessment. During the field assessment, the following indicators were used in order to determine the boundary of the riparian watercourses identified to be associated with the proposed development and associated investigation area:

- **Topography/elevation** was used to determine which parts of the landscape watercourses are most likely to occur. Since watercourses occur where there is a prolonged presence of water in the landscape, the most common place one could expect to find watercourses is in the valley bottom position (DWAF, 2008). The main tributaries, the Groot and Roggeveld Rivers are located in the valley bottom position (Figure 13). Most other watercourses (like the smaller episodic drainage lines) are also located in valleys between undulating hills within the upslope that slopes towards the larger downstream system where concentration of flow leads to drainage towards the larger tributaries and river.

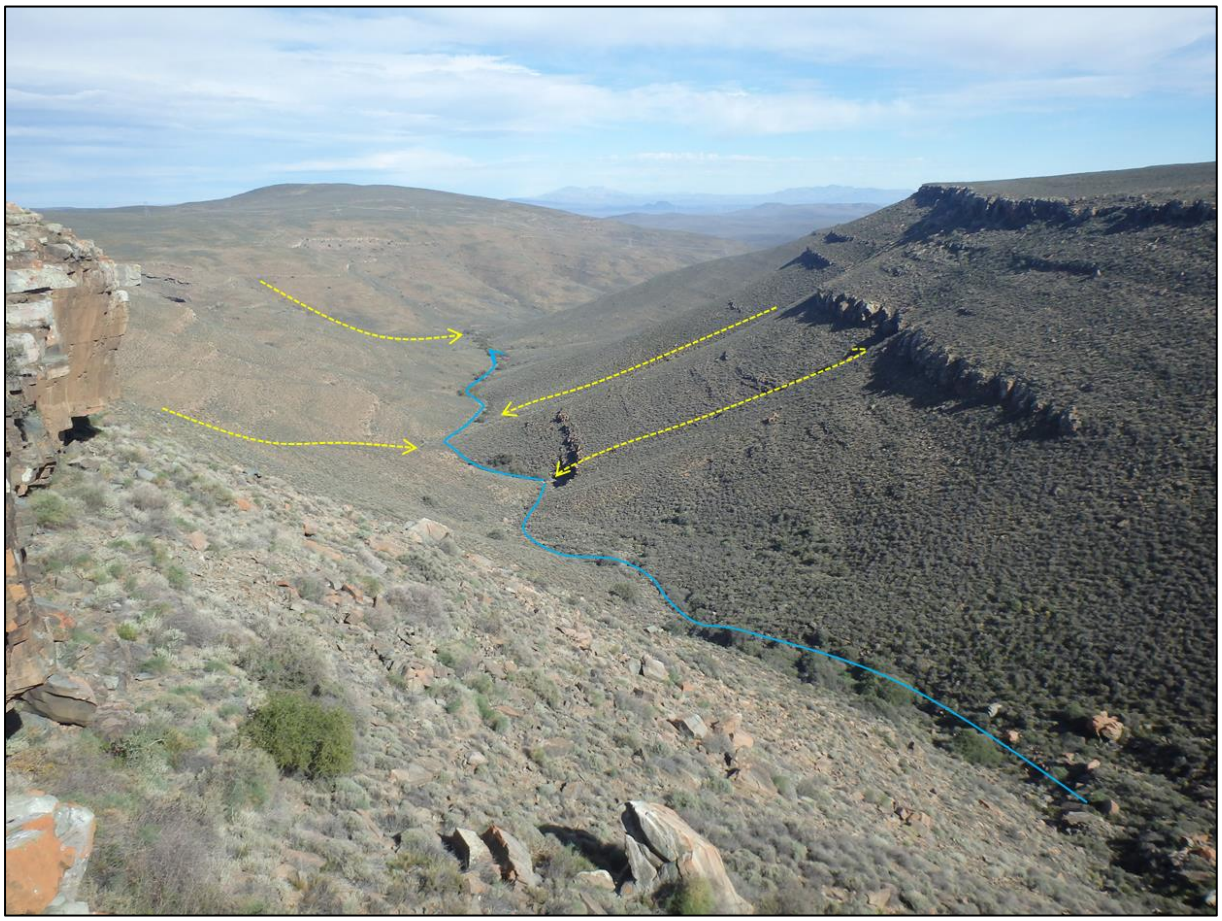

Figure 13: A photograph depicting the topographical setting of the smaller episodic drainage lines in the higher slope position (yellow dashed line) relative to the larger ephemeral tributary of the Muishond River in the valley bottom position (blue arrow).

- **Vegetation associated with riparian areas:** the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs:
  - in species composition relative to the adjacent terrestrial area; and
  - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, density, crowding, size, structure and/or numbers of individual plants.

Only in the larger downstream ephemeral tributaries and Groot River was a change in riparian vegetation identified from that of the terrestrial vegetation (Figure 14), where a mix of low tree and shrub species such as *Vahellia karroo, Searsia lancea, Lycium cinereum, Diospyros ausro-africana* and *Buddleja saligna* are prevalent. Trees and shrubs are less prominent along the rocky episodic drainage lines located in the upper reaches of the drainage systems (Figure 15). The channelled valley bottom wetlands identified hosts, predominantly facultative *Pseudoschoenus inanis* and *Scirpoides dioecus* sedges (Figure 15). Patches of *Phragmites australis* reeds, grasses such as *Stipagrostis namaquensis* with *Juncus spp* rushes were also identified in isolated patches within the ephemeral rivers/tributaries located in the valley bottom position, specifically where anthropogenic impacts have occurred, such as the construction of instream artificial impoundments.

Figure 14: Photographs depicting the vegetation component of the watercourses associated with the proposed development. (Left) the lower reaches of the ephemeral tributaries and rivers host tree species (indicated by the yellow arrows) in its marginal zones, which can be easily distinguished from the surrounding terrestrial vegetation. (Right) the vegetation of the smaller episodic drainage line watercourses is similar to that of the surrounding terrestrial areas.

Figure 15: A photograph depicting the typical vegetation of the identified wetlands, predominantly sedges.

- ***The presence of alluvial soil:*** The presence of alluvial soil was used as an indicator of riparian zones, as defined by the National Water Act, 1998 (Act No. 36 of 1998). The occurrence of alluvial deposited material adjacent to the active channel is a good indicator of the riparian zone of a riparian watercourse (such as that of the identified river, tributaries and ephemeral drainage lines). Alluvial soil is soil derived from materials deposited by flowing water, especially in the valley bottom position. Riparian areas often, but not always, have alluvial soil. While the presence of alluvial soil cannot always be used as a primary indicator to delineate riparian watercourses accurately, it can be used in conjunction with the topographical and vegetative indicators. Unlike wetland areas, riparian zones are usually not saturated for a long enough period of time for redoximorphic features to develop. This is because riparian watercourses are mainly driven by flow, originating from its local catchment which flows through the watercourse and does not reside in the riparian watercourse as with wetlands. This is specifically true for ephemeral and episodic systems that experience flash flooding in response to rainfall events.
- **Soil form indicators** were used to determine the presence of soil that are associated with prolonged and frequent saturation with key wetland indicators including gleying, mottling, organic streaking and increased clay content, as well as alluvial soil. A thick layer of clay above impermeable rock retains sufficient moisture for facultative species to have established within the identified wetlands (Figure 16).

Figure 16: (Left) the embankment of the wetland channel consists of a thick clay layer above impermeable rock. (Right) the soil auger samples consisted of high clay content that was noted to be saturated, however no other hydrogeomorphic indicators were present.

5.3 *Watercourse classification and assessment*

The identified watercourses were classified according to the Classification System outlined in **Appendix C** of this report as Inland Systems, located within the Great Karoo Ecoregion. Table 4 below presents the classification from level 3 to 4 of the Wetland Classification System (Ollis *et al.* 2013).

Table 4: Classification of the watercourses associated with the proposed development.

Watercourse	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Channelled valley bottom wetland.	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	Channelled valley-bottom wetland: A valley bottom wetland with a river channel running through it.
Ephemeral rivers and tributaries with riparian vegetation.		A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Episodic Drainage lines.	Slope—an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	

Tables 5, 6 and 7 provides a summary of the field verification findings in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. Due to the similar watercourse characteristics of the ephemeral tributaries and that of the episodic drainage lines, and each of these watercourse types having been subjected to the same anthropogenic impacts, the ecoservice provision, hydrological regime, geomorphological characteristics, water quality and habitat of these watercourses, all of the ephemeral rivers and tributaries and all of the episodic drainage lines were assessed in a combined fashion. The details pertaining to the methodology used to assess the watercourses is contained in **Appendix C**.

Table 5: Summary of results of the assessment of the episodic drainage lines associated with the Groot, Roggeveld, Muishond and Wilgebos River systems to be traversed by the proposed development.

Watercourse characteristics overview:
EDLs of these different river systems arise from the slopes of the surrounding mountainous areas. The identified EDLs are considered part of the headwaters of these larger river systems, as they are located in the landscape where runoff flows as surface water over impermeable bedrock at the point of outcropping. Road crossings (informal road crossings associated with the existing public minor roads) and small instream impoundments within the EDLs have resulted in small changes to existing flow patterns. However, overall, changes to the hydrological functioning of the EDLs are not pronounced, allowing for uninterrupted hydrological functionality of the downstream systems. The vegetation associated with the EDLs are predominantly short growing shrubs, but no facultative vegetation species were identified within these EDLs. The vegetation cover within the immediate vicinity of the EDLs (along its active channel) remains fairly intact and indicative of the natural species composition expected of the vegetation type, however some invasive species were present in areas where disturbance has occurred (i.e., road crossings). Some erosion of the downstream reaches of the EDLs just below the instream impoundments and at road crossings were noted, however, this is not considered significant. Despite erosion noted within isolated areas of the EDLs, no significant deposition of sediment was observed.
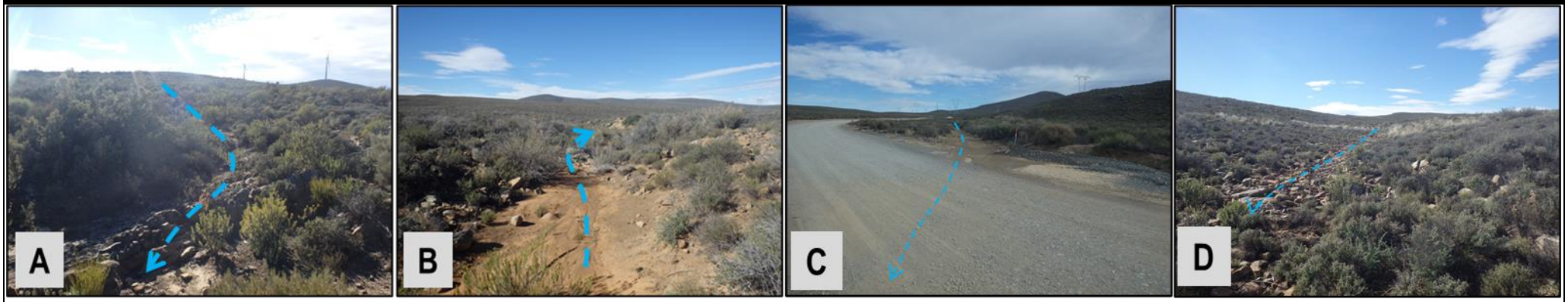
Figure 17: Representative photographs of the episodic drainage lines of the Groot River system (A, B), the Roggeveld River system (C) (existing road crossing without through flow structures) and the Muishond River system (D). These drainage lines are clearly defined by an unvegetated channel of exposed bedrock. No significant change between the vegetation associated with the edge of the drainage line channel to that of the surrounding terrestrial area is evident. Blue dashed lines indicate direction of flow.

Assessment of the EDLs of the Groot River System	**IHI Outcome**	**IHI Riparian PES Category: B (Largely natural with few modifications)** Due to the position of the EDLs in the landscape, they are considered largely intact, with limited change to the cover, abundance and species composition of the EDLs. Informal road crossings were determined to be an anthropogenic impacting factor.	**EIS Discussion**	**High** The EDLs are considered of ecological importance on a landscape scale, primarily due to these EDLs being classified as ESAs as per the WCBSP (2017) and the catchment thereof classified as an upstream catchment management area (according to NFEPA, 2011). Even though modifications to these EDLs have occurred, albeit limited, they still provide habitat to a variety of biota, given the high degree of connectivity of these features with the surrounding landscape.
	Ecoservice provision	**Ecoservice Provisioning: 1,4 (Intermediate)** Important for providing habitat (functions as migratory corridors) and erosion control, with intermediate nutrient and toxicant assimilation.	**REC Category, BAS and RMO**	**REC: Category B (Largely natural with few modifications)** **BAS: Category B RMO: B (Improve)** The RMO is to, at minimum, maintain these EDLs in their current ecological state (although the outcome of the RMO indicated to 'improve', given that the proposed activities will be limited in extent and most likely associated with existing disturbances; to maintain the PES is considered acceptable), as any potential impacts my also impact cumulatively on the downstream larger tributaries and wetland system. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.

Assessment of the EDLs of the Roggeveld River System	**IHI Outcome**	**IHI Riparian PES Category: B/C (Largely natural with few modifications)** Due to the position of the EDLs in the landscape, they are considered largely intact, but due to anthropogenic activities, such as gravel roads and powerline infrastructure crossings (Figure 16C), impacts have resulted in minor modification to the EDLs.	**EIS Discussion**	**High** The EDLs are considered of ecological importance on a landscape scale, primarily due to these EDLs being classified as CBA 1 (of aquatic importance) as per the WCBSP (2017) and the catchment thereof classified as a Freshwater Ecosystem Priority Area (according to NFEPA, 2011). Even though modifications to these EDLs have occurred, they still provide habitat to a variety of biota, given the high degree of connectivity of these features with the surrounding landscape.
	Ecoservice provision	**Ecoservice Provisioning: 1,4 (Intermediate)** Important for providing habitat (functions as migratory corridors) and erosion control, with intermediate nutrient and toxicant assimilation.	**REC Category, BAS and RMO**	**REC: Category B (Largely natural with few modifications)** **BAS: Category B RMO: B/C (Improve)** The RMO is to, at minimum, maintain these EDLs in its current ecological state (although the outcome of the RMO indicated to 'improve', given that the proposed activities will be limited in extent and most likely associated with existing disturbances; to maintain the PES is considered acceptable), as any potential impacts my also impact cumulatively on the downstream wetland and river system. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.
Assessment of the EDLs of the Muishond River System	**IHI Outcome**	**IHI Riparian PES Category: B (Largely natural with few modifications)** Due the remote locality of these EDLs, they have not been subjected to may anthropogenic impacts, with the exception of informal road crossings. This has resulted in erosion and subsequent sedimentation in isolated areas.	**EIS Discussion**	**High** The EDLs are considered of ecological importance on a landscape scale, primarily due to these EDLs being classified as CBA 1 (of aquatic importance) as per the WCBSP (2017) and the catchment thereof classified as a Freshwater Ecosystem Priority Area (according to NFEPA, 2011). Even though modifications to these EDLs have occurred (with specific mention of existing powerline infrastructure crossings), they still provide habitat to a variety of biota, given the high degree of connectivity of these features with the surrounding landscape.
	Ecoservice provision	**Ecoservice Provisioning: 1,4 (Intermediate)** Important for providing habitat (functions as migratory corridors) and erosion control, with intermediate nutrient and toxicant assimilation.	**REC Category, BAS and RMO**	**REC: Category B (Largely natural with few modifications)** **BAS: Category B RMO: A/B (Improve)** The RMO is to, at minimum, maintain these EDLs in its current ecological state (although the outcome of the RMO indicated to 'improve', given that the proposed activities will be limited in extent and most likely associated with existing disturbances; to maintain the PES is considered acceptable), as any potential impacts my also impact cumulatively on the downstream larger Muishond River system. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.
Impact Significance:	**Moderate** (With the implementation of mitigation measures)	No proposed surface infrastructure (i.e., wind turbines, crane pads, substation or construction camp) will be located directly within any watercourses, however, roads traversing some of the EDLs will be upgraded. Underground cables will be installed along these watercourse crossings. Such activities were identified to pose a negative moderate impact on the watercourses. Despite some reaches of these watercourses being considered to be in a degraded state, they are still considered of high ecological importance and sensitivity; as such the upgrading of the watercourse road crossings poses a Moderate risk significance to the watercourses. It is the opinion of the ecologist that formalising watercourse crossings with appropriate through flow structures is considered advantageous as existing informal watercourse crossings have resulted in erosion of the watercourses which have caused interruption of hydrological connectivity between the upstream and downstream reaches. It is highly recommended that the upgrading of the watercourse crossings be undertaken during the driest period of the year. The upgraded watercourse crossings must be appropriately sized to cater for high flood events and suitable erosion and scouring protection must be installed during the construction phase. The construction footprints within these watercourses must be suitably rehabilitated and monitored for the establishment of alien and invasive plant species during the operational phase and to ensure the structures are hydraulically and geotechnically stable. Should the upgrade of roads in close proximity to the watercourses take place during the low flow season, the risk to the receiving environment will be significantly reduced.		

Table 6: Summary of results of the assessment of the Groot River and ephemeral tributaries to be traversed by the proposed development.

Watercourse characteristics overview:				
The Groot River and various ephemeral tributaries associated with the Groot, Roggeveld and Wilgebos River systems have been impacted by surrounding agricultural activities and gravel road crossings. These disturbances have resulted in some bank erosion, an increase in the presence of alien vegetation species and some loss of tree diversity within the riparian zone (albeit not considered extensive). These watercourses function as a migratory corridor due to its connectivity with the smaller upstream EDLs and larger river systems (thus high hydrological connectivity in the landscape). These watercourses also provide habitat for a variety of faunal species, even more so due to the presence of small trees species within the marginal zone.				
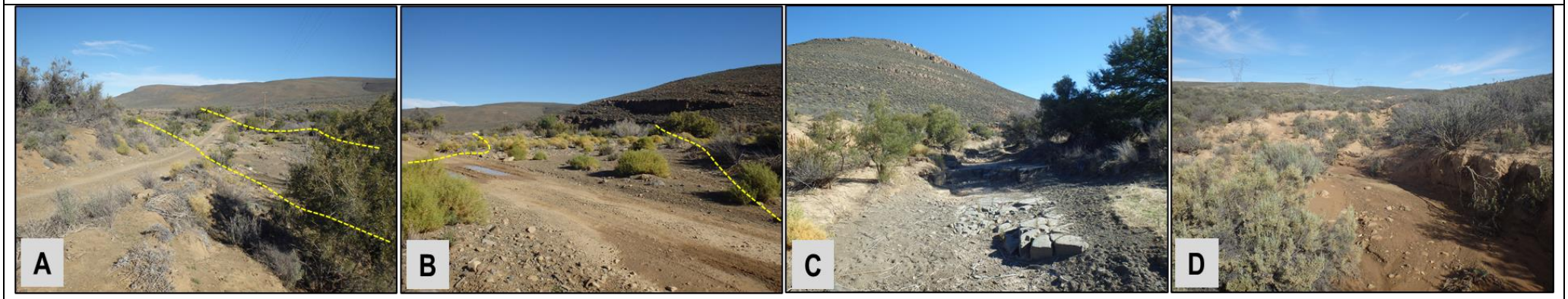				
Figure 18: Representative photographs of the Groot River (A and B) with existing road crossings, proposed to be upgraded as part of the proposed development; an ephemeral tributary associated with the Groot River system (C); and an ephemeral tributary associated with the Roggeveld River system (D).				
Assessment of the tributaries located in the investigation area	**IHI Outcome**	**IHI Riparian PES Category: C (Moderately modified)** The assessed reaches of these watercourses have been subjected to impacts associated with existing informal crossings and agricultural activities (including instream impoundments). This has resulted in changes to the riparian vegetation components, which is evident by the reduction of vegetation coverage and the invasion of alien and invasive vegetation species (albeit limited).	**EIS Discussion**	**High** These watercourses are considered of ecological importance on a landscape scale, primarily due to the watercourses being classified as CBA 1 (of aquatic importance) as per the WCBSP (2017) and the catchment thereof classified as a Freshwater Ecosystem Priority Area (according to NFEPA, 2011). Even though modifications to the watercourses have occurred, these systems still provide habitat to a variety of biota, given the high degree of connectivity with the surrounding landscape to the larger rivers outside the investigation area.
	Ecoservice provision	**Ecoservice Provisioning: 1,5 (Intermediate)** These watercourses are considered important for biodiversity maintenance. As these are ephemeral watercourses, they are of seasonal importance for the supply of water for a variety of faunal species. The watercourses are not considered important for harvestable resources or cultivated foods, mainly due to them being located in a natural water scarce region.	**REC Category, BAS and RMO**	**REC: Category C (Moderately modified)** **BAS: Category C RMO: B/C (Improve)** The RMO is to, at minimum, maintain the watercourses in their current ecological state (although the outcome of the RMO indicated to 'improve', given that the proposed activities will be limited in extent and most likely associated with existing disturbances; to maintain the PES is considered acceptable), as any potential impacts my also impact cumulatively on the downstream larger river systems. Small scale rehabilitation of areas which may potentially be impacted must be undertaken.

Assessment of the Groot River	**IHI Outcome**	**IHI Riparian PES Category: C (Moderately modified)** The assessed reach of this river has been impacted by ongoing surrounding agricultural development, instream impoundments and gravel road crossings. These impacts resulted in change to the cover, abundance and species composition of the vegetation component and selective erosion.	**EIS Discussion**	**High** The river is considered of ecological importance on a landscape scale, primarily due to the wetland vegetation type associated with the investigation area (according to NFEPA, 2011) which is considered to be critically endangered and almost the entire extent of the investigation area is located within an ESA as per the CBANC (2016). Even though modifications to these tributaries have occurred, it still provides habitat to a variety of biota, given the high degree of connectivity of these features with the surrounding landscape.
	Ecoservice provision	**Ecoservice Provisioning: 1,5 (Intermediate)** Important for providing habitat (functions as migratory corridors) and erosion control, with intermediate nutrient and toxicant assimilation.	**REC Category, BAS and RMO**	**REC: Category B (Largely natural with few modifications)** **BAS: Category B RMO: A/B (Improve)** The RMO is to, at minimum, maintain the river in its current ecological state, as any potential impacts my also impact cumulatively on the system. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken, specifically at direct road crossings.

Impact Significance:	**Moderate** (With the implementation of mitigation measures)	No proposed surface infrastructure (i.e., wind turbines, crane pads, substation or construction camp) will be located directly within any watercourses, however, roads traversing some of the tributaries and the Groot River system will be upgraded. Underground cables will be installed along these watercourse crossings. Such activities were identified to pose a negative moderate impact on the watercourses. Despite some reaches of these watercourses considered to be degraded, they are still considered of high ecological importance and sensitivity; as such the upgrading of the watercourse road crossings poses a Moderate risk significance to the watercourses. It is the opinion of the ecologist that formalising watercourse crossings with appropriate through flow structures is considered advantageous as existing informal watercourse crossings have resulted in erosion of the watercourses which have caused interruption of hydrological connectivity between the upstream and downstream reaches. It is highly recommended that the upgrading of the watercourse crossings be undertaken during the driest period of the year. The upgraded watercourse crossings must be appropriately sized to cater for high flood events and suitable erosion and scouring protection must be installed during the construction phase. The construction footprints within these watercourses must be suitably rehabilitated and monitored for the establishment of alien and invasive plant species during the operational phase and to ensure the structures are hydraulically and geotechnically stable. Should the upgrade of roads in close proximity to the watercourses take place in the low flow season, the risk to the receiving environment will be significantly reduced.

Table 7: Summary of results of the assessment of the channelled valley bottom wetlands to be traversed by the proposed development.

<table>
<tr><td colspan="2">Watercourse characteristics overview:

The channelled valley bottom wetland form part of the headwaters of the Roggeveld and Groot River systems. These wetlands have primarily been impacted by informal road crossings and historical agricultural fields within its immediate catchment. It is also noted that MR 8041 an MR 6159 (proposed to be upgraded) are located directly adjacent to the wetlands associated with the Groot River systems. This has resulted in localised erosion and subsequent sedimentation of the immediate downstream reaches. Due to the thick clay layer associated with the wetlands, high substrate moisture allows for the persistence of facultative wetland species in the wetlands providing habitat and foraging for a variety of faunal species, making the wetlands sensitive to changes in the landscape. The wetlands function as migratory corridors due to its connection to the surrounding terrestrial areas, EDLs, tributaries and larger river systems (thus high hydrological connectivity in the landscape).</td><td colspan="2"> 
Figure 19: (Left) A representative photograph of a channelled valley bottom wetland located in the northern extent of the investigation area. (Right) Existing powerline infrastructure crossing the wetland, with an existing access road within close proximity to the wetland. Yellow dashed arrow indicates direction of flows</td></tr>
<tr><td>PES Discussion</td><td>PES Category: B/C (Largely natural with few modifications)
Despite some reaches of the wetlands not having any anthropogenic impacts, existing gravel roads do traverse the wetlands and the upstream systems connected to the wetlands. Instream dams (immediately south of the MR 8041) and historical agricultural fields have impacted on the overall integrity of the wetlands, with specific mention of its hydrological connectivity. Nevertheless, the wetlands are still considered in a largely natural ecological condition providing important ecological functions.</td><td>EIS Discussion</td><td>High
The wetlands are considered of ecological importance on a landscape scale, primarily due to the wetlands being classified as CBAs 1 (of aquatic importance) and ESAs 1 as per the WCBSP (2017) and the catchment thereof classified as an upstream Freshwater Ecosystem Priority Area (according to NFEPA, 2011). Even though modifications to the wetlands have occurred, they provide habitat to a variety of biota, given the high degree of connectivity with the surrounding landscape to the larger riparian watercourses outside the investigation area.</td></tr>
<tr><td>Ecoservice Provision</td><td>Ecoservice Provisioning: 1,5 (Intermediate)
Important for providing habitat (functions as migratory corridors) within the vast terrestrial landscape. Due to the soil characteristics of the wetlands, it provides intermediate levels of erosion control, and nutrient and toxicant assimilation services.</td><td>REC Category, BAS and RMO</td><td>REC: Category B (Largely natural with few modifications)
BAS: Category B RMO: B/C (Improve)
The RMO is to, at minimum, maintain the wetlands in their current ecological state (although the outcome of the RMO indicated to ‘improve’, given that the proposed activities will be limited in extent and most likely associated with existing disturbances; to maintain the PES is considered acceptable), as any potential impacts my also impact cumulatively on the downstream larger river systems. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.</td></tr>
</table>

Impact Significance:	**Moderate** (With the implementation of mitigation measures)	No proposed surface infrastructure (i.e., wind turbines, crane pads, substation or construction camp) will be located directly within any wetlands, however, roads traversing some of the wetlands will be upgraded and an extensive section of an existing informal road adjacent to a wetland will be upgraded. Underground cables will be installed along these watercourse crossings. Such activities were identified to pose a negative moderate impact on the wetlands. Despite some reaches of these wetlands being considered to be in a degraded condition, they are still considered of high ecological importance and sensitivity; as such the upgrading of the watercourse road crossings poses a Moderate risk significance to the wetlands. It is the opinion of the ecologist that formalising watercourse crossings with appropriate through flow structures is considered advantageous as existing informal watercourse crossings have resulted in erosion of the watercourses which have caused interruption of hydrological connectivity between the upstream and downstream reaches. It is highly recommended that the upgrading of the watercourse crossings be undertaken during the driest period of the year. The upgraded watercourse crossings must be appropriately sized to cater for high flood events and suitable erosion and scouring protection must be installed during the construction phase. The construction footprints within these watercourses must be suitably rehabilitated and monitored for the establishment of alien and invasive plant species during the operational phase and to ensure the structures are hydraulically and geotechnically stable. Should watercourse crossings development and the upgrade of roads within close proximity to the watercourses take place in the low flow season, the risk to the receiving environment will be significantly reduced.

All comprehensive results calculated are available in **Appendix D.**

6 LEGISLATIVE REQUIREMENTS & SENSITIVITY MAPPING

The following legislative requirements were considered during the assessment. A detailed description of these legislative requirements is presented in **Appendix B** of this report:

- The Constitution of the Republic of South Africa, 1996[6];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on watercourses arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted, however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of the assessed watercourses can be summarised in table that follows.

Table 8: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation (DWS)**	**Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the **absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse** where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.**

Based on the above applicable legislation, a 100 m Zone of Regulation (ZoR) has been applied to the riparian watercourses (rivers, ephemeral tributaries and episodic drainage lines) and a 500m ZoR to the wetlands in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) (Figures 20 to 23).

[6] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

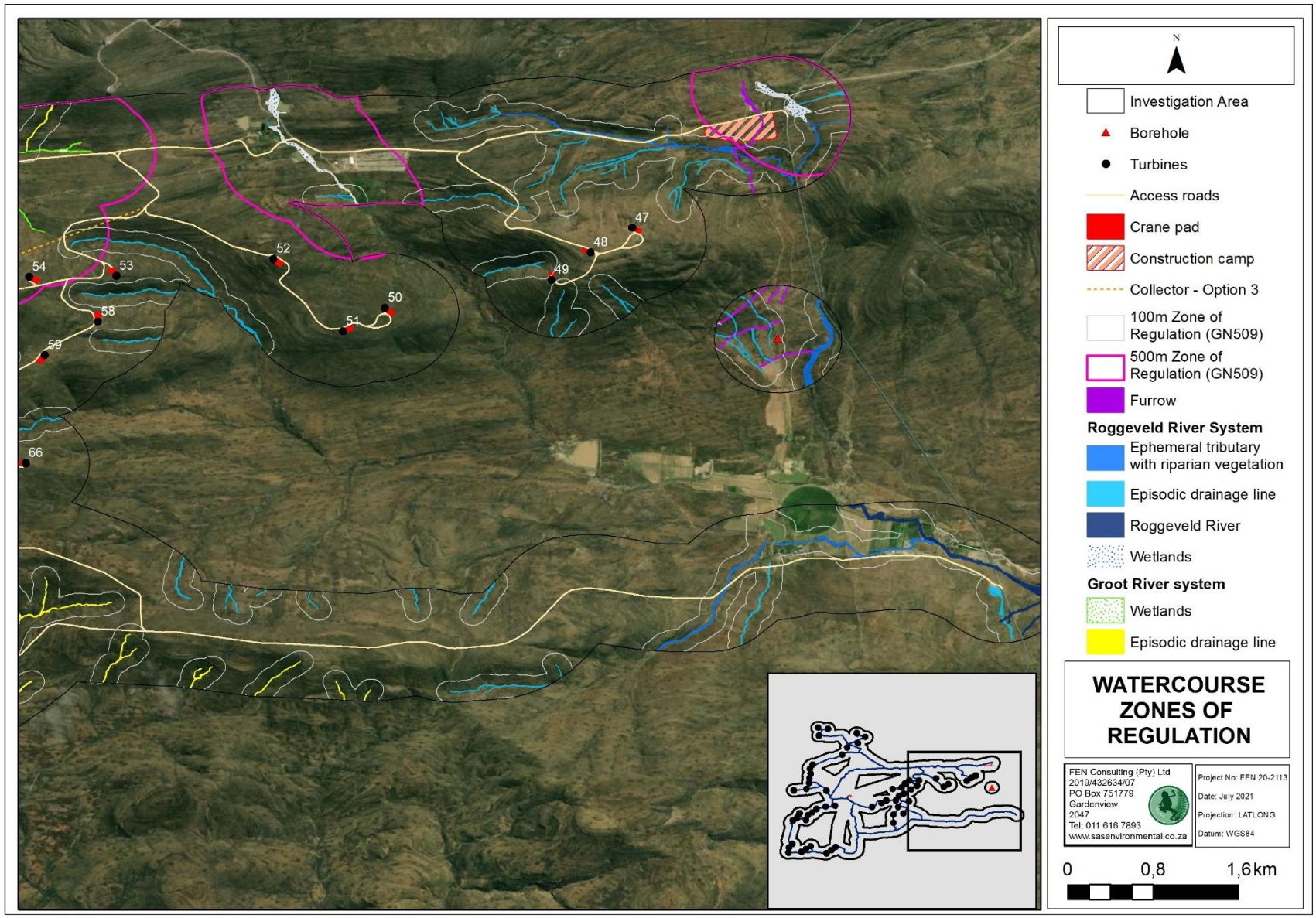

Figure 20: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA for the watercourses associated with the eastern portion of the investigation area.

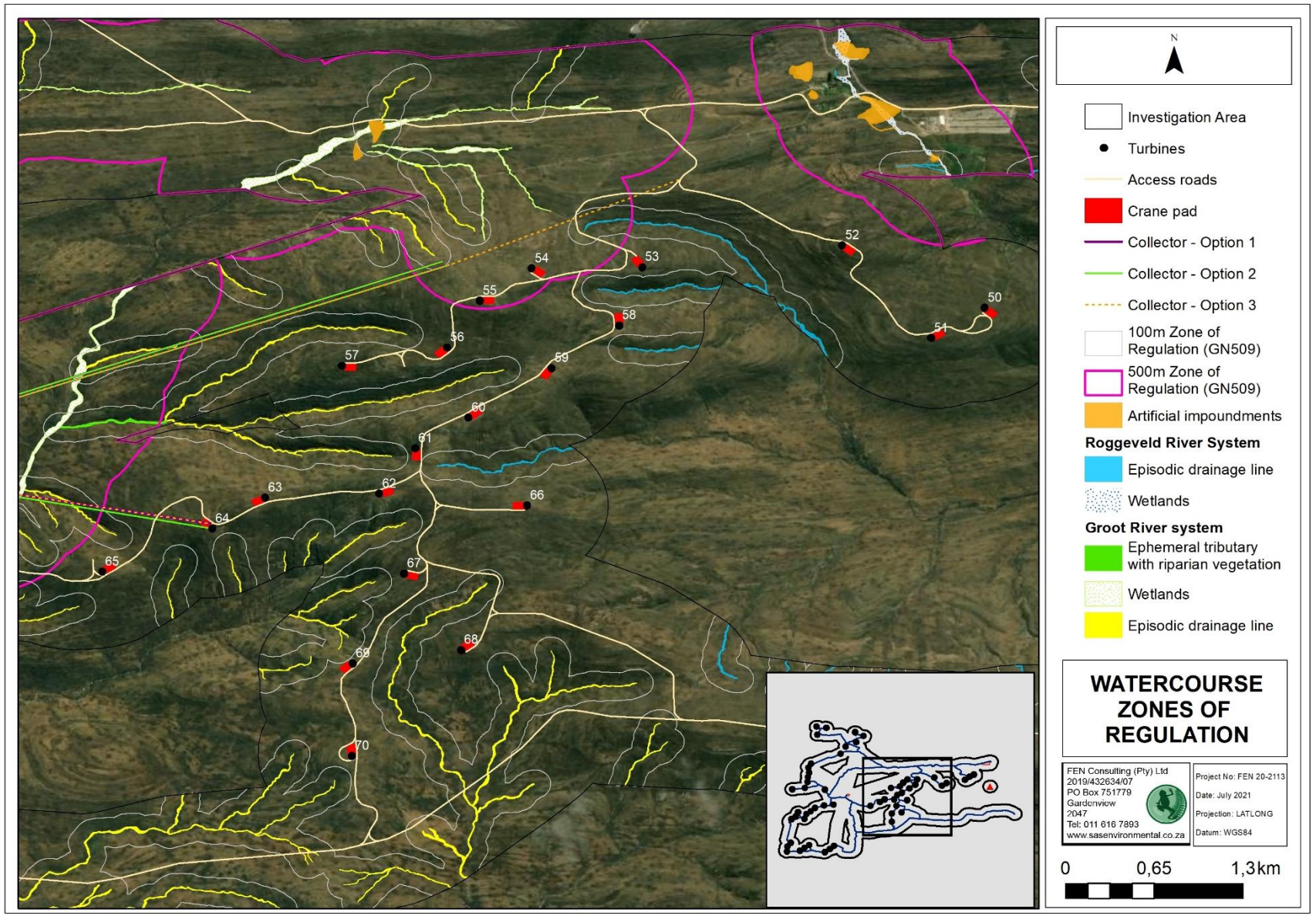

Figure 21: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA for the watercourses associated with the central portion of the investigation area.

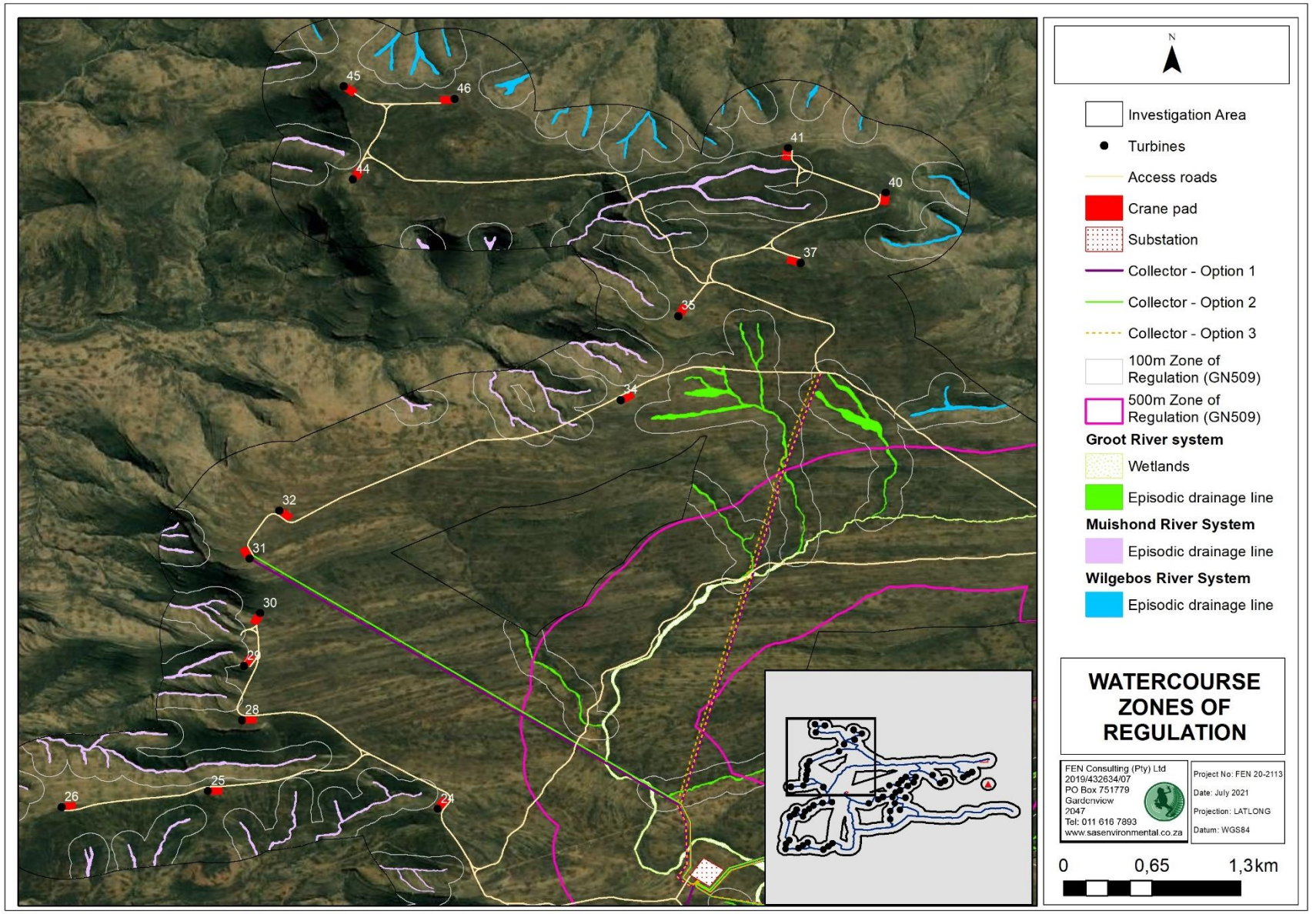

Figure 22: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA for the watercourses associated with the north-western portion of the investigation area.

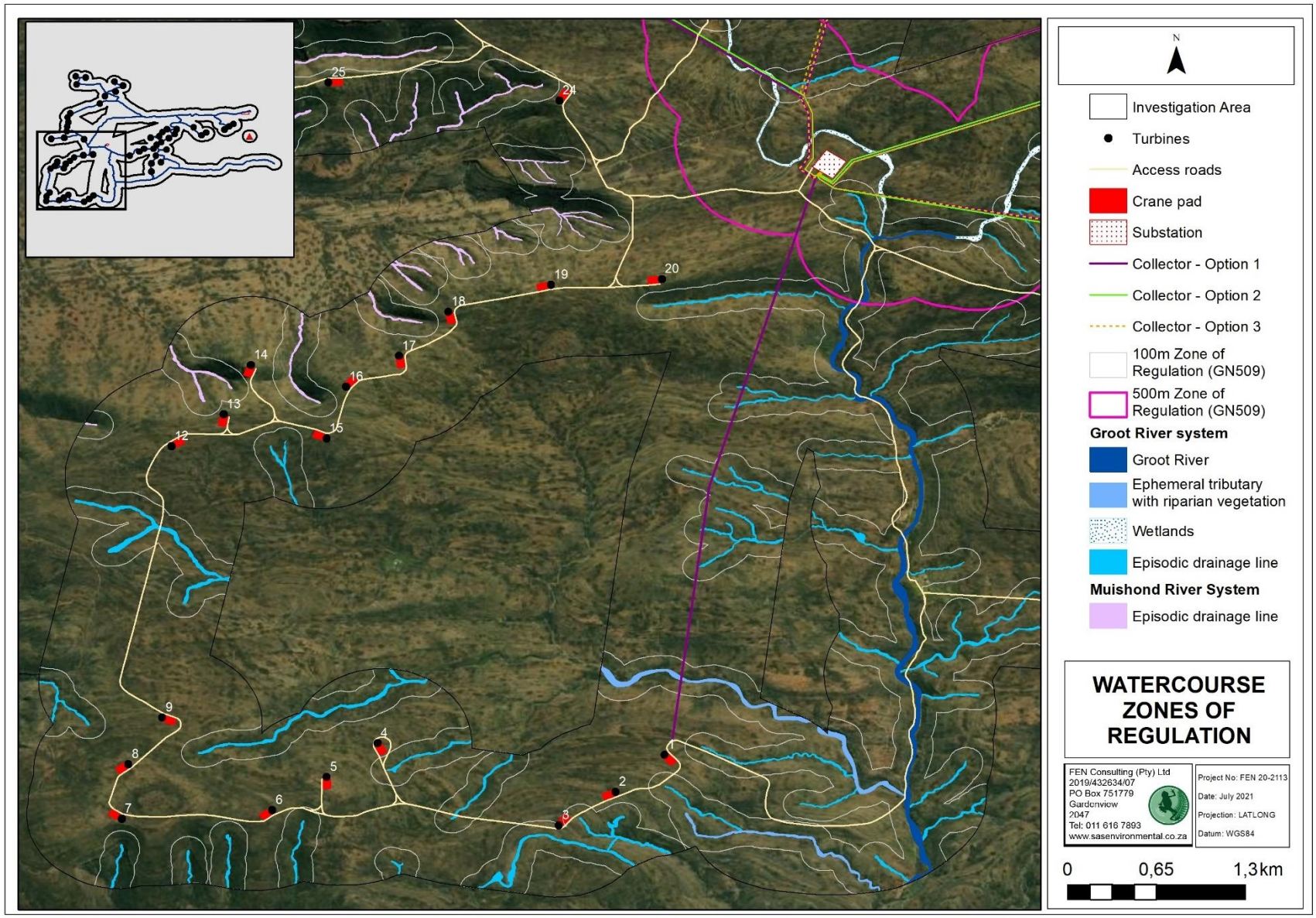

Figure 23: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA for the watercourses associated with the south-western portion of the investigation area.

7 RISK ASSESSMENT

This section presents the significance of potential impacts on the ecology of the identified watercourses associated with the proposed development. In addition, it also indicates the recommended mitigatory measures needed to minimise the perceived impacts of the proposed development and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures.

7.1 *Risk Assessment considerations and outcome*

Following the assessment of the watercourses associated with the proposed development, the impact assessment was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these watercourses. The impact assessment was undertaken for the proposed layout as provided by the proponent and as described in Section 2 of this report and presented in Figures 1 and 2. The points below summarise the considerations made when applying the impact assessment:

- The risk assessment was applied considering the risk significance of the proposed surface infrastructure components, as described in Section 2 and depicted in Figures 1 and 2;
- Only access road watercourse crossings are located directly within watercourses. The following table provides a summary of the proposed development infrastructures which may potentially impact on the watercourses:

Table 9: Summary of the distance the proposed surface infrastructure components are located relative to a watercourse.

Proposed surface infrastructure component	Approximate distance from the closest watercourse
Borehole	Locate 69m from an EDL. Thus, located within the 100 m GN509 ZoR.
Construction camp	Located 57m from an ephemeral tributary and 102 m from a channelled valley bottom wetland (both watercourses associated with the Roggeveld River System. Thus, located within the 100 m and 500 m GN509 ZoR.
Substation	Located 90 m from a channelled valley bottom wetland associated with the Groot River system. Thus, located within the 500 m GN509 ZoR.
Crane pads	Crane pads located within the 100 m GN509 ZoR: • Crane pad associated with Turbine 49, located approximately 68 m from a riparian watercourse. • Crane pad associated with Turbine 29, located approximately 94 m from a riparian watercourse. • Crane pad associated with Turbine 41, located approximately 65 m from a riparian watercourse. • Crane pad associated with Turbine 3, located approximately 53 m from a riparian watercourse. Crane pads located within the 500 m GN509 ZoR: • Crane pad associated with Turbine 54, located approximately 370 m from a channelled valley bottom wetland. • Crane pad associated with Turbine 55, located approximately 406 m from a channelled valley bottom wetland.
Collector system – Option 1, 2 and 2	Several watercourse crossings: (It must be noted that all powerline support structures will be constructed outside of the delineated extent of the watercourses and as far as feasible, at least 32 m from its delineated extent and therefore are not considered to pose a direct negative risk to the delineated watercourses).

Access roads	• Several watercourse crossings (new and existing). • Upgrading of extensive sections of the proposed access roads which are located adjacent to wetlands and the Groot River system (Figure 24).  **Figure 24: Photographs depicting the locality of existing roads (red line) to be upgraded relative to the relevant watercourses (blue dashed lines). (Right) Groot River; (Left) channeled valley bottom wetland upstream of the Groot River.**

- All other turbines/crane pads not listed in the table above are located outside the 100m/500m GN509 Zone of Regulation. The risk significance of these infrastructure components was not considered as these components are considered to not pose a quantum of risk to the identified watercourses due to their distance;
- As per Figure 10, a man-made irrigation furrow drains through the proposed construction camp location. Since the furrow is an anthropogenic feature, it is not protected under the National Water Act, 1998 (Act No. 36 of 1998). Nevertheless, it is still connected to downgradient natural watercourses and the construction camp may thus pose indirect negative impacts to these watercourses, which was assessed as part of the risk assessment;
- Based on hydro census investigations undertaken by Tsunami Resources (pers. comm Johan Smit, hydrogeologist), abstracting water from borehole 264 has a minimal, if any, impact on the surface watercourses, as the watercourses are hydrologically driven by surface water runoff (please refer to the hydro census analysis report for more detail). As such, the risk significance of the abstraction of water was not considered for Section 21(c) and (i) water uses as this activity is considered to not pose a quantum of risk to the identified watercourses. A Water Use Licence for the required Section 21(a) water use will need to be applied for;
- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report present the perceived impact significance post-mitigation;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the Department of Forestry, Fisheries and Environment (DFFE) *et al* (2013) would be followed, i.e., the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required. However, it is acknowledged that new watercourse crossings will be created, and others upgraded and thus direct impacts to the watercourses from this activity are considered inevitable;
- The default score for legal issues (for all watercourses proposed to be traversed) is '5' since some activities, as listed in Table 9, will be located within the 100 m/500 m ZoR in terms of GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The activities relating to the proposed development are all considered to be highly site specific, not of a significant extent relative to the area of the watercourses assessed, and therefore have a limited spatial extent;
- While the operation of the proposed development will be a permanent activity, the construction thereof is envisioned to take between 12 and 24 months. However, the frequency of the construction impacts may be daily during this time;

- Most impacts are considered to be easily detectable, with the exception of contamination of surface and groundwater (which will require some effort); and
- The considered mitigation measures are easily practicable.

Table 10 below provides a summary of the outcome of the DWS Risk Assessment for the above-listed activities, based on the method presented in **Appendix D.** All general good housekeeping mitigation measures and the full impact assessment scoring is provided in **Appendix F**.

Table 10: Summary of the results of the DWS risk assessment applied to the proposed development activities.

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
CONSTRUCTION PHASE									
1	Site preparation prior to construction activities of the proposed construction camp, substation, overhead powerline support structures as listed in Table 9 located within the 100m GN509 ZoR but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the 100m/500m GN509 ZoR but outside the delineated extent of watercourses.	Vehicular movement (transportation of construction materials).	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	1	3	12	36	L	• All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; • Retain as much indigenous vegetation as possible; • All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility; • During construction of the surface infrastructure within the 100 m/500m GN509 Zone of Regulation (but outside the watercourses), regular spraying of non-potable water or the use of chemical dust suppressants, that are approved for use near watercourses must be implemented to reduce dust and to ensure no smothering of vegetation within the watercourses occurs from excessive dust settling. It must be noted that specifics as to what type of dust suppressant (grey water vs. chemical dust suppressant) that will be utilised as part of the proposed development was not available at the time of assessment. Should this detail become available, it is recommended that the freshwater ecologist provide a statement on the suitability of the use of the proposed dust suppressant; • The watercourses outside the construction footprint not having authorised road crossings must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may traverse through these watercourses (except on approved road crossings); • As far as possible, existing roads must be utilised to gain access to sites; • Contractor laydown areas, and material storage facilities to remain outside of the 100 m/500 m GN509 ZoR; • All vehicle re-fuelling is to take place outside of the 100 m/500 m GN509 ZoR; and • No vegetation may be removed from the 100 m/500 m GN509 ZoR surrounding the watercourse where no infrastructure is planned, as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.
2		Removal of vegetation and associated disturbances to soils.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; • Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1,25	3,25	12	39	L	
3	Site preparation prior to construction activities relating to the development of new watercourse road crossings: • Upgrading of existing roads; and • Installation of underground cables	Removal of vegetation and associated disturbances to soils.	• Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	5	7	14	98	M	• It is imperative that all construction works be undertaken during the driest period of the year when there is no flow within the watercourses, and thus no diversion of flow would be necessary; • The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas can be marked at a maximum distance of 5 m upstream and downstream of the proposed road upgrade crossing. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the road is proposed to be upgraded;

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
	traversing through watercourses, and • Upgrading of roads within close proximity (within 32 m) to watercourses.								• For trenching of the cables, the topsoil has to be stored separately and may not be contaminated. Furthermore, the soil layers should be replaced in the same order and the topsoil returned last; and • The removed vegetation must be stockpiled outside of the delineated boundary of the watercourse. The footprint areas of these stockpiles should be kept to a minimum, and may not exceed a height of 2 m. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.
4	Creating new watercourse crossings, upgrading existing watercourse crossings and upgrading of existing roads within close proximity (within 32 m) to watercourses: • Excavation within the watercourse for the removal of existing infrastructure (where applicable) and for the casting of proposed concrete base. • Placement of culvert structures atop concrete base.	• Disturbances to soil of the watercourses; • Movement of construction machinery/ vehicles within the watercourses; and • Possible spills / leaks from construction vehicles.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	5	7	15	105	M	• The construction footprint must be limited to the 5 m construction buffer (upstream and downstream of the watercourse crossing) only. • Upgrading of the most westerly access route (associated with MR 8041 and MR 6159) must take cognisance of the delineated extent of the wetland located within close proximity to the road. Should the road be increased in width, the road must be expanded on the side opposite of the wetland, to ensure that the remaining natural buffer between the access road and the wetland remains intact; • Material to be used (gravel – if applicable) as part of the upgrading of the existing roads must be stockpiled outside the delineated extent of the watercourses (preferably at least 32 m from the watercourse) to prevent sedimentation thereof and to avoid any other vegetation being impacted by the construction activities. These stockpiles may not exceed a height of 2 m and should be protected from wind using tarpaulins; • The area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; • It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; and • All existing alien and invasive vegetation should be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site. <u>With regards to excavation and soil compaction activities within the watercourses</u> Although the proposed watercourse crossings are associated with existing road servitudes (existing public roads) or farm roads, and as such the most significant impacts have already occurred, the existing gravel roads are relatively small with no formal through flow structures in most cases. The following are applicable with regards to excavation works and any concrete related activities: • The culvert crossing must be designed to ensure that the structures are geotechnically sound and that they are hydraulically stable, even if a 1:100 year flood event was to occur. The designs should include culverts installed intermittently to ensure a free draining landscape. It is recommended that a suitably qualified hydrologist be consulted to provide guidance on the relevant sizes and width requirements to ensure that hydraulic

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									functioning of the system is maintained. In addition, the crossings must be designed such that should they be overtopped, they remain stable and do not lead to excessive downstream erosion and incision. Similarly, a freshwater ecologist must ensure that the final design accounts for appropriate wetting frequencies and patterns are maintained in the pre-development condition; • During the excavation activities, any soil/sediment or silt removed from the watercourse may be temporarily stockpiled in the road reserve but outside the delineated extent of the watercourse. These stockpiles may not exceed 2 m in height, and their footprint should be kept to a minimum. Stockpiling of removed materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and should be disposed of at a registered waste disposal facility; • Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, for later usage as backfill material or as part of rehabilitation activities; • Care must be taken to ensure that no scouring or erosion occurs as a result of the proposed culvert crossing. Installation of riprap or gabion mattresses adjacent to the abutments may be required (especially within the larger, low lying watercourses such as the Groot River) and/or concrete aprons associated with any culverts; • All construction material (with specific mention of prefabricated culvert structures) must be stockpiled in the construction camp and must only be imported to the construction site when required; • Machinery/vehicles used to install culvert structures must be parked on the existing road surface and may not enter the watercourses; and • Reno-mattresses or riprap must be installed at the outlet side of the culvert/bridge structures to ensure energy dissipation and prevent concentrated runoff into the downstream watercourse. The reno mattress/riprap must be installed flush with the culvert outlet. <u>Control measures specific to concrete works:</u> High alkalinity associated with cement can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to: • Fresh concrete and cement mortar should not be mixed near or in the watercourses. Mixing of cement may be done within a construction camp, however it may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be given to the use of ready-mix concrete; • No mixed concrete shall be deposited directly onto the ground or within the watercourses. All concrete must be brought in via a cement mixing truck which must remain within the road reserve, and cement must be piped down to the proposed crossing. Any areas that require manual application of cement require that the mixed

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									materials be placed on a batter board or other suitable platform/mixing tray until it is deposited; • A washout area should be designated outside of the delineated extent of the watercourses, and wash water should be treated on-site or discharged to a suitable sanitation system; • At no point may batter boards/mixing trays or cement trucks be rinsed off on site and run-off water may not be allowed into the watercourses; • Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream; and • Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided.
5	Construction of surface infrastructure outside of the watercourses but still within the 100 m/500m GN509 ZoR, which includes: • Collector overhead powerlines; • Construction camp; • Substation; and • 6 crane pads.	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; • Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; • Potential impacts on the water quality of surface water runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete casting; and • Potential of backfill material entering the watercourses, increasing the sediment loads therein.	1,75	3,75	12	45	L	As this activity was assessed based on the recommendation that the proposed powerline support structures (associated with the overhead collector powerlines) be located as far as feasible, at least 32 m from the delineated extent of a watercourse, this in itself is considered a mitigation measure which complies with the mitigation hierarchy as advocated by the DFFE et al. (2013). With regards to ground-breaking activities outside the delineated extent of a watercourse, but within the 100 m/500 m GN509 ZoR: • During excavation activities, the topsoil and vegetation should be stockpiled separately from other material outside the delineated extent of the watercourses; • Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up by any stockpiled materials. The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced; • All exposed soils must be protected from wind using tarpaulins for the duration of the construction phase to prevent potential erosion and sedimentation of the watercourses; • Suitable drainage should be insured along the crane pads and specifically the construction camp (associated with an existing furrow connected to natural watercourses), in order to ensure that water does not pond or drain in a concentrated manner into the nearby watercourses. This must be considered as part of the stormwater management plan and be overseen by a freshwater ecologist; • Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the watercourses which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction areas enter the watercourses by installing silt traps or placing haybales down gradient of the construction footprint (until suitable basal vegetation cover has been restored) to ensure no sediment laden or concentrated runoff generates from the construction footprint; and

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									• It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction. With regards to concrete mixing on site: Refer to Activity 4 above. With regards to backfilling of excavated areas: • Stockpiled material should be used as backfill material; • All excavated areas should be backfilled to the natural ground level with excavated material; and • Soil must be suitably compacted, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process. Rehabilitation of the construction footprint areas: • All footprint areas which have been compacted should be ripped and revegetated with indigenous vegetation as soon as the construction activities have been completed. This will prevent soil erosion and the creation of gullies within the operational area; and • The operational area should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.
OPERATIONAL PHASE									
6	Operation and maintenance of the surface infrastructure outside the watercourses but still within the 100m/500m GN509 ZoR, which includes: • Collector overhead powerlines; • Construction camp; • Substation; and • 6 crane pads.	• Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; and • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure.	• Disturbance to soils and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	1,5	3,5	12	42	L	• No indiscriminate movement of construction equipment through the watercourses may be permitted during standard operational activities or maintenance activities. Use must be made of the existing watercourse crossings only; • Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; • Vehicles used in the development site must be regularly washed (on a non-permeable surface or off-site) to avoid the dispersal of seeds on any alien or invasive species into the watercourses; • Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor any build-up of debris that will impact on structure integrity or lead to erosion and sedimentation. Furthermore, monitoring to determine the establishment of indigenous vegetation and the presence of any alien or invasive plant species; • Should erosion be noted at the base of the powerline support structures, the construction camp or surrounding the crane pads that may potentially impact on a watercourse in the surrounding area, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation;

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									• The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas form erosion gullies leading to erosion and sedimentation of receiving watercourses. Should these impacts be noted, these gullies/preferential flow paths must be infilled with *in situ* material and appropriately stabilised and/or revegetated; and • Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructures. Should alien and invasive plant species be identified, they must be removed and disposed of as per an alien and invasive species control plan and the area must be revegetated with suitable indigenous vegetation.
7	Operation and maintenance of roads traversing watercourses.	• Concentrated runoff entering the watercourses; and • Disturbance to the vegetation within and surrounding the watercourses.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	2,5	4,5	12	54	L	• Hot spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure. • Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings/instream infrastructure. Such maintenance activities must specifically be undertaken after high rainfall events; • Stormwater runoff from the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager), to ensure it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas); • Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the watercourses may be permitted; • During periodic maintenance activities of the roads, monitoring for erosion should be undertaken; and • Should erosion be observed, caused by the road crossings/instream infrastructure, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks collected from the surrounding area to infill any area prone to erosion, as a natural dispersal mechanism.
DECOMMISSIONING PHASE									
8	Removal of all surface infrastructure from the project area.	• Movement of construction vehicles and personnel; and • Disturbance to the buffer zone surrounding the watercourses.	• Disturbance of soil and vegetation that established within the operational area.	2,25	4,25	13	55,24	L	• No indiscriminate movement of construction equipment in the watercourses and buffer zones surrounding the watercourses may be permitted. Use must be made of the existing roads during the decommissioning phase; • All surface infrastructure must be decommissioned. All materials must be removed from the watercourses (where applicable) and may temporarily be stored/ stockpiled outside of the delineated extent of the watercourses, where after it must be removed from site and disposed of at a registered disposal facility; • High flood peaks from the decommissioning footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure area and subsequent cleared

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									area enters the watercourses. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the watercourses is intact or by the strategic placement of silt traps of haybales as a means to obstruct flow but still allow flow to percolate at a reduced velocity and encourages a diffuse flow pattern. In this regard it is recommended at an alien and invasive plant species management plan be implemented during the construction and operational phases to specifically prevent the spread of any such species into the sensitive ecological areas; • Areas where surface infrastructure have been decommissioned and removed must be suitably compacted/ripped and revegetated to ensure that no erosion occurs which may contribute to the sediment load of the watercourses; • Should erosion gullies be noted, these areas must be rehabilitated by infilling them with suitable soil and ensuring the area is vegetated. The increased surface roughness will discourage concentrated flow paths to develop and ensure diffuse flow patterns; • Should road crossings be decommissioned, road footprint areas within the watercourse must be levelled to the same level and shape as that of the upstream and downstream reaches. This will ensure a continuous bed level and prevent any concentration of surface flow from occurring; • Watercourse embankments must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring; • All bare areas in the investigation area, specifically where vegetation was initially cleared for surface infrastructure components) must be ripped and be revegetated within suitable indigenous vegetation species; • Follow up revegetation should take place where initial revegetation is not successful; and • Post-closure monitoring of the watercourses (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended to be undertaken.

The activities associated with the construction and operational phases of the proposed development poses a moderate to low risk significance to the watercourses, with the application of the recommended mitigation measures. Due to the extent of access roads proposed to be upgraded adjacent to sensitive channelled valley bottom wetlands and the Groot River and the upgrading of wetland road crossings, the direct impacts during the construction phase pose a Moderate risk significance to the watercourses. It is the opinion of the ecologist that formalising watercourse crossings with appropriate through flow structures is considered advantageous over the long-term as existing informal watercourse crossings have resulted in erosion of the watercourses which have caused interruption of hydrological connectivity between the upstream and downstream reaches.

Although the irrigation furrow located within the development footprint of the construction camp is considered an anthropogenic feature and thus not protected under the National Water Act, 1998 (Act No. 36 of 1998), this furrow is connected to downgradient watercourses and therefore suitable mitigation measures, such as potential realignment of the furrow to maintain the connectivity as well as stormwater management measures must be implemented to limit indirect negative impacts to the downgradient watercourses.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, as recommended in Table 10, the significance of impacts arising from the construction and operation of other infrastructure components (such as the construction camp and collector overhead powerline support structures) located outside of the watercourses and at least 32 m from the delineated extent of a watercourse, but within the 100 m/500 m GN509 ZoR are likely to be of very low significance. It is recommended that ongoing monitoring of the surface water areas be undertaken to minimise the risk of indirect impacts on the overall watercourse integrity. Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix F** of this report.

Authorisation by means of a Water Use Licence Application (WULA) in terms of Sections 21 (a), (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) must be obtained from the DWS for the proposed development prior to the commencement of any works.

7.2 *Cumulative Impact Statement*

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified in Section 7.1 above. Watercourses within the region are under continued threat due to rapid land use transformation in the surrounding landscape, with specific mention of renewable energy facilities (REF) and associated powerline infrastructure.

Direct and indirect impacts identified within the assessed watercourses can predominantley be attributed to the upgrading of extensive sections of access roads direcltey adjacent to a wetland and formalising watercourse road crossings the disturbance to the hydrological connectivity and functioning of the watercourses and alien and invasive species establishment. Although mitigation measures are provided to limit the significance of the direct negative impacts to the watercourses, considering the proposed development and ather proposed REFs in the catchment of the identified watercourses, a cumulative negative impact to the biophysical environment is expected. With management and mitigation measures implemented during the construction phase and monitoring of all proposed development infrastructure for any erosion during the operational phase, the direct and indirect negative impacts can be reduced and managed.

8 CONCLUSION

FEN Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the WUA processes for the proposed Brandvalley WEF and associated infrastructure.

During the site visit undertaken in May 2021, several headwater episodic drainage lines (EDLs) without riparian vegetation which flow into larger ephemeral tributaries and rivers in the valley bottom position were identified. These watercourses form part of the Groot, Roggeveld, Huishond and Wilgebos River systems.

Although these EDLs cannot be classified as riparian resources in the traditional sense, due to the lack of saturated soils and riparian vegetation, they do still function as waterways, due to the episodic conveyance of water. However, based on the definition of a watercourse (see Section 3.1) water flows regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient tributaries and eventually into the larger river systems. As such, they can be considered as watercourses and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998).

The results of the ecological assessment of the watercourses are discussed in Section 5 of this report is summarised in the table below:

Table 11: Summary of results of the ecological assessment as discussed in Section 5.

Watercourse	PES	Ecoservices	EIS	REC /BAS/RMO
Channelled valley bottom wetlands	B/C (Largely natural with few modifications)	Intermediate (1,5)	High	REC: Category B (Largely natural with few modifications) BAS: Category B RMO: B/C (Improve)
Ephemeral river (Groot River) and tributaries with riparian vegetation	C (Moderately modified)	Intermediate (1,5)	High	REC: Category C (Moderately modified) BAS: Category B RMO: B/C (Improve)
Episodic drainage line (EDL)	B (Largely natural with few modifications)	Intermediate (1,4)	High	REC: B (Largely natural with few modifications) BAS: Category B RMO: B (Improve)

No surface infrastructure components are located within any of the delineated watercourses, with the exception of road crossings, which entails the construction of new watercourse road crossings and upgrading of existing crossings. Due to the ecological sensitivity and importance of the watercourses, the upgrading of access roads directly adjacent to watercourses and upgrading of watercourse crossings by means of installing formal through flow structure poses a moderate risk significance to the watercourses, with the application of the recommended mitigation measures. The proposed collector overhead powerlines will also traverse several watercourses; however the powerline support structures will be constructed outside the delineated extent of the watercourses and as far as feasible, at least 32m from the delineated extent of the watercourses. Should the recommended mitigation measures be implemented with specific mention of ensuring proper stormwater management practices during the construction and operational phases, the crane pads pose a Low risk significance.

Despite direct negative impacts expected from the proposed development, with implementation and strict enforcement of cogent, well-developed mitigation measures as outlined in this report, with specific mention of ensuring all instream construction footprints are rehabilitated and the watercourses monitored for any alien and invasive species establishment, no fatal flaws in terms of freshwater ecological aspects were identified and the proposed development can be considered acceptable.

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APPENDIX A: Indemnity and Terms of Use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and FEN CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

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APPENDIX B: Legislative Requirements

The Constitution of the Republic of South Africa, 1996[7]	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive normalization of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	The objectives of this act are (within the framework of the National Environmental Management Act) to provide for: ➢ the management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity; ➢ the use of indigenous biological resources in a sustainable manner; ➢ the fair and equitable sharing among stakeholders of benefits arising from bio prospecting involving indigenous biological resources; ➢ to give effect to 'ratified international agreements' relating to biodiversity which are binding to the Republic; ➢ to provide for co-operative governance in biodiversity management and conservation; and ➢ to provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act. This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of surrounding areas is not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of benefits arising from indigenous biological resources. Furthermore, a person may not carry out a restricted activity involving either: a) a specimen of a listed threatened or protected species; b) specimen of an alien species; or c) a specimen of a listed invasive species without a permit. Permits for the above may only be issued after an assessment of risks and potential impacts on biodiversity is carried out. Before issuing a permit, the issuing authority may in writing require the applicant to furnish it, at the applicant's expense, with such independent risk assessment or expert evidence as the issuing authority may determine. The Minister may also prohibit the carrying out of any activity, which may negatively impact on the survival of a listed threatened or protected species or prohibit the carrying out of such activity without a permit. Provision is made for appeals against the decision to issue/refuse/cancel a permit or conditions thereof. ***National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (Alien and Invasive Species Regulations, 2014)*** NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. In terms of alien and invasive species. This act in terms of alien and invasive species aim to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. Alien species are defined, in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) as: (a) a species that is not an indigenous species; or

[7] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

	(b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention. Categories according to NEMBA (Alien and Invasive Species Regulations, 2014): ➢ **Category 1a**: Invasive species that require compulsory control. ➢ **Category 1b**: Invasive species that require control by means of an invasive species management programme. ➢ **Category 2**: Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread. ➢ **Category 3**: Ornamentally used plants that may no longer be planted.
National Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). A watercourse is defined as: a) A river or spring; b) A natural channel in which water flows regularly or intermittently; c) A wetland, lake or dam into which, or from which water flows; and d) Any collection of water which the minister may, by notice in the Gazette, declare a watercourse.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act , 1998 (Act No. 36 of 1998)	In accordance with Government Notice (GN)509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: ➢ The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; ➢ In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or ➢ A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C: Method of Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses and drainage line features present in close proximity of the proposed wind farm development are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present in the vicinity of the proposed wind farm development.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

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

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

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

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

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

FUNCTIONAL UNIT		
LEVEL 4:HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	B	C
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[8] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

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

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

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et. al*., 2009).

3. Wet-Ecoservices (2009)

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

- Flood attenuation;

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

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

Table C3: Classes for determining the likely extent to which a benefit is being supplied.

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

4. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in the table below.

Table C4: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans et al. 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

5. WET-Health

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

Level of Evaluation

Two levels of assessment are provided by WET-Health:

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

Framework for the Assessment

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

Units of Assessment

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

Quantification of Present State of a wetland

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

Table C5: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

Assessing the Anticipated Trajectory of Change

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

Table C6: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

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

Overall health of the wetland

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

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

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

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

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

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

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

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

7. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

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

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the watercourse (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C8: Recommended management objectives (RMO) for watercourses based on PES & EIS scores.

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a watercourse fall into one of these PES categories, a REC class D is allocated by default, as the minimum acceptable PES category.**

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

Table C9: Description of Recommended Ecological Category (REC) classes.

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

8. Watercourse Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as "land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".
The wetland zone delineation took place according to the method presented in the DWAF (2005) document "A practical field procedure for identification and delineation of wetlands and riparian areas.

An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

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

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008).
Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soil and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

APPENDIX D: Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[9]. The interaction of an aspect with the environment may result in an impact;
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Frequency of activity** refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial extent** refers to the geographical scale of the impact; and
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[10].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[9] The definition has been aligned with that used in the ISO 14001 Standard.

[10] Some risks/impacts that have low significance will however still require mitigation

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, an E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA (after the application of mitigation measures)

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develop or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts[11] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

[11] Mitigation measures should address both positive and negative impacts

APPENDIX E: Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES), ECOSERVICES AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the IHI assessment applied to the ephemeral tributaries & Groot River

	MRU
INSTREAM IHI	
Base Flows	0,0
Zero Flows	0,0
Floods	3,0
HYDROLOGY RATING	**0,9**
pH	1,0
Salts	1,0
Nutrients	1,0
Water Temperature	1,0
Water clarity	1,0
Oxygen	1,0
Toxics	1,0
PC RATING	**0,1**
Sediment	2,0
Benthic Growth	2,0
BED RATING	**2,0**
Marginal	0,5
Non-marginal	0,5
BANK RATING	**0,5**
Longitudinal Connectivity	2,5
Lateral Connectivity	2,0
CONNECTIVITY RATING	**2,3**
INSTREAM IHI %	**76,8**
INSTREAM IHI EC	**C**
INSTREAM CONFIDENCE	**3,0**

	MRU
RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	1,0
Large Floods	1,0
HYDROLOGY RATING	**0,6**
Substrate Exposure (marginal)	2,0
Substrate Exposure (non-marginal)	1,5
Invasive Alien Vegetation (marginal)	2,0
Invasive Alien Vegetation (non-marginal)	1,5
Erosion (marginal)	2,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	1,0
Physico-Chemical (non-marginal)	1,0
Marginal	2,0
Non-marginal	1,5
BANK STRUCTURE RATING	**1,8**
Longitudinal Connectivity	0,0
Lateral Connectivity	0,0
CONNECTIVITY RATING	**0,0**
RIPARIAN IHI %	**80,2**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2,9**

Table E2: Presentation of the results of the IHI assessment applied to the EDLs.

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	1,0
Large Floods	1,0
HYDROLOGY RATING	**0,6**
Substrate Exposure (marginal)	1,5
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	1,5
Invasive Alien Vegetation (non-marginal)	1,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	1,0
Physico-Chemical (non-marginal)	1,0
Marginal	1,5
Non-marginal	1,0
BANK STRUCTURE RATING	**1,3**
Longitudinal Connectivity	0,0
Lateral Connectivity	0,0
CONNECTIVITY RATING	**0,0**
RIPARIAN IHI %	**84,6**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2,9**

Table E3: Presentation of the results of the PES assessment applied to the channelled valley bottom wetlands.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	10	100	3,0	-1	1,1	-1	1,6	0
Area weighted impact scores*			3,0	-1,0	1,1	-1,0	1,6	0,0
PES Category (See Table 5.29)			C	↓	B	↓	B	→

Table E4: Presentation of the results of the Socio-cultural and Ecoservice provision provided by the assessed watercourses

Ecosystem service	Episodic drainage lines	Ephemeral tributary	Channelled wetland
Flood attenuation	1,7	1,8	2,4
Streamflow regulation	1,6	2,2	2,4
Sediment trapping	1,6	1,8	2,0
Phosphate assimilation	1,9	1,9	1,9
Nitrate assimilation	1,7	1,7	1,7
Toxicant assimilation	1,8	1,8	1,6
Erosion control	2,1	1,8	1,3
Carbon Storage	0,8	0,8	1,3
Biodiversity maintenance	2,3	2,4	2,4
Water Supply	0,7	0,7	0,7
Harvestable resources	0,6	0,8	0,8
Cultivated foods	0,4	0,4	0,6
Cultural value	0,5	0,5	0,5
Tourism & recreation	2,0	2,5	1,1
Education & research	0,8	1,8	2,0
SUM	**20,3**	**22,6**	**22,6**
Average score	**1,4**	**1,5**	**1,5**

Table E4: Presentation of the EIS assessment applied to the assessed watercourses.

FRESHWATER FEATURE:			Episodic drainage lines	Channelled wetland	Ephemeral tributaries
Ecological Importance and Sensitivity			Score (0-4)		
Biodiversity support			**A (average)**		
			0,67	1,00	1,00
Presence of Red Data species			0	0	0
Populations of unique species			0	1	1
Migration/breeding/feeding sites			2	2	2
Landscape scale			**B (average)**		
			2,00	2,60	2,20
Protection status of the wetland			2	2	2
Protection status of the vegetation type			2	2	2
Regional context of the ecological integrity			2	3	2
Size and rarity of the wetland type/s present			2	4	3
Diversity of habitat types			2	2	2
Sensitivity of the wetland			**C (average)**		
			1,67	1,67	2,00
Sensitivity to changes in floods			2	2	3
Sensitivity to changes in low flows/dry season			1	1	1
Sensitivity to changes in water quality			2	2	2
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			**B**		**B**
Hydro-Functional Importance			**Score (0-4)**		
Regulating & supporting benefits	**Flood attenuation**		1,7	2,4	1,8
	Streamflow regulation		1,6	2,4	2,2
	Water Quality Enhancement	***Sediment trapping***	1,6	2	1,8
		Phosphate assimilation	1,9	1,9	1,9
		Nitrate assimilation	1,7	1,7	1,7
		Toxicant assimilation	1,8	1,6	1,8
		Erosion control	2,1	1,3	1,8
	Carbon storage		0,8	1,3	0,8
HYDRO-FUNCTIONAL IMPORTANCE (average score)			2	2	2
Direct Human Benefits			**Score (0-4)**		
Subsistence benefits	***Water for human use***		0,7	0,7	0,7
	Harvestable resources		0,6	0,8	0,8
	Cultivated foods		0,4	0,6	0,4
Cultural benefits	***Cultural heritage***		0,5	0,5	0,5
	Tourism and recreation		2	1,1	2,5
	Education and research		0,8	2	1,8
DIRECT HUMAN BENEFITS (average score)			0,83	0,95	1,12

APPENDIX F: Risk Analysis and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the watercourse ecology and biodiversity, will include any activities which take place in close proximity to the proposed activities that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the watercourse identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should not encroach into watercourses unless absolutely essential and where project activities are located in the watercourses. It must be ensured that the watercourse habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes (if applicable) should avoid watercourses and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)) Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;* and
  - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

Soil

- Sheet runoff from access roads should be slowed down by the strategic placement of berms;
- As far as possible, all construction activities should occur in the low flow season, during the drier summer months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;

- No stockpiling of topsoil is to take place within the recommended buffer zone around the watercourses (unless specified otherwise), and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourses;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble/silt removed from the construction area must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed wind farm development should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed.

Risk significance on the watercourse ecology of the project area

The table below serves to summarise the anticipated impacts that might occur during the construction and operational phases as well as the mitigation measures that must be implemented in order to maintain and enhance the ecological integrity of the resource.

Table F1: DWS Risk Assessment outcomes for the proposed development.

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction Phase	Site preparation prior to construction activities of the proposed construction camp, substation, overhead powerline support structures as listed in Table 9 located within the 100m GN509 ZoR but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the 100m/500m GN509 ZoR but outside the delineated extent of watercourses.	Vehicular movement (transportation of construction materials)	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L
2			Removal of vegetation and associated disturbances to soils.	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles. • Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; • Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; • Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	1	1	1	2	1,25	1	1	3,25	5	1	5	1	12	39	L

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
3		Site preparation prior to construction activities relating to the development of new watercourse road crossings: • upgrading of existing roads; and • installation of underground cables traversing through watercourses, and within close proximity (within 32 m) to watercourses.	Removal of vegetation and associated disturbances to soils.	• Earthworks and exposure of soils could result in sedimentation of the watercourses, which may be transported as runoff into the downstream watercourse areas and may smother vegetation associated with the watercourses; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	5	5	5	5	5	1	1	7	5	3	5	1	14	98	M
4		Creating new watercourse crossings, upgrading existing watercourse crossings and upgrading of existing roads within close proximity (within 32 m) to watercourses: • Excavation within the watercourse for the removal of existing infrastructure (where applicable) and for the casting of proposed concrete base. • Placement of culvert structures atop concrete base.	• Disturbances to soil of the watercourses; • Movement of construction machinery/ vehicles within the watercourses; and • Possible spills / leaks from construction vehicles.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	5	5	5	5	5	1	1	7	5	4	5	1	15	105	M

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
5		Construction of surface infrastructure outside of the watercourses but still within the 100 m/500m GN509 ZoR, which includes: • Collector overhead powerlines; • Construction camp; • Substation; and • 6 crane pads	• Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; • Mixing and casting of concrete for construction purposes; • Backfilling of excavated and disturbed areas; and • Miscellaneous activities by construction personnel.	• Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; • Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; • Potential impacts on the water quality of surface water runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete casting; and • Potential of backfill material entering the watercourses, increasing the sediment loads therein.	1	1	3	2	1,75	1	1	3,75	5	1	5	1	12	45	L
6	**OPERATIONAL PHASE**	Operation and maintenance of the surface infrastructure outside the watercourses but still within the 100m/500m GN509 ZoR, which includes: • Collector overhead powerlines; • Construction camp; • Substation; and • 6 crane pads	• Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; and • Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure	• Disturbance to soils and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	1	1	2	2	1,5	1	1	3,5	5	1	5	1	12	42	L

	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
7		Operation and maintenance of roads traversing watercourses.	• Concentrated runoff entering the watercourses; and • Disturbance to the vegetation within and surrounding the watercourses.	• Concentrated runoff from the road crossings leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	3	1	3	3	2,5	1	1	4,5	5	1	5	1	12	54	L
8	**DECOMMISSIONING PHASE**	Removal of all surface infrastructure from the project area.	• Movement of construction vehicles and personnel; and • Disturbance to the buffer zone surrounding the watercourses.	• Disturbance of soil and vegetation that established within the operational area.	2	1	3	3	2,25	1	1	4,25	5	2	5	1	13	55,25	L

APPENDIX G: Details, Expertise and Curriculum Vitae of Specialists

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

Christel du Preez	MSc Environmental Sciences (North West University)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Stephen van Staden	MSc Environmental Management (University of Johannesburg)

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

Company of Specialist:	SAS Environmental Gorup of Companies		
Name / Contact person:	Christel du Preez		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	
Telephone:		Fax:	086 724 3132
E-mail:	christel@sasenvgroup.co.za		
Qualifications	MSc Environmental Sciences (North West University)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)		

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

I, Christel du Preez, declare that -

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

C du Preez

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

I, Kim Marais, declare that -

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

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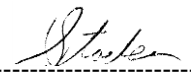
1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

Position in Company	Senior Scientist (Watercourse ecology)
Joined SAS Environmental Group of Companies	2016

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP)
(SACNASP – Reg No. 120240/19)
Member of the Western Cape Wetland Forum (WCF)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

MSc Environmental Sciences (North West University)	2017
BSc Hons Environmental Sciences (North West University)	2012
BSc Environmental and Biological Sciences (North West University)	2011

Short Courses

Wetland and Aquatic plant Identification presented by Carin van Ginkel (Crispis Environmental)	2019
Wetland Management: Introduction and Delineation presented by the Centre of Environmental Management University of the Free State	2018
Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2017
Basic Principles of ecological rehabilitation and mine closure presented by the Centre for Environmental Management North West University	2015

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Limpopo, Western Cape, Northern Cape, Eastern Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plan
- Freshwater Offset Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Senior Scientist (Water Resource Manager)
Joined SAS Environmental Group of Companies	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)
Member of the Western Cape Wetland Forum (WCWF)

EDUCATION

Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Watercourse Maintenance and Management Plans
- Freshwater Offset Plan

Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions
- Public Participation processes

SAS ENVIRONMENTAL GROUP OF COMPANIES
SPECIALIST CONSULTANT INFORMATION –

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing Member, Group CEO, Water Resource Discipline Lead, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SEGC	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

CORE FIELDS OF EXPERTISE

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments