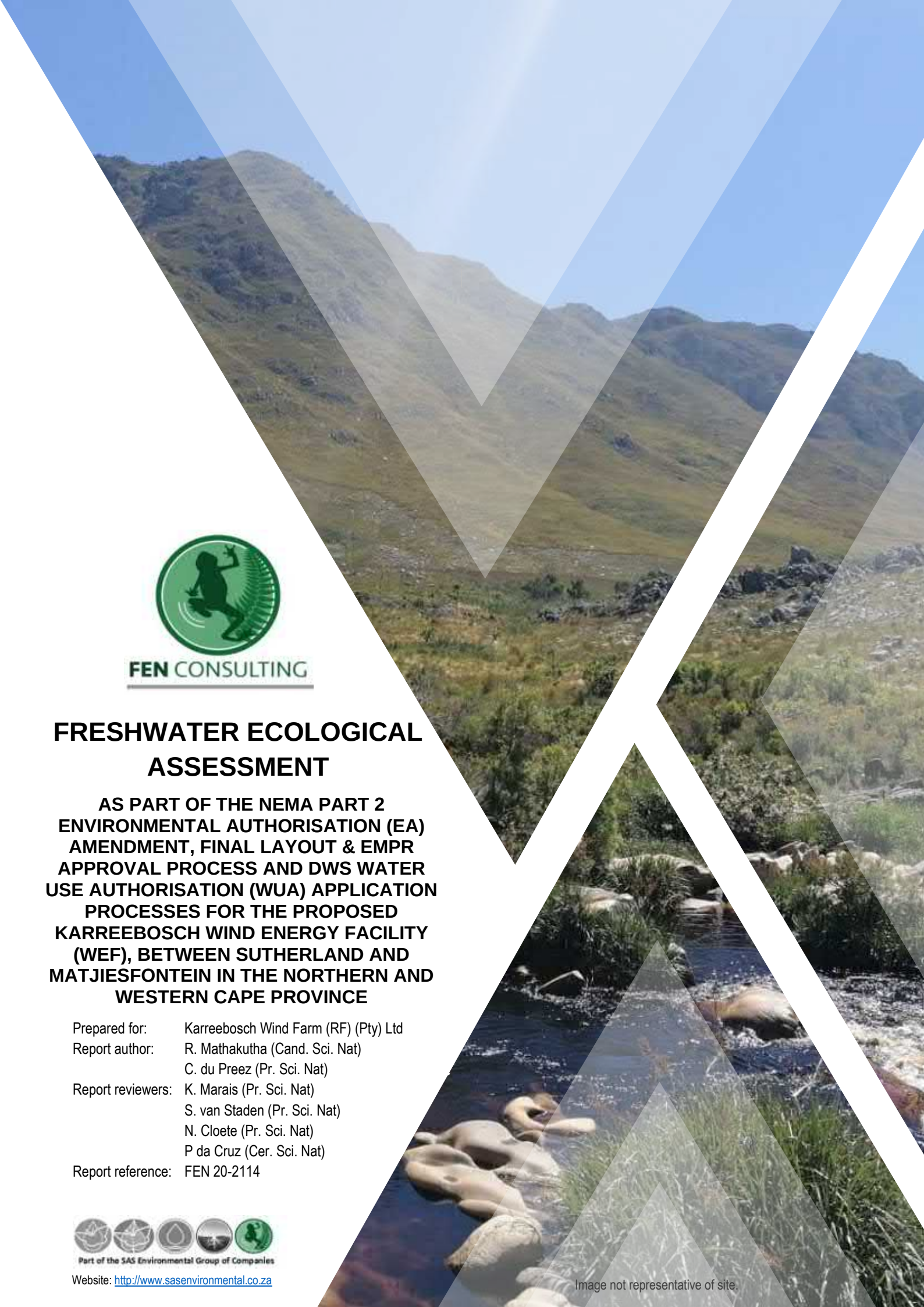

FEN CONSULTING

FRESHWATER ECOLOGICAL ASSESSMENT

AS PART OF THE NEMA PART 2 ENVIRONMENTAL AUTHORISATION (EA) AMENDMENT, FINAL LAYOUT & EMPR APPROVAL PROCESS AND DWS WATER USE AUTHORISATION (WUA) APPLICATION PROCESSES FOR THE PROPOSED KARREEBOSCH WIND ENERGY FACILITY (WEF), BETWEEN SUTHERLAND AND MATJIESFONTEIN IN THE NORTHERN AND WESTERN CAPE PROVINCE

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Image not representative of site.

EXECUTIVE SUMMARY

FEN Consulting was appointed to conduct a specialist freshwater ecological assessment as part of the NEMA Part 2 EA Amendment, Final Layout and Environmental Management Programme (EMPr) approval process and DWS Water Use Authorisation (WUA) application processes for the authorised Karreebosch Wind Energy Facility (WEF) and associated infrastructure.

The authorised Karreebosch WEF and associated infrastructure is currently undergoing a Part 2 EA Amendment Process with the proposed amendments detailed in this report. Condition 16 of the original EA (EA Ref: 14/12/16/3/3/2/807) requires that the final development layout plan be made available for public comment and thereafter submitted to Department of Forestry, Fisheries and Environment (DFFE) for approval. Condition 18 of the original EA (Ref: 14/12/16/3/3/2/807) states that the EMPr submitted as part of the Final EIA Report (2015) was not approved and must be amended to include the final layout which has undergone micro siting and walkdowns by relevant specialists, be made available for public comment and thereafter re-submitted to the DFFE for final approval. The associated 132V overhead powerline (OHPL) and onsite 33/132kV substation are currently subject to a separate EA application process.

The proposed development includes the construction of various turbines linked via underground and/or above ground cabling (33kV collector system), 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. Construction of new watercourse road crossings, upgrading of existing watercourse road crossings and the upgrading of existing roads where necessary are proposed.

A large drainage network of ephemeral watercourses, associated with the Tankwa, Roggeveld, Kleinpoorts and Wilgebos Rivers were identified. Most of these watercourses are considered to be in a largely natural to moderately modified ecological condition and of high ecological importance and sensitivity.

Access roads are proposed to traverse watercourses. Access road crossings as well as trenching of cabling within these crossings will directly impact on watercourses. All other proposed infrastructure will be located outside of the delineated extent of the watercourses; however, some will be located within the Government Notice (GN) 509 of 2016 regulated area as it relates to the National Water Act, 1998 (Act No. 36 of 1998). The proposed overhead 33kV 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 an existing access road located adjacent to the Wilgebos River (including several crossings) and an ephemeral tributary.

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), and the EA amendment, final layout and EMPR approval in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) must be obtained, prior to the commencement of any works.

MANAGEMENT SUMMARY

FEN Consulting was appointed to conduct a specialist freshwater ecological assessment as part of the NEMA Part 2 Environmental Authorisation (EA) Amendment, Final Layout and Environmental Management Programme (EMPr) approval process and DWS Water Use Authorisation (WUA) application processes for the authorised Karreebosch 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:

- Up to 40 turbines and associated crane pads;
- Internal access roads (including to access road route options to the eastern most turbine ridge), with underground and/or aboveground cables installed along these roads, as feasible;
- 33kV Collector overhead powerlines (2 options proposed dependent on the approved substation alternative);
- Substation (2 alternatives proposed);
- Construction camp (4 alternatives proposed); and
- Onsite 33/132kV substation.

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.

The authorised Karreebosch WEF and associated infrastructure is currently undergoing a Part 2 EA Amendment Process with the proposed amendments. Condition 16 of the original EA (EA Ref: 14/12/16/3/3/2/807) requires that the final development layout plan be made available for public comment and thereafter submitted to Department of Forestry, Fisheries and Environment (DFFE) for approval. Condition 18 of the original EA (Ref: 14/12/16/3/3/2/807) states that the EMPr submitted as part of the Final EIA Report (2015) was not approved and must be amended to include the final layout which has undergone micro siting and walkdowns by relevant specialists, be made available for public comment and thereafter re-submitted to the DFFE for final approval.

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 WilgebosRiver system, Roggeveld River system, Tankwa River system and Kleinpoorts River system were identified to be traversed by the proposed development. The Wilgebos River is 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). 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)
Wilgebos River	C (Moderately modified)	Intermediate (1,5)	High	REC: Category C (Moderately modified) BAS: Category B RMO: B/C (Improve)
Ephemeral tributaries with riparian vegetation	B (Largely natural with few modifications)	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) / C (Moderately modified)	Intermediate (1,4)	High	REC: B (Largely natural with few modifications) BAS: Category B RMO: B (Improve)

With the exception of watercourse road crossings, all other surface infrastructure components (such as the proposed substation, 33kV collector overhead powerline support structures, construction camp, turbines and crane pads) are located outside the delineated extent of the watercourses, but some still within the Government Notice (GN) 509 of 2016 zone of regulation (ZoR) as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), considered as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline of the watercourses, where applicable.

Although the 33kV 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 risk significance of roads, Substation Option 1, turbines and crane pads located more than 100 m from the delineated extent of a watercourse was not considered as they are located outside the GN509 ZoR.

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 GN509 ZoR (as described in Section 6) but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the GN509 ZoR but outside the delineated extent of watercourses. • Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; • Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles; and • 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, with specific mention of the access road adjacent to the Wilgebos River) 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 soil, and increased risk of sedimentation/erosion; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Moderate

Impact and Aspect		Risk
	Creation of 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; and • Placement of culvert structures atop concrete base.	**Moderate**
	Construction of surface infrastructure outside of the watercourses but within the GN509 ZoR, which includes the 33kV collector overhead powerlines, Construction Camp Options 1 to 4, Substation Option 2 and 7 crane pads: • Removal of vegetation and topsoil and associated stockpiling; • Ground-breaking and earthworks relating to foundations and trenches; and • Mixing and casting of concrete for construction purposes.	**Low**
Operational Phase	Operation and maintenance of the surface infrastructure outside the watercourses but within the GN509 ZoR, which includes the 33kV collector overhead powerlines, turbines, crane pads, Construction Camp Options 1 to 4, and Substation Option 2: • 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 (with specific mention of the crane pads and Construction Camp Options 2 to 4).	**Low**
	Operation and maintenance of roads traversing watercourses: • Concentrated runoff entering the watercourses; and • Disturbance to the watercourse vegetation.	**Low**
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.	**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 the development 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 33kV 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.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, as recommended in this report, the significance of impacts arising from the construction and operation of the surface infrastructure components and all their alternatives (except roads and underground cables traversing watercourses), located outside of the watercourses and at least 32 m from the delineated extent of a watercourse, but within the GN509 ZoR, are considered to pose a Low risk significance to the identified watercourses. Preference is given to Substation Option 1 and thus the proposed 33kV collector Option 1 and associated 4 x 4 access roads, since the proposed Substation Option 1 is located outside the GN509 ZoR, and no direct or indirect impacts from Substation Option 1 are expected, as opposed to Substation Option 2 that is located in very close proximity to a watercourse. In addition, although transformers such as substations have a spill tray/bund factored into the design to catch any potential accidental spills (of hazardous material), the risk of pollution due to an accidental leakage is higher for Substation Option 2 considering its distance from the delineated watercourses (located at least 20 m of a watercourse), and is therefore, not preferred. Furthermore, Construction Camp Options 1, 2 and 4 are considered acceptable from a freshwater management perspective considering their distance from the nearest watercourse (approximately at least 28 m from a watercourse), compared to the proposed Construction Camp Option 3 which is located directly outside the delineated boundary of a watercourse, increasing the likelihood of negative indirect and cumulative impacts to the receiving watercourse.

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. Therefore, provided that the recommended mitigation measures are applied, the proposed final layout for the authorised Karreebosch WEF is considered acceptable from a freshwater ecological perspective and should be approved.

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, and the EA amendment, Final layout and Environmental Management Programme (EMPR) approval in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) must be obtained, 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 220 km north west of the proposed development
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 provide 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
DFFE	Department of Forestry, Fisheries and the Environment
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 and 'site walkdown' and micro-siting as part of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) Water Use Authorisation (WUA) application process, and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) Part 2 EA Amendment, Final Layout and EMPr approval process for the authorised Karreebosch Wind Energy Facility (WEF) and associated infrastructure between Matjiesfontein and Sutherland in the Northern and Western Cape Provinces (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.

The authorised Karreebosch WEF and associated infrastructure is currently undergoing a Part 2 EA Amendment Process with the proposed amendments. Condition 16 of the original EA (EA Ref: 14/12/16/3/3/2/807) requires that the final development layout plan be made available for public comment and thereafter submitted to Department of Forestry, Fisheries and Environment (DFFE) for approval. Condition 18 of the original EA (Ref: 14/12/16/3/3/2/807) states that the EMPr submitted as part of the Final EIA Report (2015) was not approved and must be amended to include the final layout which has undergone micro siting and walkdowns by relevant specialists, be made available for public comment and thereafter re-submitted to the DFFE for final approval.

The data contained in this report (and results on the site assessment undertaken in May 2021) was utilised to supplement the observations made during the site assessment undertaken in 2015 for the previously submitted EMPr as part of the Final EIA Report, to identify any areas of potential concern, increased sensitivity including potential 'no-go' areas, ascertain the necessity for approvals and/or permits required and to determine whether the final layout for the authorised Karreebosch WEF can be approved by the DFFE as part of the Part 2 EA Amendment process, Final layout and EMPr approval process or whether any changes are required to the proposed layout (due to presence of sensitive / "no-go" areas and/ or any other special features). It is a further aim of this study to ascertain whether the proposed layout will result in additional potential impacts and whether there is a requirement for additional mitigation measures to be implemented by the proponent.

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 of the national web based Environmental Screening Tool DFFE (2020) (previously Department of Environmental Affairs (DEA)) which was undertaken to screen the proposed development site for any environmental sensitivity, with specific focus on aquatic sensitivities. This section also 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);

[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.

- 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 & Sensitivity Mapping
Provides the applicable legislative requirements based on the findings from Section 4 and 5 and indicates any applicable zones of regulation that may trigger various enviro-legal authorisation requirements.

Section 7: Risk Assessment and Micro-Siting Considerations
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. This section also provides the outcome of the site walkdown/micro-siting considerations which identifies any areas of potential concern, increased sensitivity including potential 'no-go' areas, and consideration of necessary approvals and/or permits required as part of the Part 2 EA Amendment process, Final layout and EMPr approval process. A cumulative impact statement is also provided.

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

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. This is a report update following slight layout changes (see Section 2 for details);
- 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 soil, 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 development is located approximately 40 km north of Matjiesfontein, and approximately 40 km south of Sutherland (Figures 1 and 2). The site falls within the Karoo Hoogland Local Municipality of the Namakwa District Municipality within the Northern Cape Province as well as the Laingsburg Local Municipality of the Central Karoo District Municipality and the Witzenberg Local Municipality of the Cape Winelands District Municipality within the Western Cape Province.

Kareebosch Wind Farm (Pty) Ltd (the Applicant) applied for Environmental Authorisation (EA) for the proposed Karreebosch WEF in 2015. The original Environmental Impact Assessment (EIA) was undertaken in September of 2015 for up to 71 wind turbines with a hub height of up to 100 m and a rotor diameter of up to 140 m including associated infrastructure. EA for 65 turbines was granted on 29 January 2016 (EA Ref: 14/12/16/3/3/2/807). The project underwent subsequent amendments (EA Ref: 14/12/16/3/3/2/807/AM1, 14/12/16/3/3/2/807/AM2, 14/12/16/3/3/2/807/AM3) which included increases in the hub height (up to 125m), rotor diameter (up to 160m), blade length (up to 80 m), and minor amendments to the wording of certain conditions of the authorisation, as well as an extension of the validity of the EA to 2026.

The associated 132V overhead powerline (OHPL) and onsite 33/132kV substation are currently subject to a separate EA application process.

The authorised Karreebosch WEF and associated infrastructure is currently undergoing a Part 2 EA Amendment Process with the proposed amendments tabulated in Table 1 below. Condition 16 of the original EA (EA Ref: 14/12/16/3/3/2/807) requires that the final development layout plan be made available for public comment and thereafter submitted to Department of Forestry, Fisheries and Environment (DFFE) for approval. Condition 18 of the original EA (Ref: 14/12/16/3/3/2/807) states that the Environmental Management Programme (EMPr) submitted as part of the Final EIA Report (2015) was not approved and must be amended to include the final layout which has undergone micro siting and walkdowns by relevant specialists, be made available for public comment and thereafter re-submitted to the DFFE for final approval. The final layout and EMPR approval process will run concurrently with the Part 2 EA Amendment process.

Table 1 below outlines the amendments proposed to the existing EA. Figures 1 to 3 illustrate the proposed final up to 40-turbine layout subject to this Part EA amendment, final layout and EMPr approval process, to which this freshwater ecological assessment was undertaken.

Table 1: Proposed amendments to the Karreebosch EA (DFFE Ref: 14/12/16/3/3/2/807/AM3).

Aspect to be amended	Authorised	Proposed amendment
Number of Turbines	Up to 65 with a foundation of 25m in diameter and 4m in depth	Up to 40 turbines with a foundation of 30m in diameter and 5m in depth
Turbine generating capacity	Up to 5.5 MW	up to 7.5 MW in capacity each
Turbine Hub Height	A range up to and including 125m	All turbines up to 140 m
Rotor Diameter	A range up to and including 160m	All turbines up to 170 m
Blade length	~80 m	~85 m
Area occupied by transformer stations/ substation	• Two 33/132kV Substation 100 m x 200m • Extension of the existing 400 kV substation at Komsberg • Transformer art each turbine: total area <1500 m² (2 m² per turbine up to 10 m² at some locations)	• one 33/132 kV substation 150 m x 200 m (3 ha) • Extension of the existing 400 kV substation at Komsberg • Transformer at each turbine: 6 m x 3 m= 720 m² total area <0.4 ha (up to 10 mX10 m at some locations)

Aspect to be amended	Authorised	Proposed amendment
Capacity of on-site substation	132 kV	33/132 kV
Areas occupied by construction camp	300 x 300 m = 90 000 m²	Areas occupied by construction camp and laydown areas up to 14 ha. Crane pads and turbines footprints up to 41 ha.
Area occupied by laydown areas	Operation: (70 x 50) x 71 =248 500 m²	
Areas occupied by buildings	~10 000 m²	~10 000 m² and will be located within the construction camp for use during the operational phase
Length of (new) internal access roads	~40 km	~77 km of new internal access roads and up to ~14 km of 4x4 access tracks. ~30 km of existing access roads which are 4 m wide will be widened by up to 9 m.
Width of internal roads	Up to 12 m	Internal Access roads up to 12 m wide (turns will have a radius of up to 55 m) with additional yet associated servitudes/ reserve for above/underground cabling installation and maintenance where needed. 200 m wide road corridor along the internal access roads for micro-siting during construction. Internal 4x4 tracks associated with the 33 kV and 132kV OHPLs will be up to 4 m wide and substation access roads of up to 9 m.
Height of fencing	Up to 3 m	Up to 4 m

** The present study considers the proposed amended layout.*

In addition to the above, the following provides the infrastructure that was assessed in relation to the watercourses (as depicted in Figures 1 and 2 below):

- Internal access roads up to 12 m wide (including alternatives access routes for 1) the eastern turbine ridge, and 2) the 4x4 access roads associated with the 33kV overhead collectors – two (2) alternative routes proposed depending on the approved substation alternative), 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, from where existing informal gravel roads will be upgraded or new roads developed. Typical existing watercourse crossings that will be upgraded include large rectangular culverts and pipe culverts, where required;
- 33 kV overhead powerlines linking groups of wind turbines to the onsite 33/132kV substation (referred to as the 33 kV collector – two (2) route options proposed depending on the approved substation alternative);
- Above/underground 33 kV cabling between turbines buried along access roads, where feasible;
- 33/132kV onsite substation location (approximately 150m x 200m) – two (2) alternatives proposed;
- Construction camp including an on-site concrete batching plant (four (4) alternative locations proposed for the construction camp).

It is important to note that only one (1) onsite substation, one (1) 33 kV collector option, one (1) 4x4 access roads option and one (1) construction camp (associated with a batching plant) option are proposed to be constructed (Figures 1 and 2). Therefore, the proposed 33 kV collector Option 1 and 4 x 4 access roads Option 1 are associated with the proposed substation Option 1 (Figures 1 and 2), and the proposed 33 kV collector Option 2 and 4 x 4 access roads Option 2 are associated with the proposed substation Option 2 only (Figures 1 and 2). Only 1 alternative option will be constructed, not both.

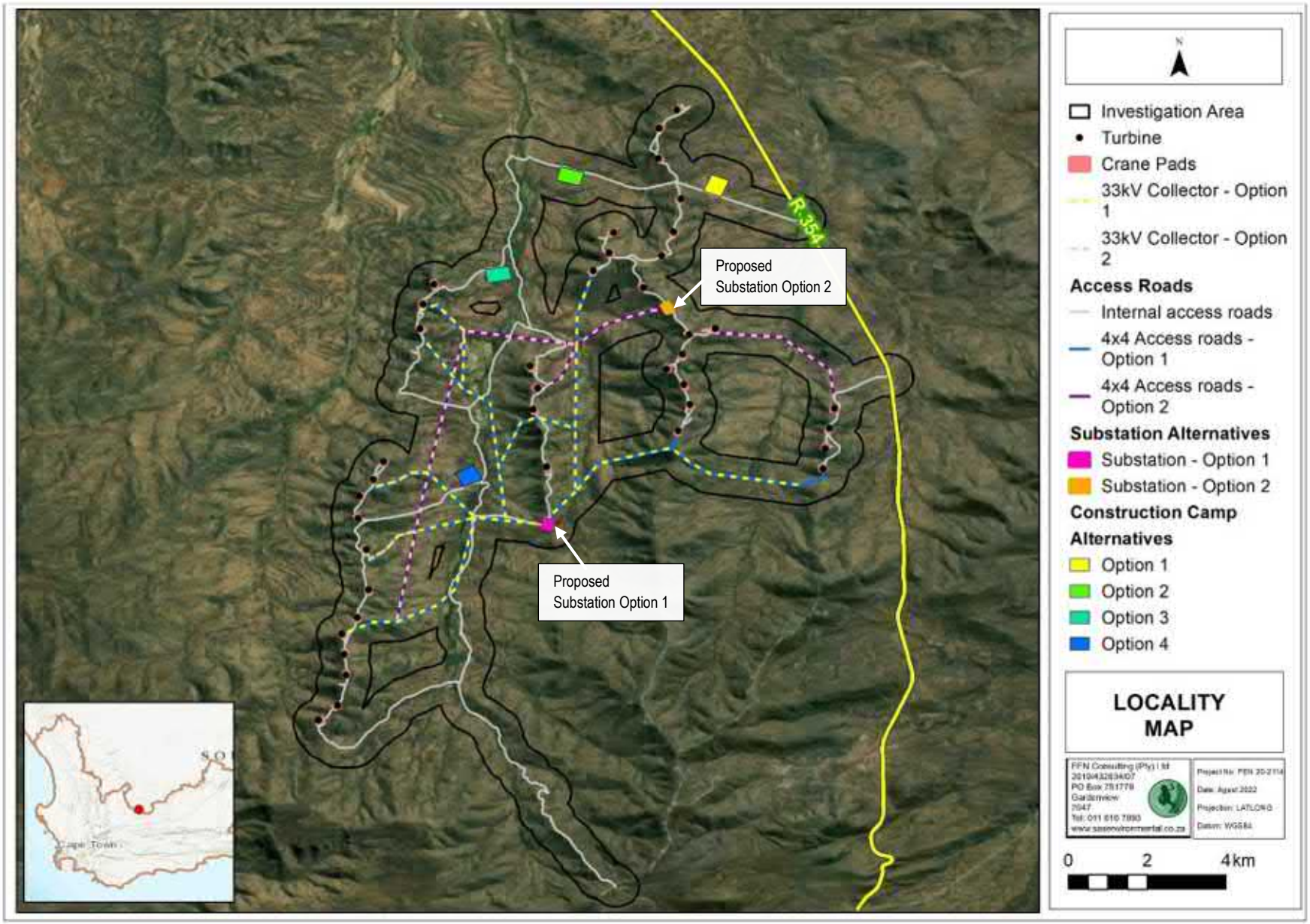


Figure 1: Digital satellite image depicting the proposed development and the associated investigation area in relation to its surroundings.

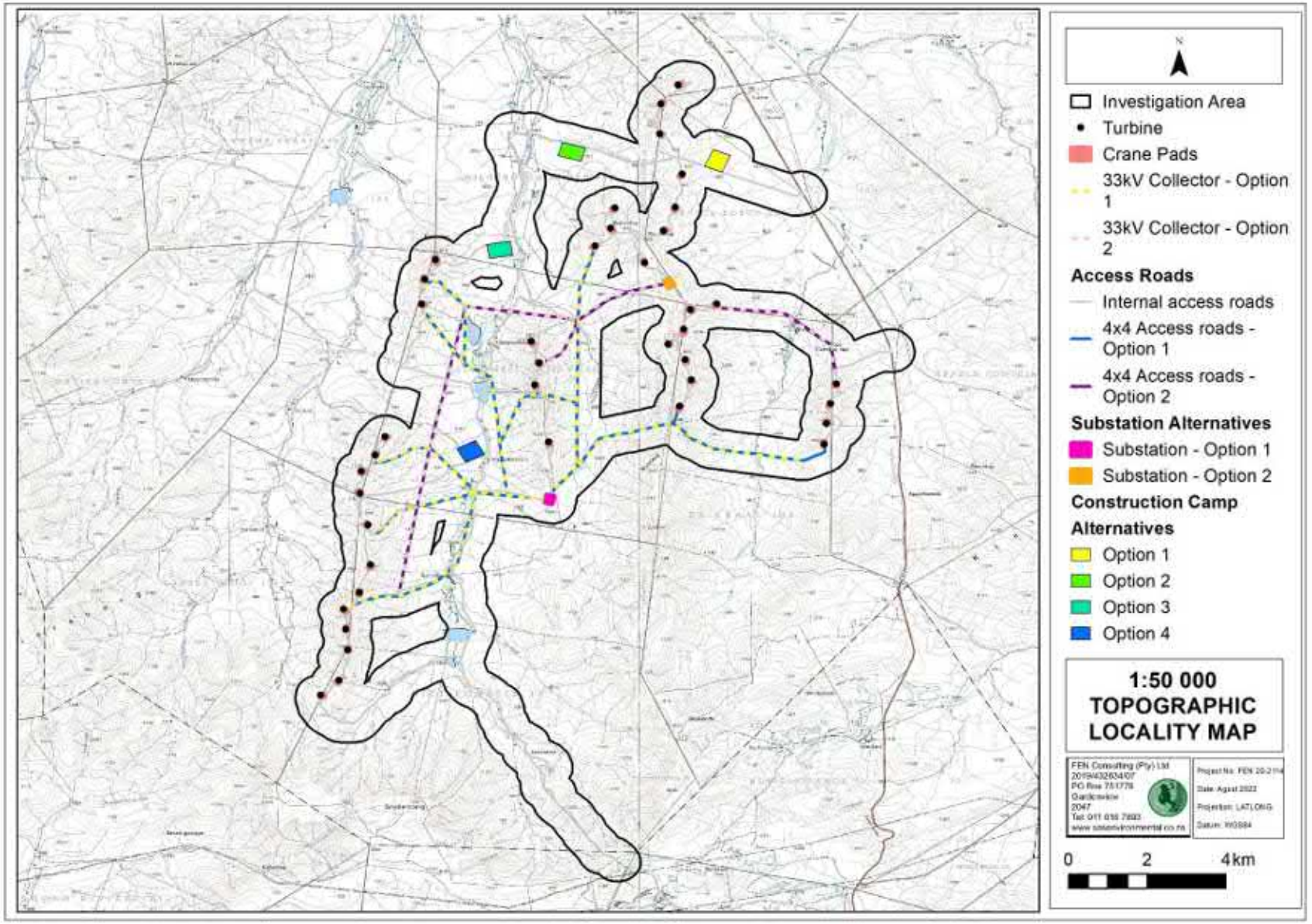


Figure 2: Location of the proposed development and the associated investigation area depicted on a 1:50 000 topographical map in relation to surrounding areas.

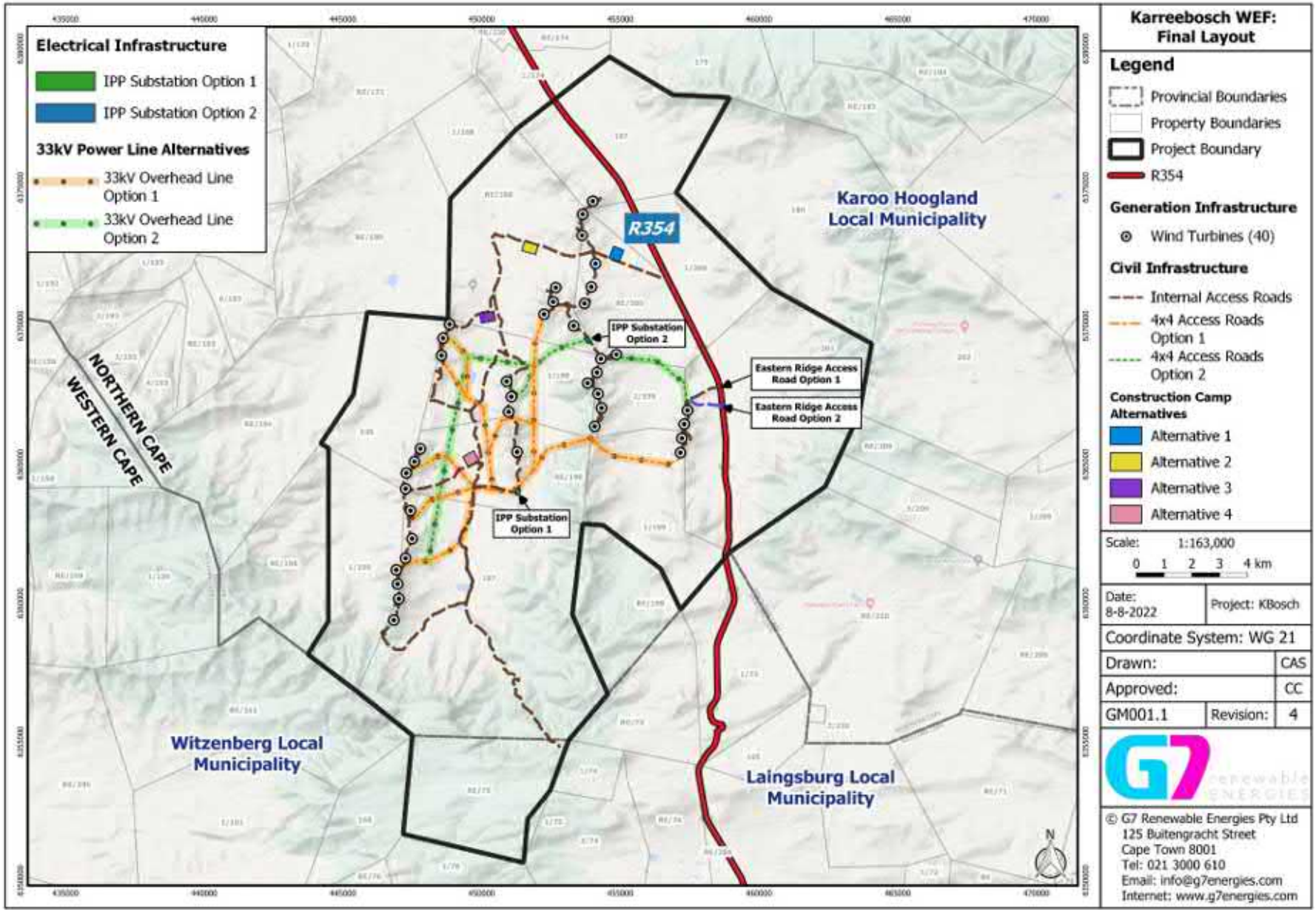


Figure 3: Proposed final layout of the Karreebosch WEF and associated infrastructure as provided by G7 Renewable Energies (Pty) Ltd (2022).

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. Floodline assessments were also done in July 2022, from which assessment and impacts could be determined.

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*

The protocol for the assessment of freshwater and aquatic biodiversity prepared in support of the Department of Forestry, Fisheries and Environment (DFFE) (previously the Department of Environmental Affairs (DEA)) national web based environmental screening tool (2020), provides the criteria for the assessment and reporting of impacts on aquatic/freshwater biodiversity for activities requiring EA. For the aquatic/freshwater biodiversity theme, the requirements are for sites which support various levels of biodiversity. The relevant aquatic/freshwater biodiversity theme in the national web based environmental screening tool (2020) has been provided by the South African National Biodiversity Institute (SANBI). Based on the sensitivity rating, a suitably qualified specialist must prepare the relevant report or opinion memo which is to be submitted as part of the EA application.

As part of the process of the background information gathering, the FEN applied the DFFE (previously DEA) screening tool (2020) to the investigation area. According to the guidelines, an applicant intending to undertake an activity on a site identified as being of “very high sensitivity” for an aquatic biodiversity theme must submit an Aquatic Biodiversity Impact Assessment or if the area is identified as being of “low sensitivity” then an Aquatic Biodiversity Compliance Statement must be compiled and submitted to the competent authority. It is noted, however, that during a site survey undertaken by a suitably qualified freshwater ecologist should the sensitivity be determined different from that assigned by the screening tool (i.e. that a high risk to the regional aquatic biodiversity or freshwater ecosystems in the area is likely even though it is assigned as a “low” sensitivity, or if it is assigned a high sensitivity, however, the proposed develop risk are deemed low) then the relevant assessment approach must be followed based on the site survey results and not the DFFE screening tool allocation.

The findings of the national web based Environmental Screening Tool (DFFE, 2020) are provided in Section 4. 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 2: 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	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	E23A		
WMA	Olifants/Doorn		
subWMA	Doring		
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, classified as either channelled or unchannelled wetlands, of which some of the natural wetlands 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 (Figure 5)	The majority of the investigation area is located in the Rainshadow Valley Karoo (Skv) Wetland vegetation Type (Critically Endangered). Some of the southern portions of the investigation area are located in the Karoo Shale Renosterveld Wetland Vegetation type (Least Threatened). The threat status of the wetland vegetation type is provided by Mbona *et al.* (2015), which may differ to the threat status provided by the National Vegetation Map (2018) for non-wetland vegetation types.
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 Wilgebos bisects the investigation area in a south to north direction – proposed to be traversed by access roads and overhead powerlines. The Tankwa River is located in the eastern portion of the investigation area. Both these rivers are considered to be in a moderately modified (Class C) ecological condition by the PES 1999 dataset. According to the NFEPA data set the Wilgebos River is considered to be largely natural with only a few modifications (RIVCON = AB), and the Tankwa River moderately modified (RIVCON = C).
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 (WCBSP) (2017) (Figure 6)			
According to the WCBSP (2017), the most southern 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.			
Importance of the investigation area according to the Critical Biodiversity Areas of the Northern Cape (2016) (Figure 6)			
According to the Critical Biodiversity Areas of the Northern Cape (2016), the north eastern portion of the investigation area is located within several areas classified as Critical Biodiversity Areas (CBAs) 1 and 2 of terrestrial importance. CBAs are areas that must remain in good ecological condition in order to meet biodiversity targets for ecosystem types, species of special concern or ecological processes. CBA 1 areas that are considered to be irreplaceable or near irreplaceable for meeting biodiversity targets. CBA 2 areas are areas that have been selected as the best option for meeting biodiversity targets, based on complementarity, efficiency, connectivity and/or avoidance of conflict with other land or resources uses. The western portion of the investigation area are 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. The Namakwa Bioregional Plan for the Northern Cape (2008) (Namakwa District Critical Biodiversity Areas (CBA) Map) does not show the investigation area as important in terms of aquatic CBAs but of only terrestrial CBA importance and was thus not included in the results of this desktop assessment. These desktop results for the terrestrial CBAs, ESAs and ONA should be read in consideration of the site based findings of the terrestrial ecologist as part of the Part 2 EA Amendments.			
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA) (Figure 7)			
According to the NBA 2018: SAIIAE a single wetland feature classified as a 'river' are located within the investigation area. This river feature is associated with the downstream reach of the Wilgbos River, located in the north western portion of the investigation area (proposed to be traversed by the access roads). As per the NFEPA Database, the Wilgebos and Tankwa Rivers are located in the investigation area. The Ecosystem Threat Status (ETS) of these rivers are considered Least Concerned, while the ecosystem protection level (EPL) of the of the rivers are poorly protected.			

National Web Based Environmental Screening Tool (2020): Aquatic Biodiversity sensitivity	
The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the migration hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	The majority of the investigation area is located within areas considered of low aquatic biodiversity sensitivity. However, the Tankwa River associated with the eastern portion and the Wigebos River associated with the western portion of the investigation area is considered to be of very high aquatic biodiversity importance. Similarly, these rivers are considered of biodiversity importance as per the WCBSP (2017) and NCCBA (2016) datasets.

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.

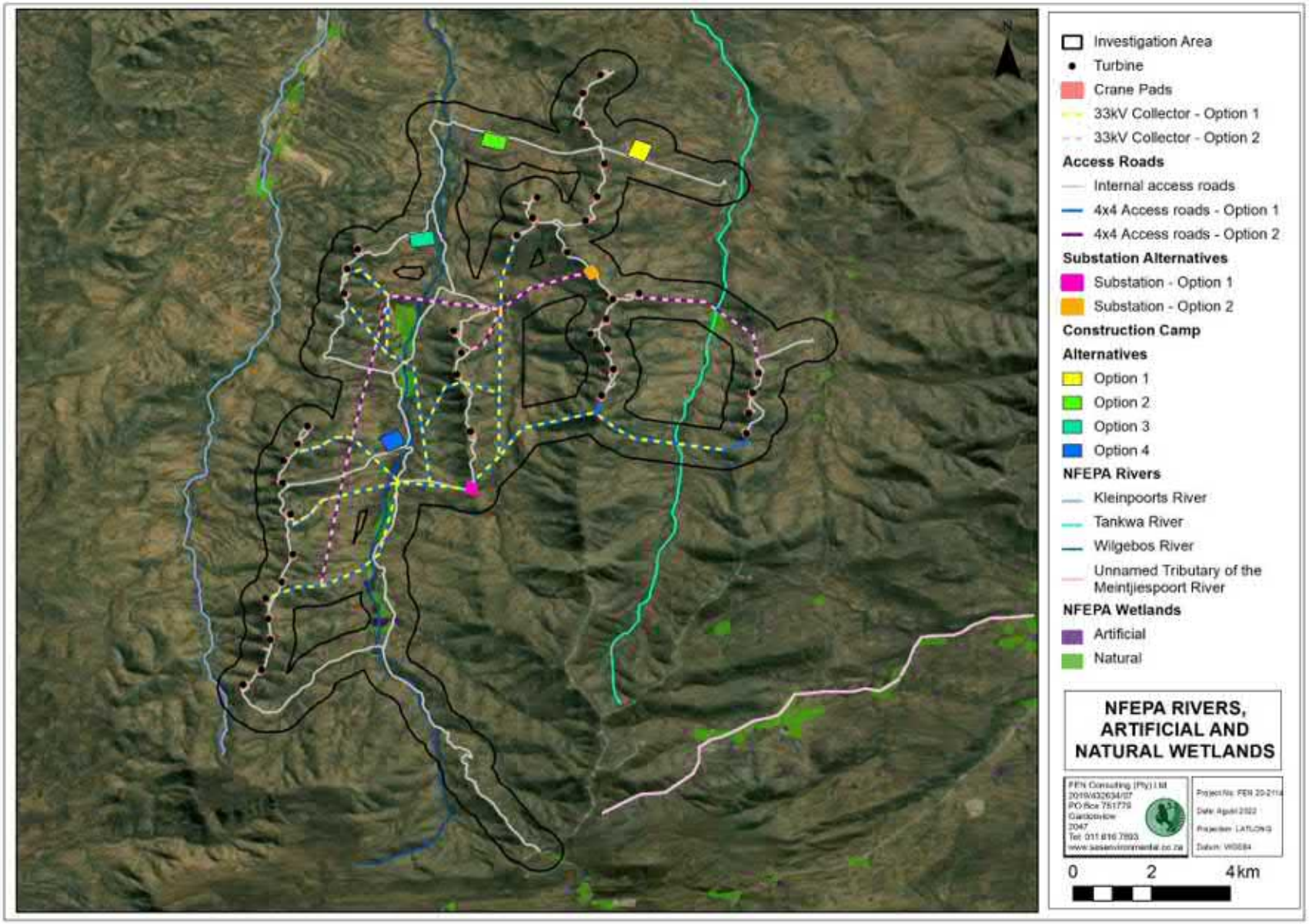


Figure 4: NFEPA listed rivers and natural and artificial wetlands associated with the proposed development and investigation area, according to the NFEPA database (2011).

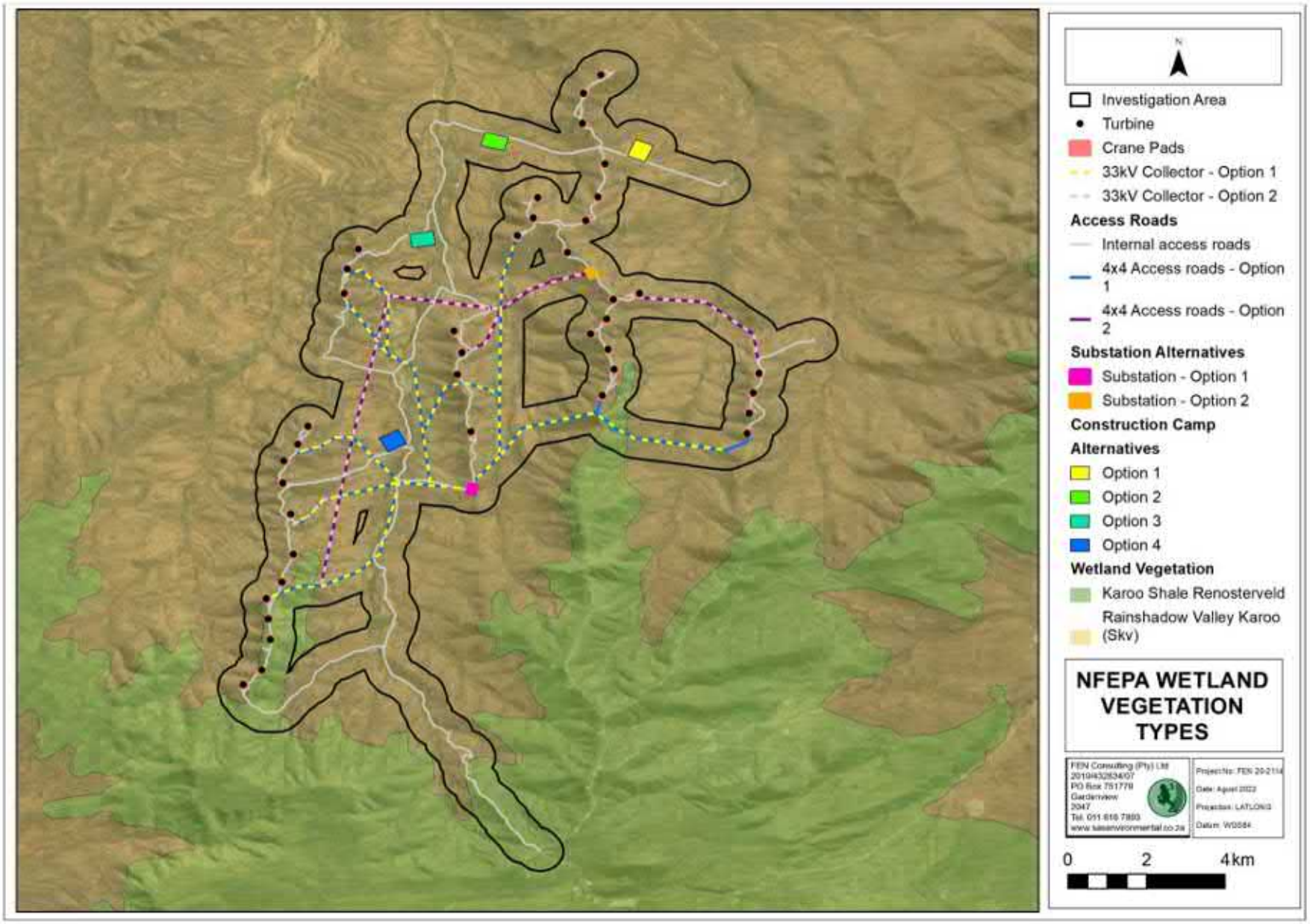


Figure 5: Wetland vegetation types associated with the proposed development and investigation area, according to the NFEPA database (2011).

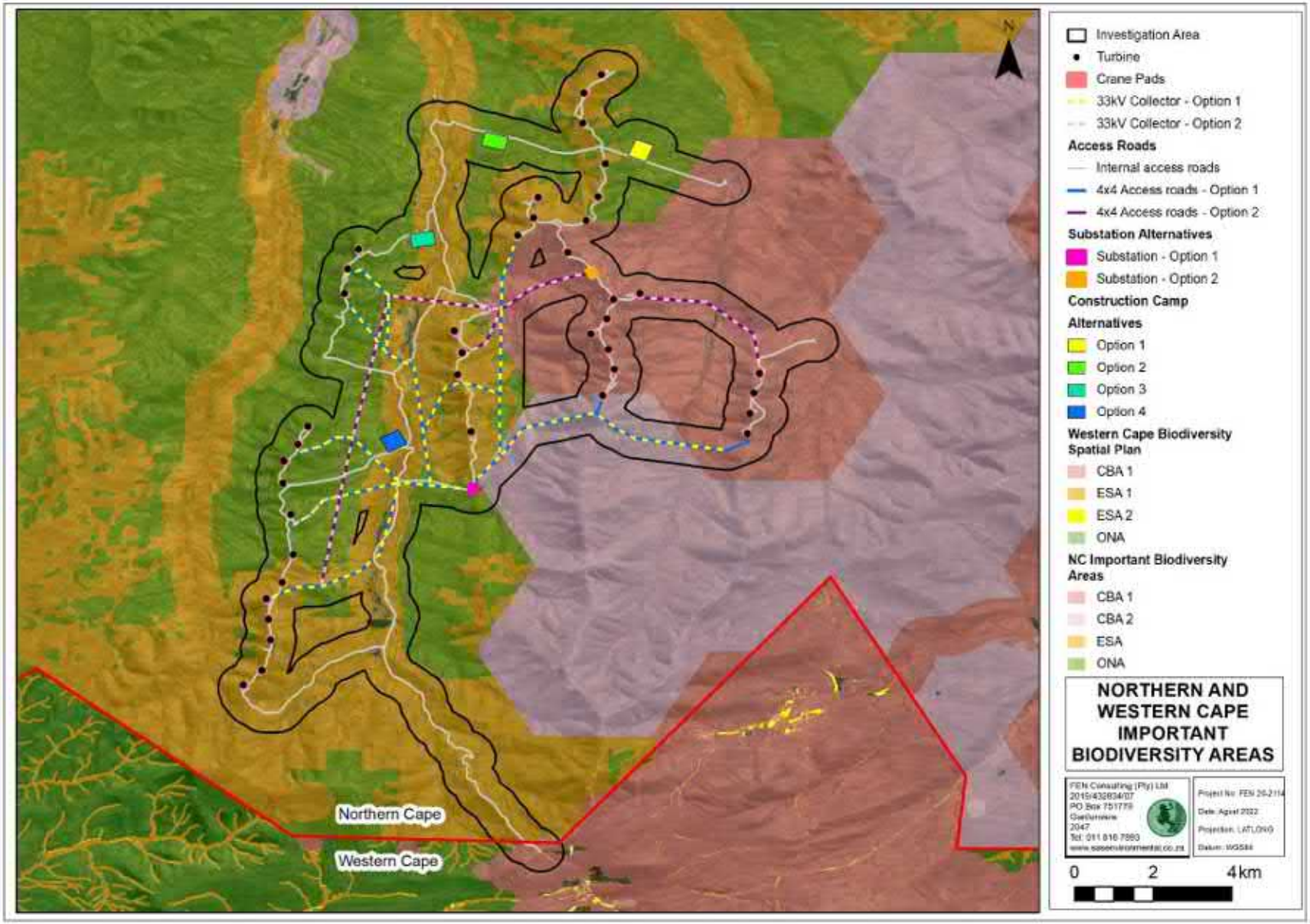


Figure 6: The areas of biodiversity importance associated with the proposed development and investigation area, according to the Western Cape Biodiversity Spatial Plan (2017) and Critical Biodiversity Areas of the Northern Cape (2016) databases.

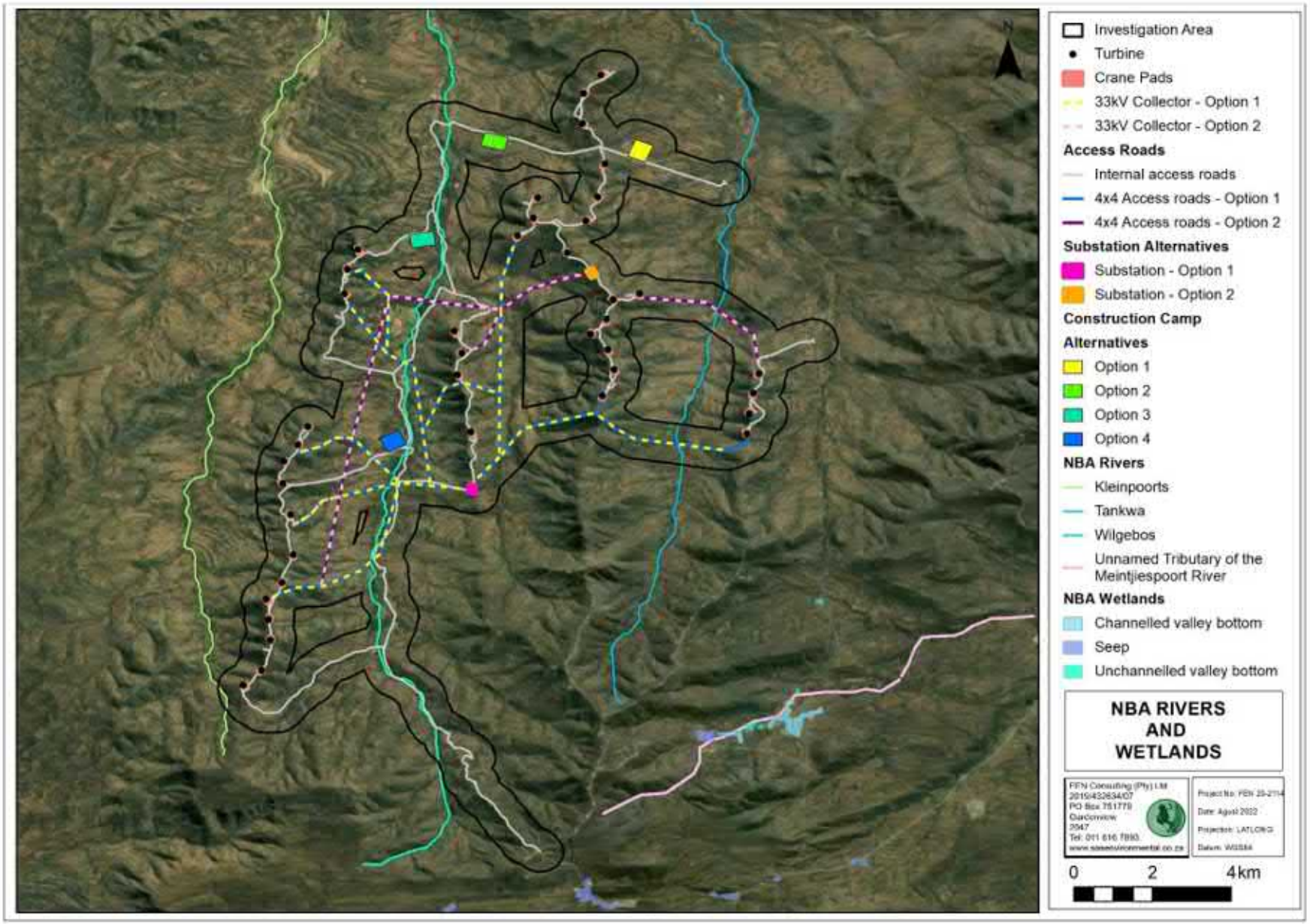


Figure 7: NBA identified wetlands and rivers associated with the proposed WEF development and investigation area, according to the NBA database (2018).

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 E23A-07860 (Tankwa River) and E23A-07875 (Wilgebos River) as contained in this database and pertaining to the PES and EIS are tabulated in Tables 3 and 4 and visually represented in Figure 8 that follows.

Table 3: Invertebrates previously collected from or expected at the SQR monitoring points.

Macro-Invertebrates	E23A-07860 (Tankwa River)	E23A-07875 (Wilgebos River)
Aeshnidae	X	X
Ancylidae	X	X
Baetidae 1 Sp	X	X
Belostomatidae	X	X
Ceratopogonidae	X	X
Caenidae	X	X
Chironomidae	X	X
Coenagrionidae	X	X
Corduliidae	X	X
Corixidae	X	X
Culicidae	X	X
Dytiscidae	X	X
Gerridae	X	X
Gyrinidae	X	X
Hydracarina	X	X
Lestidae	X	X
Libellulidae	X	X
Lymnaeidae	X	X
Muscidae	X	X
Notonectidae	X	X
Oligochaeta	X	X
Physidae		X
Pleidae	X	X
Simuliidae	X	X
Veliidae/Mesoveliidae	X	X

Table 4: 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-07860 (Tankwa River)	E23A-07875 (Wilgebos River)
Synopsis		
PES Category Median	Natural/Close to natural	Natural/Close to natural
Mean EI class	High	High
Mean ES class	High	High
Length	32,4	31,84
Stream order	1	1
Default EC[4]	B (High)	B (High)
PES Details		
Instream habitat continuity MOD	None	None
RIP/wetland zone continuity MOD	Small	Small
Potential instream habitat MOD activities	None	None
Riparian/wetland zone MOD	None	None
Potential flow MOD activities	Small	Small
Potential physico-chemical MOD activities	None	None
EI Details		
Fish spp/SQ	-	-
Fish average confidence	-	-
Fish representivity per secondary class	-	-
Fish rarity per secondary class	-	-
Invertebrate taxa/SQ	25	25
Invertebrate average confidence	3	3
Invertebrate representivity per secondary class	Moderate	Moderate
Invertebrate rarity per secondary class	High	High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Very Low
Habitat diversity class	Low	Low
Habitat size (length) class	Moderate	Moderate
Instream migration link class	Very High	Very High
Riparian-wetland zone migration link	Very High	Very High
Riparian-wetland zone habitat integrity class	Very High	Very High
Instream habitat integrity class	Very High	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	Very High	Very High
ES Details		
Fish physical-chemical sensitivity description	-	-
Fish no-flow sensitivity	-	-
Invertebrates physical-chemical sensitivity description	Moderate	Moderate
Invertebrates velocity sensitivity	High	High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	Very High
Stream size sensitivity to modified flow/water level changes description	High	High
Riparian-wetland vegetation intolerance to water level changes description	Very High	Very 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.

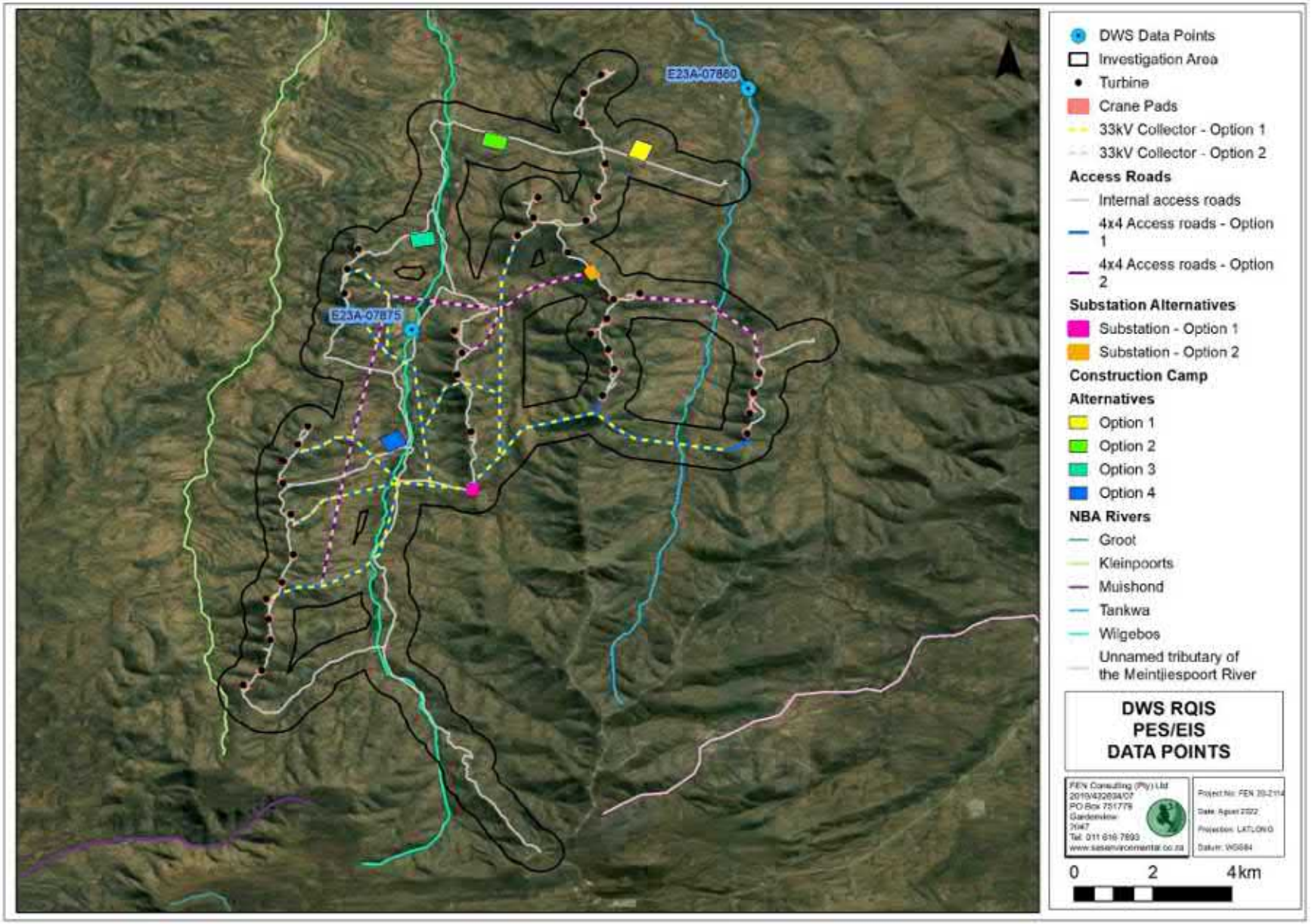


Figure 8: DWS RQIS PES/EIS sub-quaternary catchment reaches (SQRs) indicated relative to the proposed development and investigation area.

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 Wilgebos, Tankwa, Roggeveld and Kleinpoorts River systems were identified within the investigation area. The proposed development is located immediately east of the southern extent of the greater Kudusberge Mountains and directly north of the operational Roggeveld WEF. Turbines 12 to 18 are located on Skurwekop associated with the most northern extent of the proposed development, and Turbines 5 to 8 are located on Rooiberg within the eastern extent of the proposed development, which forms a catchment divide between the Wilgebos and Tankwa River systems. Turbines 29 to 40 are located atop mountainous areas forming the valley of the Wilgebos River system. Current land uses associated with the development site includes predominantly small-scale farming activities, specifically located adjacent to watercourses.

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 the Wilgebos River were also identified to be traversed by the proposed. A wetland associated with the Roggeveld River system was identified within the most southern extent of the investigation area. Since this wetland is located in a different catchment area as the proposed development, no direct and indirect impacts to this wetland are expected, and thus no further assessment of this wetland was undertaken. Nevertheless, the regulated zone associated with this wetland were considered (Section 6). Figures 9 to 12 depict 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).

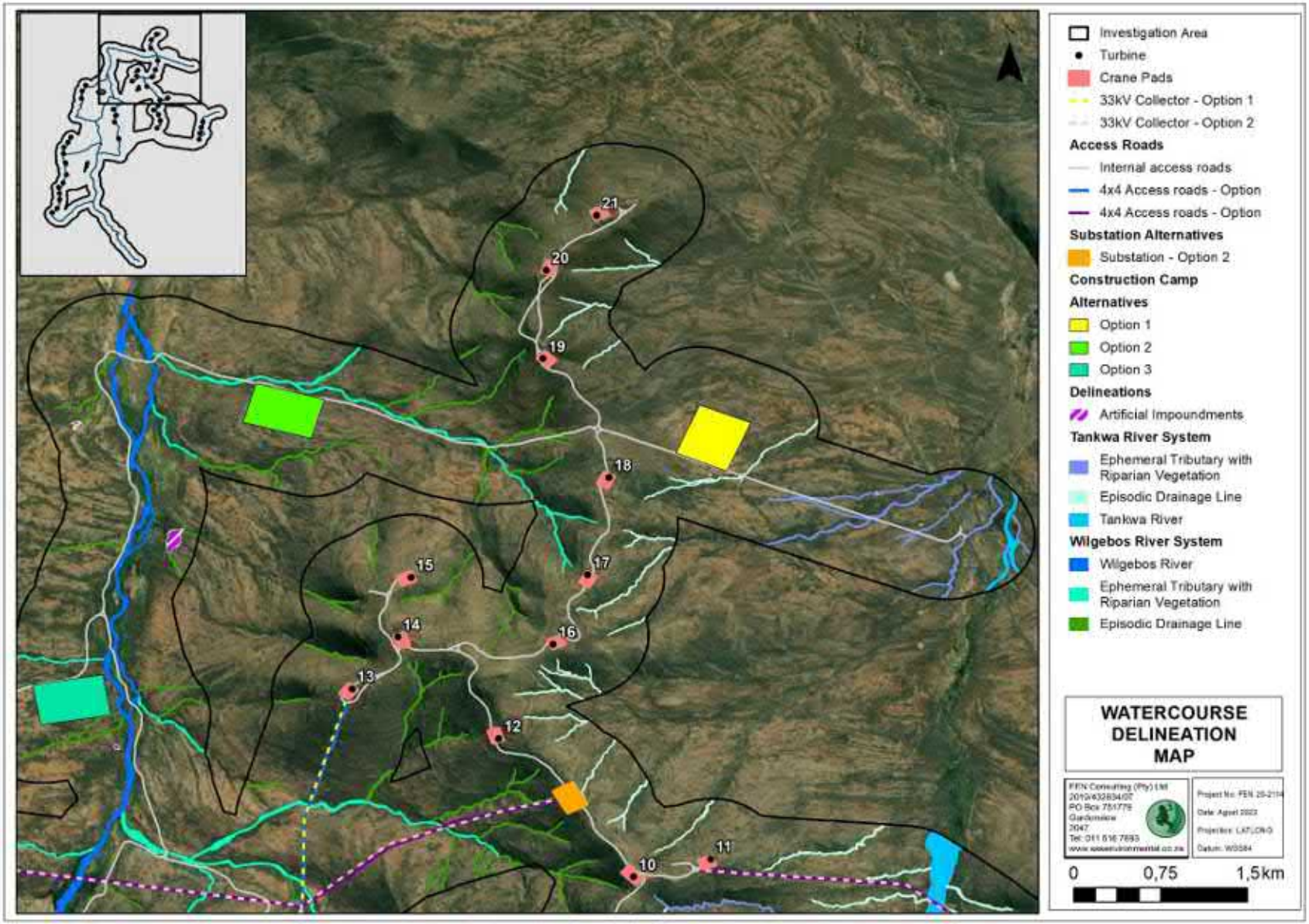


Figure 9: The locality of the delineated watercourses in the northern most portion of the investigation area. (Take note due to the scale of the map: Substation Option 2 and all construction camp alternatives are located outside the delineated extent of the watercourses).

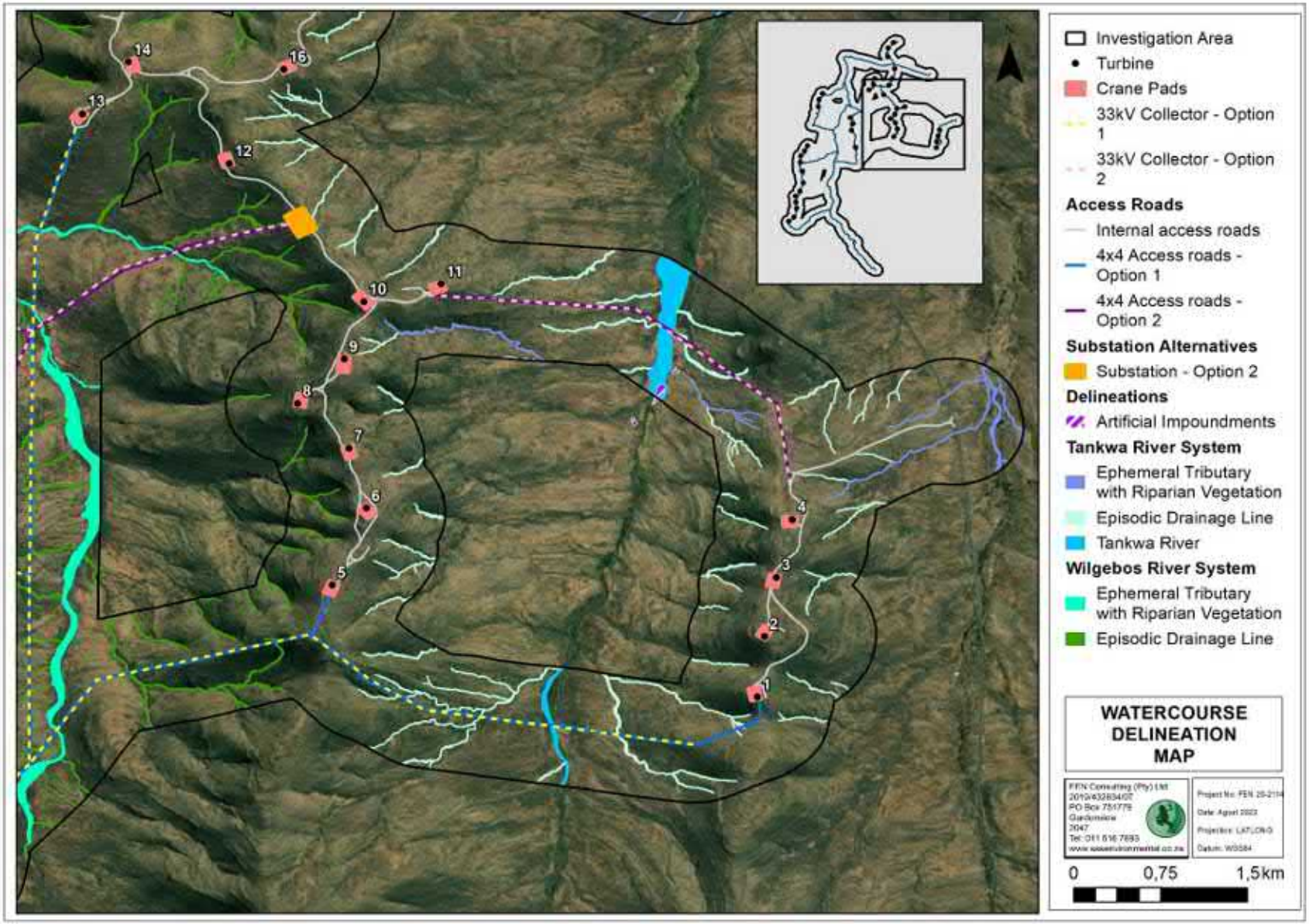


Figure 10: The locality of the delineated watercourses in the eastern portion of the investigation area. (Take note due to the scale of the map: Substation Option 2 and all construction camp alternatives are located outside the delineated extent of the watercourses).

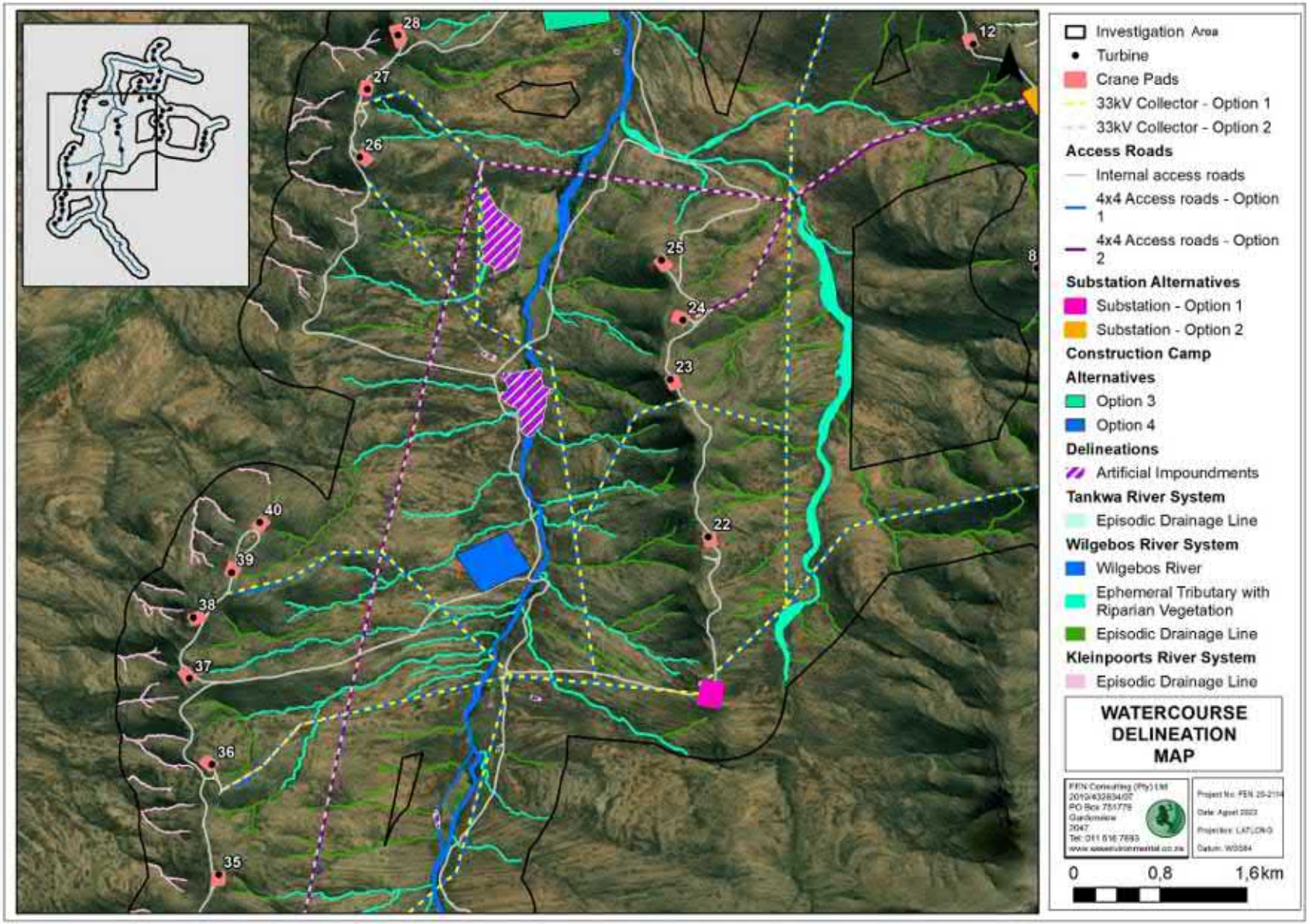


Figure 11: The locality of the delineated watercourses in the north western portion of the investigation area. (Take note due to the scale of the map: Substation Option 1 and construction Camp Option 4 are located outside the delineated extent of the watercourses).

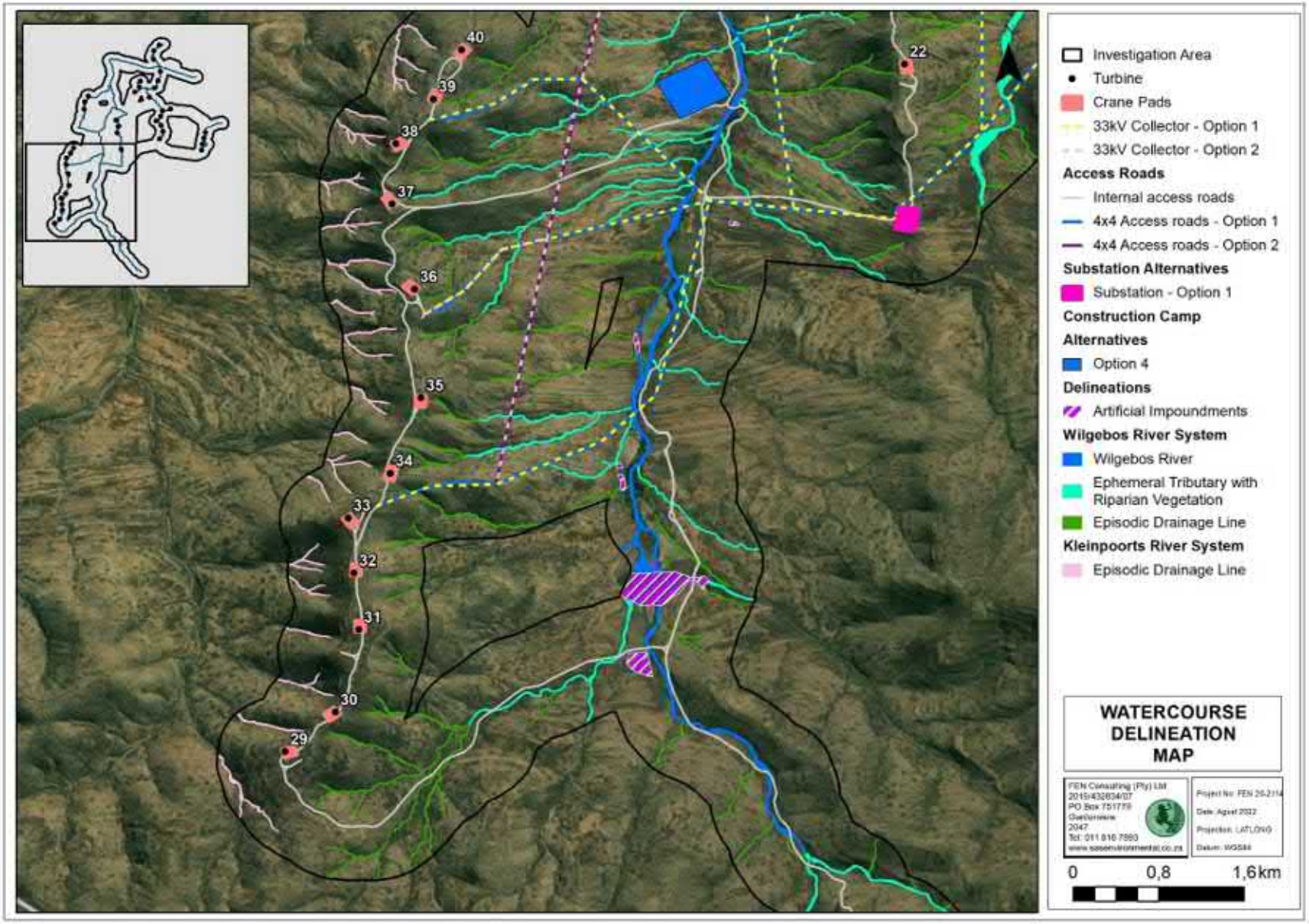


Figure 12: The locality of the delineated watercourses in the south western portion of the investigation area. (Take note due to the scale of the map: Substation Option 1 and construction Camp Option 4 are located outside the delineated extent of the watercourses).

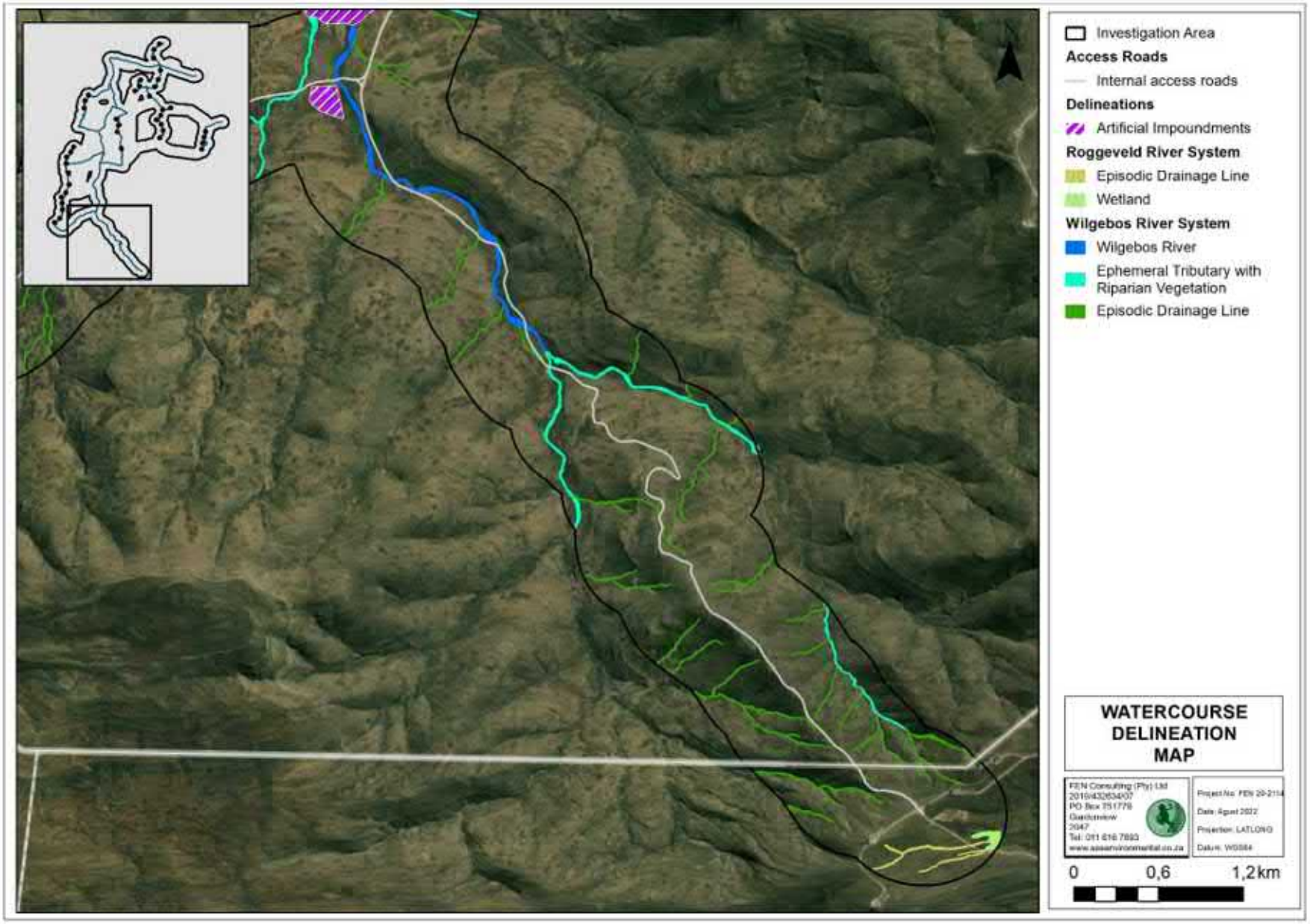


Figure 13: The locality of the delineated watercourses in the southern portion of the investigation area.

5.2 *Watercourse delineation*

The outer boundary of the identified watercourses was 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 Wilgebos and Tankwa Rivers are located in the valley bottom position (Figure 14). 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.

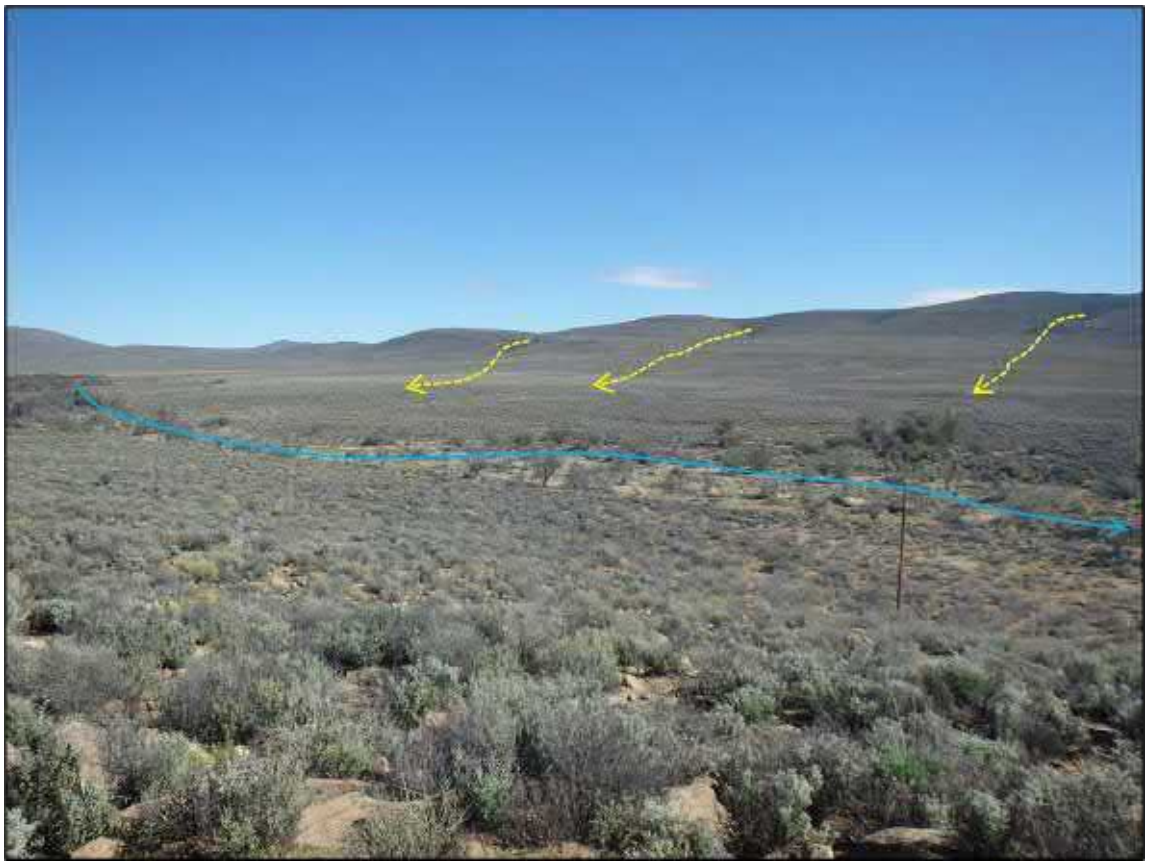


Figure 14: A photograph depicting the topographical setting of the smaller episodic drainage lines in the higher slope position (yellow dashed line) relative to the larger ephemeral Wilgebos River in the valley bottom position (blue arrow).

- **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 Wilgebos and Tankwa Rivers was a change in riparian vegetation identified from that of the terrestrial vegetation (Figure 15), 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). 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 15: 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 (Photograph of the Wilgebos River), 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.

- ***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) (Figure 16). 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.

Figure 16: (Left) a shallow layer of alluvial soil is present in the active channel of this ephemeral tributary. (Right) the upper reaches of the tributaries and smaller episodic drainage lines have exposed bedrock, and only present with small, isolated areas where alluvial soil is deposited.

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 5 below presents the classification from level 3 to 4 of the Wetland Classification System (Ollis *et al.* 2013).

Table 5: Classification of the watercourses associated with the proposed development.

Watercourse	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Ephemeral rivers and tributaries with riparian vegetation.	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	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 6 and 7 provide 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 6: Summary of results of the assessment of the episodic drainage lines (EDLs) associated with the Wilgebos, Tankwa and Kleinpoorts River systems proposed to be traversed by the proposed development.

Watercourse characteristics overview:
EDLs arise from the various mountainous area located between the Wilgebos and Tankwa River systems. 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 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 and allow for uninterrupted hydrological functionality of the downstream systems. The vegetation associated with the EDLs are predominantly short growing shrubs, but no facultative wetland 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, it is not considered significant. Despite erosion noted within isolated areas of the EDLs, no significant deposition of sediment was observed.

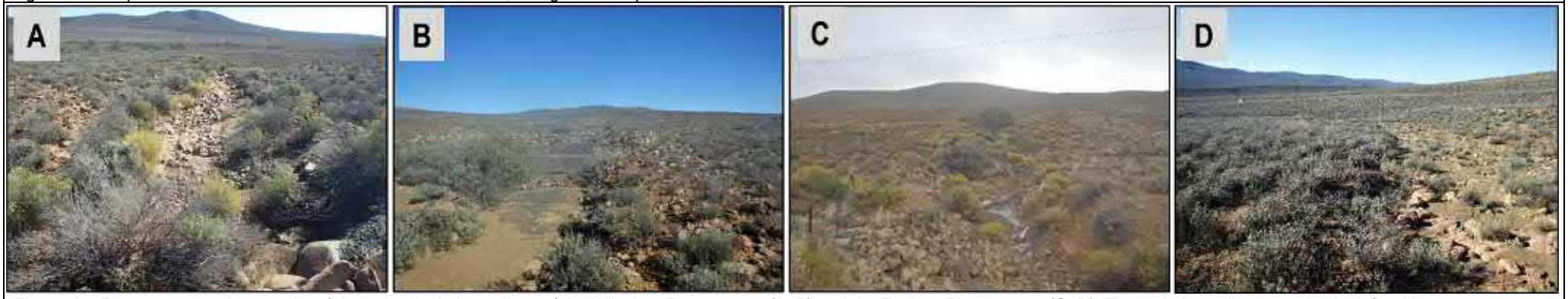



Figure 17: Representative photographs of the episodic drainage lines of the Wilgebos River system (A, B) and the Tankwa River system (C, D). These drainage lines are clearly defined by an unvegetated channel of exposed bedrock. No significant change between the vegetation associated with the edge of the drainage line channel to that of the surrounding terrestrial area is evident.

Assessment of the EDLs of the Wilgebos River System	**IHI Outcome**	**IHI Riparian PES Category: C (Moderately modified)** Due to surrounding agricultural activities and informal road crossings, these EDLs have been modified, primarily the vegetation component with evidence of erosion in isolated areas.	**EIS Discussion**	**High** The EDLs are 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 ESAs/ONAs as per the CBANC (2016) database. 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: A/B (Improve)** The RMO is to, at minimum, maintain these EDLs in their current ecological state, as any potential impacts my also impact cumulatively on the downstream larger Wilgebos 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 Tankwa 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 anthropogenic impacts which 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 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 a CBA 1/2 as per the CBANC (2016) database. Even though modifications to these EDLs 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: 1,4 (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, as any potential impacts my also impact cumulatively on the downstream larger Tankwa 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 Kleinpoorts 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 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 being located within ESAs/ONAs as per the CBANC (2016). 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: A/B (Improve)** The RMO is to, at minimum, maintain these EDLs in its current ecological state, as any potential impacts my also impact cumulatively on the downstream larger Kleinpoorts 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 or constructed. Underground cables ontop of the ridges buried along access roads, where feasible, will likely traverse along these watercourse crossings in some areas. 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 new and upgrading of the watercourse road crossings poses a Moderate risk significance to the watercourses. It is the opinion of the freshwater 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 dry periods when no surface water is present within a watercourse. 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, as per the detailed site specific Stormwater Management Plan. 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 or construction of roads in close proximity to the watercourses take place during the low flow period, the risk to the receiving environment will be significantly reduced.		

Table 7: Summary of results of the assessment of the Wilgebos River and ephemeral tributaries associated with the Wilgebos and Tankwa River systems proposed to be traversed by the proposed development.

Watercourse characteristics overview:				
The ephemeral Wilgebos River and other tributaries identified within the investigation area have remained largely intact, however these watercourses have seen more frequent impacts due to their lower position in the landscape, confluencing with the larger river systems. 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 tributaries function as migratory corridors due to its connectiveness with the smaller EDLs and larger river systems (thus high hydrological connectivity in the landscape). They also provide habitat for a variety of faunal species, even more so due to the presence of small trees species within the marginal zone.				

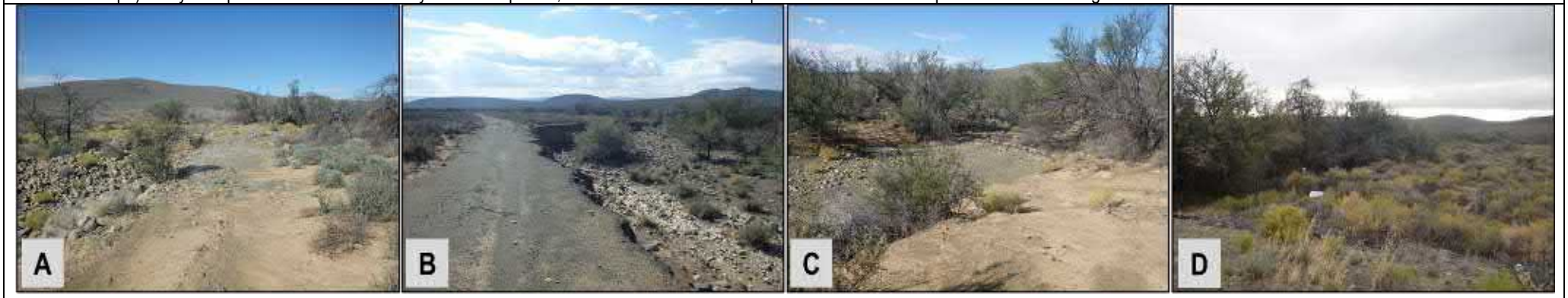



Figure 18: Representative photographs of the Wilgebos River (A & B) and other ephemeral tributaries of the Wilgebos River (C) and Tankwa Rivers (D). The active channel of these systems consists of a shallow layer of alluvial soil. Note the extensive erosion in the Wilgebos River (C) located adjacent to an existing road proposed to be upgraded. These watercourses can be distinguished in the landscape from the surrounding terrestrial area based on the presence of tree species.				
Assessment of the tributary of the Wilgebos River System	**IHI Outcome**	**IHI Riparian PES Category: B (Largely natural with few modifications)** These tributaries are fairly intact, with road crossings noted as the only anthropogenic activity to impact on the tributaries. The vegetation composition is representative of the vegetation of the biome and consists of indigenous species.	**EIS Discussion**	**High** The tributaries are 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 a CBA 1/2 as per the CBANC (2016) database. 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 to the larger rivers outside the investigation area.
	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 these tributaries in its current ecological state, as any potential impacts my also impact cumulatively on the downstream larger Wilgebos River system. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.

Assessment of the tributary of the Tankwa River System	**IHI Outcome**	**IHI Riparian PES Category: B (Largely natural with few modifications)** These tributaries are fairly intact, with road crossings noted as the only anthropogenic activity to impact on the tributaries, which may have resulted in some alien species establishing. Overall, the vegetation composition consists of largely indigenous species.	**EIS Discussion**	**High** The tributaries are 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 areas is located within a CBA 1/2 as per the CBANC (2016) database. Even though modifications to these EDLs 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 these EDLs in its current ecological state, as any potential impacts my also impact cumulatively on the downstream larger Tankwa River system located outside the northern boundary of the investigation area. Small scale rehabilitation of areas which may potentially be impacted by the proposed development must be undertaken.
Assessment of the Wilgebos River System	**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 the river 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 EDLs will be upgraded or constructed. Underground cables ontop of the ridges buried along access roads, where feasible, will likely traverse along these watercourse crossings in some areas. 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 new and upgrading of the watercourse road crossings poses a Moderate risk significance to the watercourses. It is the opinion of the freshwater 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 dry periods when no surface water is present within a watercourse. 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 or construction of roads in close proximity to the watercourses take place during the low flow period, 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.**
The original activities authorised were Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014). As a Part 2 EA Amendment	The original EA was issued in 2016 which was based on the GN 983, 984, and 985 National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014. As part of the Part 2 EA amendment process, these will be updated to the latest activities of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) as per the transitional arrangements. **Original Authorised Activity:** GN 983 (Listing Notice 1): Activity 12: **Current Activity:** GNR 327 (Listing Notice 1): Activity 12

[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.

Regulatory authorisation required	Zone of applicability
process for the proposed development currently being undertaken, authorisaton will be granted in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations 2014, as anmended in 2017. **Department of Forestry, Fisheries and the Environment (DFFE)**	**Applicable trigger:** *The development of infrastructure or structures with a physical footprint of 100 square metres or more within a watercourse, or within 32m of a watercourse.* Applicable ZoR: **32m** **Original Authorised Activity:** GN 983 (Listing Notice 1): Activity 19: **Current Activity:** GNR 327 (Listing Notice 1): Activity 19 **Applicable trigger:** *The infilling or depositing of any material of more than 10 (previously 5) cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles, or rock of more than 10 cubic metres (previously 5) from a watercourse* **Original Authorised Activity:** GN 985 (Listing Notice 3): Activity 14: **Current Activity:** GNR 324 (Listing Notice 3): Activity 14 **Applicable trigger:** *The development of infrastructure or structures with a physical footprint of 10 square metres or more;within a watercourse; or within 32 metres of a watercourse, within the relevant provicincial sensitive geographic areas* Applicable ZoR: **32m** **Original Authorised Activity:** GN 985 (Listing Notice 3): Activity 18: **Current Activity:** GNR 324 (Listing Notice 3): Activity 18 **Applicable trigger:** *The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre within the relevant provincial sensitive geographical areas* Applicable ZoR: **100m** **Original Authorised Activity:** GN 985 (Listing Notice 3): Activity 23: **Current Activity:** GNR 324 (Listing Notice 3): Activity 23 **Applicable trigger:** *The expansion of infrastructure or structures where the physical footprint is expanded by 10 square metres or more;within a watercourse; or within 32 metres of a watercourse, within the relevant provicincial sensitive geographic areas* Applicable ZoR: **32m**

The following Zones of Regulation (ZoR) are applicable to the watercourses (Figures 19 to 28):

- A 32 m Zone of Regulation (ZoR) in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was assigned to all watercourses;
- A 1:100 year floodline has been modelled for some of the watercourses within the investigation area (i.e., Tankwa and Wilgebos Rivers and ephemeral drainage lines with riparian vegetation). As such, the GN509 ZoR was assigned as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, in accordance with the National Water Act, 1998 (Act No. 36 of 1998) (NWA), for the watercourses where the 1:100 year floodline has been modelled;
- In the absence of a defined 1:100 year floodline (such as for some of the smaller episodic drainage lines without riparian vegetation), a 100 m ZoR in accordance with GN509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA, was assigned;
- The 100 m GN509 ZoR and the GN509 ZoR assigned using the 1:100 year floodline were combined to form an overall GN509 ZoR for the watercourses associated with the proposed development; and
- A 500 m ZoR in accordance with GN509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA was applied to the wetland associated with the Roggeveld River system identified within the most southern extent of the investigation area.

The proposed development will encroach into the GN509 ZoR, thus Water Use Authorisation (WUA) for water uses as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), must be obtained from the DWS prior to commencement of any construction. The outcome of the DWS Risk Assessment (Section 7) will prescribe the application of either a GA should the proposed development activities pose a low risk significance to the watercourses, or a Water Use Licence Application (WULA) should the proposed development activities pose a moderate to high risk significance to the watercourses. Additionally, the EA amendment, final layout and EMPR approval in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) must be obtained, prior to the commencement of any works.

It is recommended that a Watercourse Rehabilitation, Maintenance and Management Plan (WRMMP) be undertaken as part of the WUA approval process and be in place prior to construction.

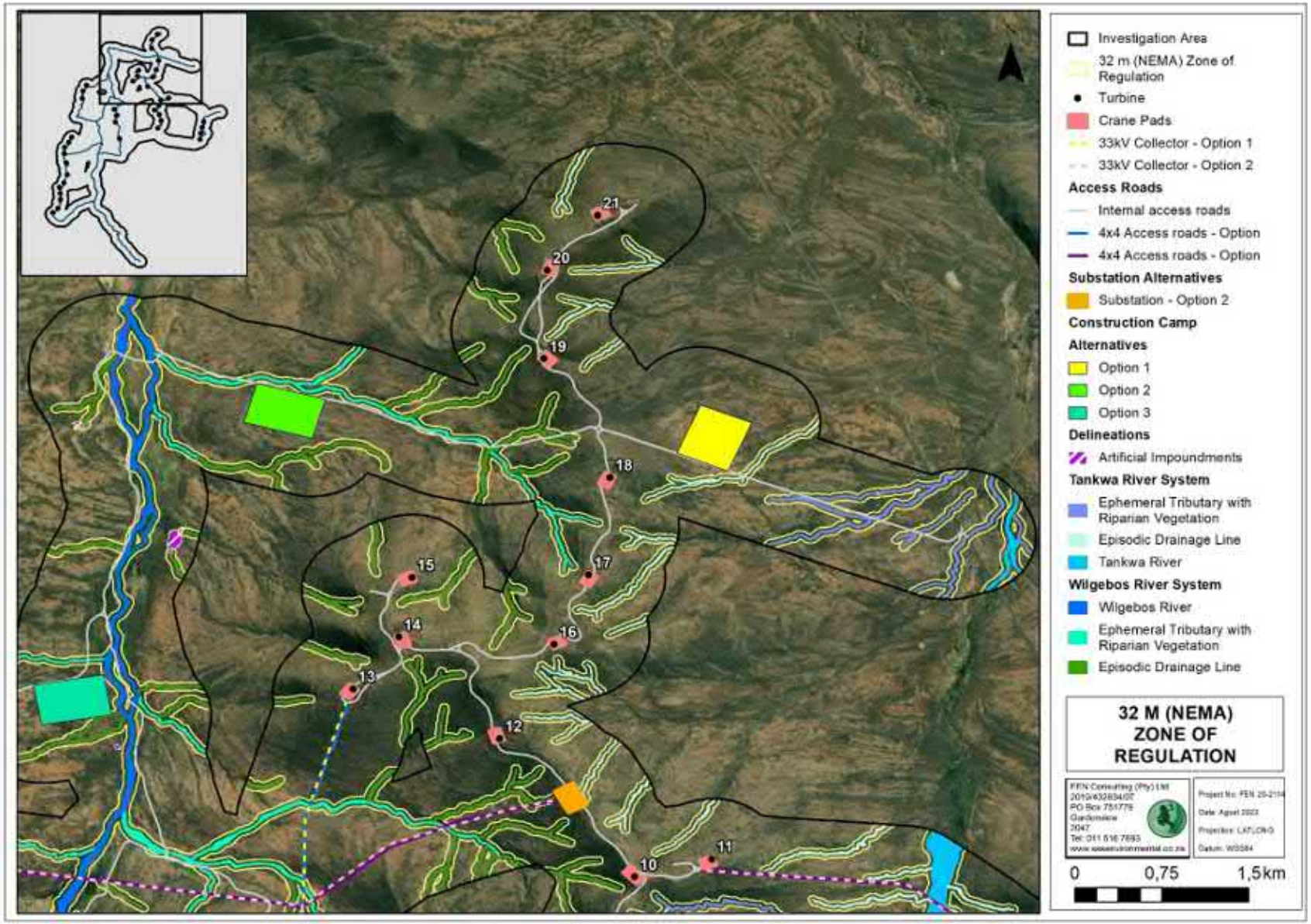


Figure 19: The conceptual presentation of the 32m NEMA zone of regulation in relation to the watercourses associated with the northern most portion of the investigation area.

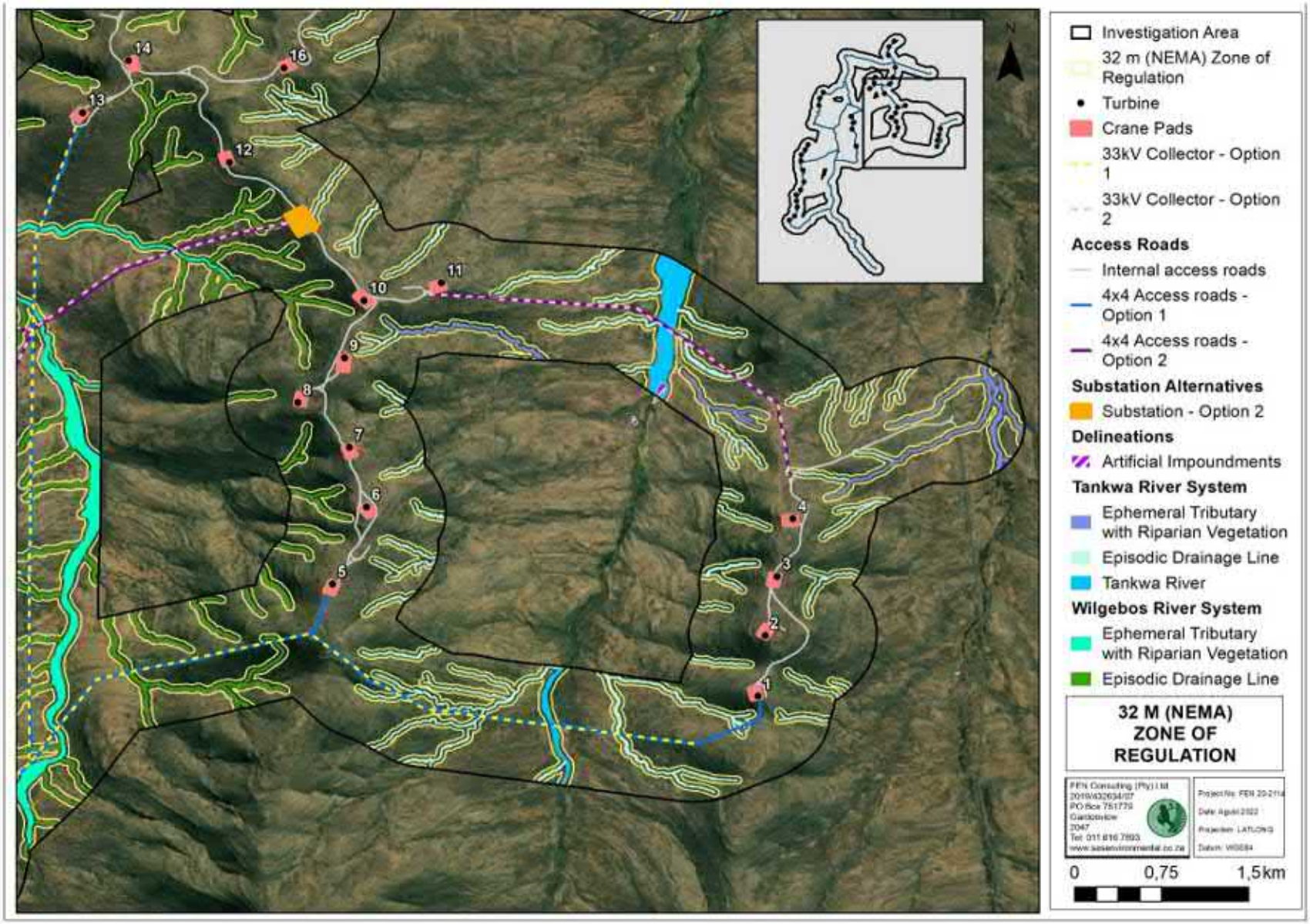


Figure 20: The conceptual presentation of the 32m NEMA zone of regulation in relation to the watercourses associated with the eastern portion of the investigation area.

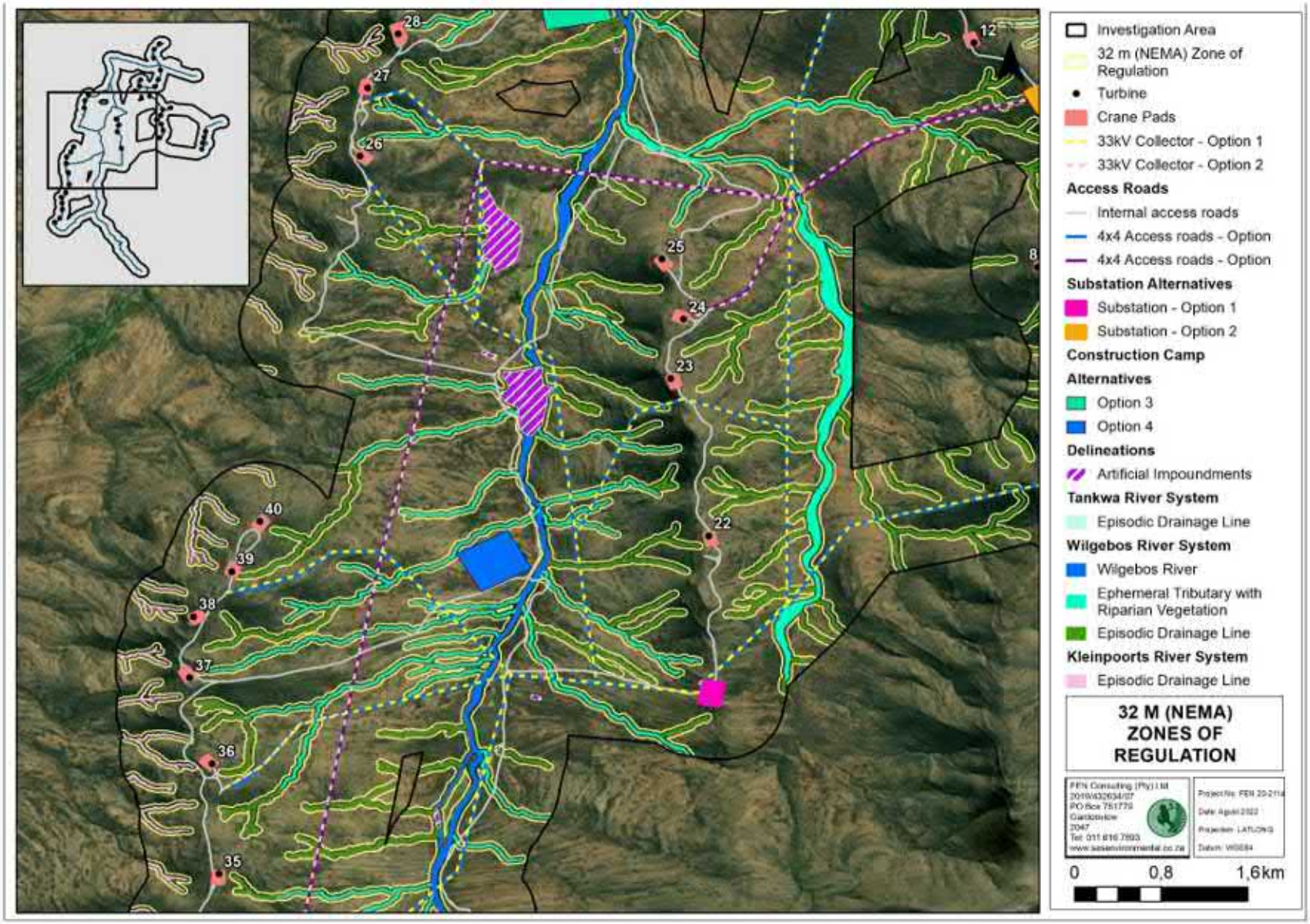


Figure 21: The conceptual presentation of the 32m NEMA zone of regulation in relation to the watercourses associated with the north western portion of the investigation area.

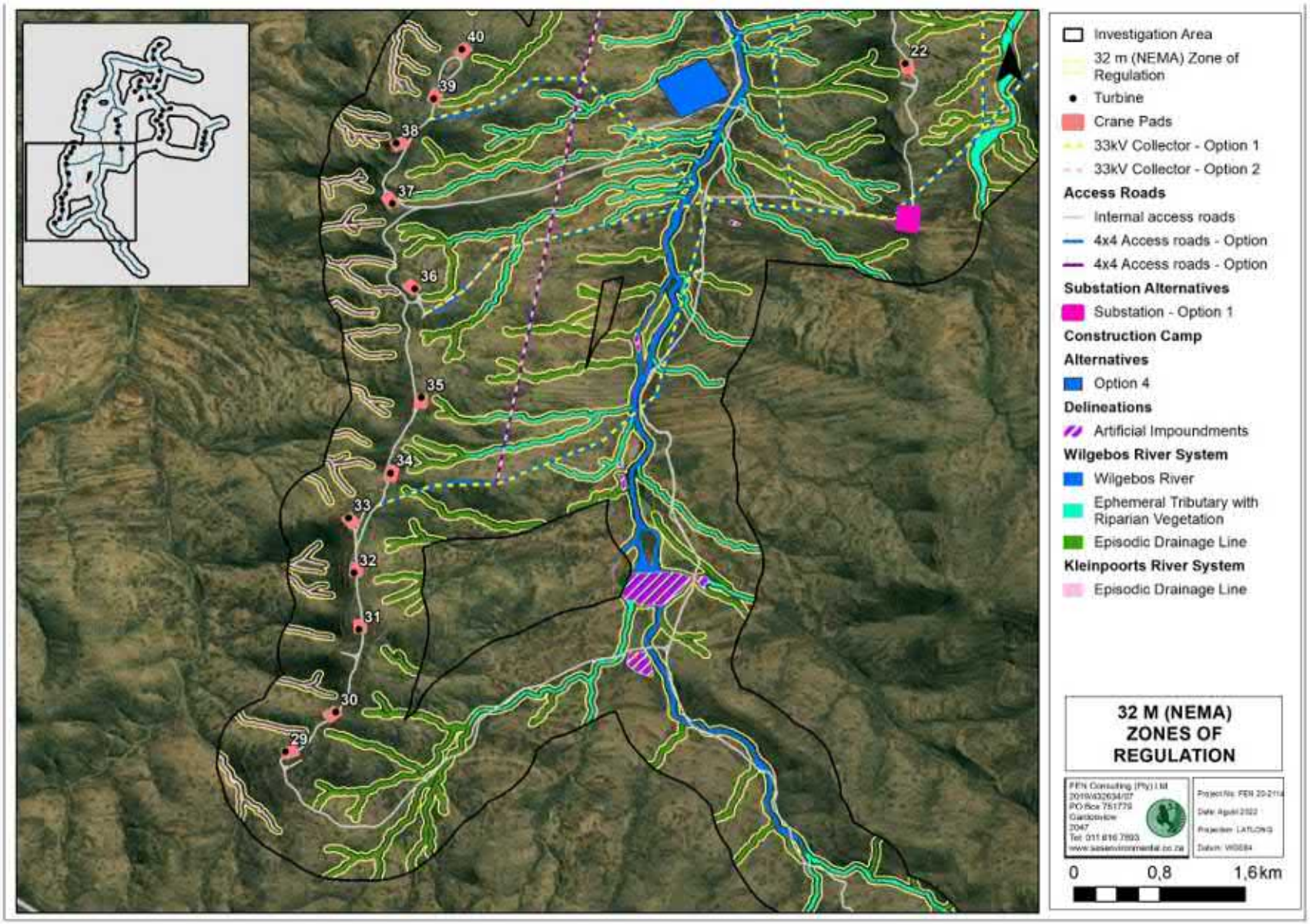


Figure 22: The conceptual presentation of the 32m NEMA zone of regulation in relation to the watercourses associated with the south western portion of the investigation area.

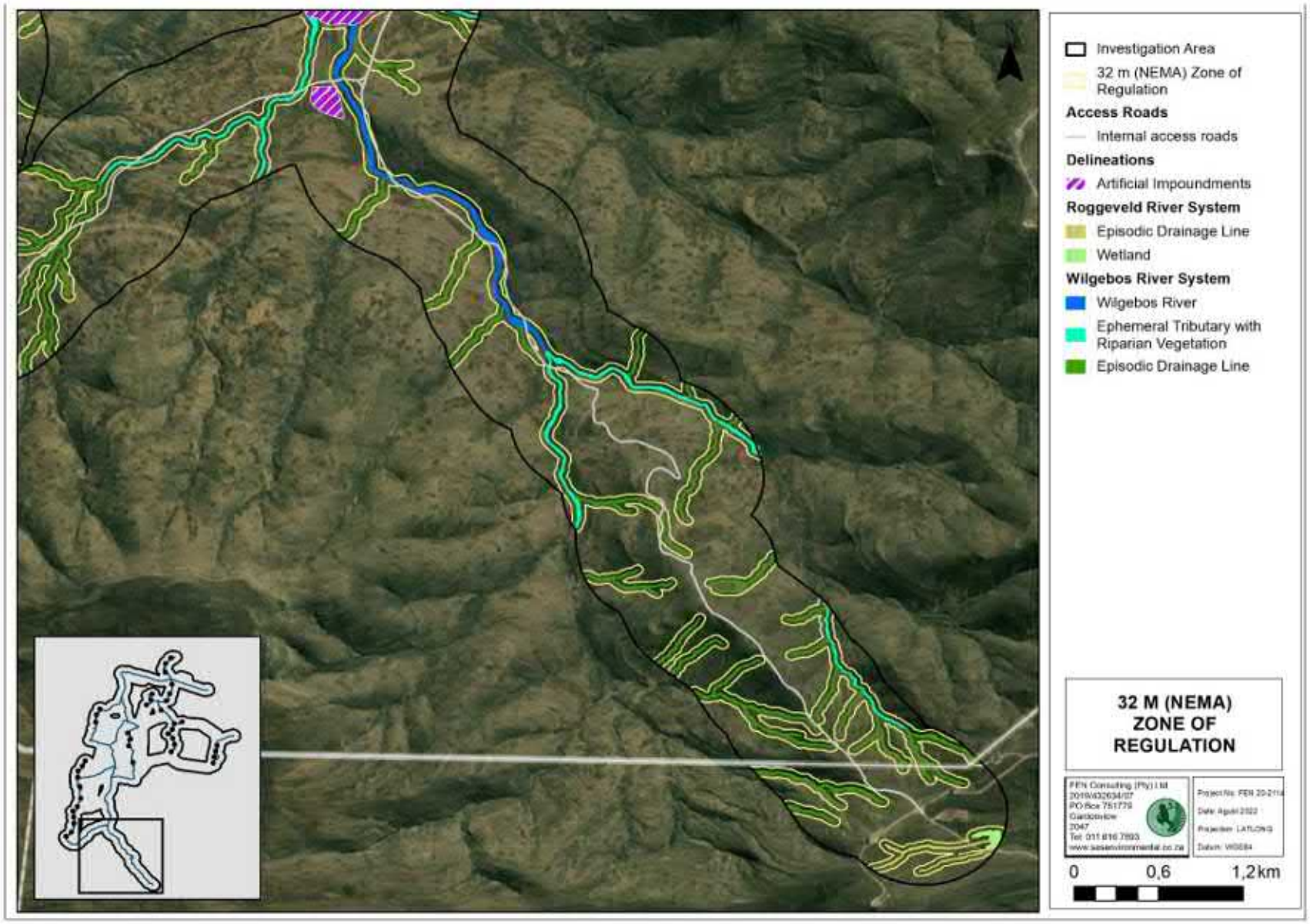


Figure 23: The conceptual presentation of the 32m NEMA zone of regulation in relation to the watercourses associated with the southern portion of the investigation area.

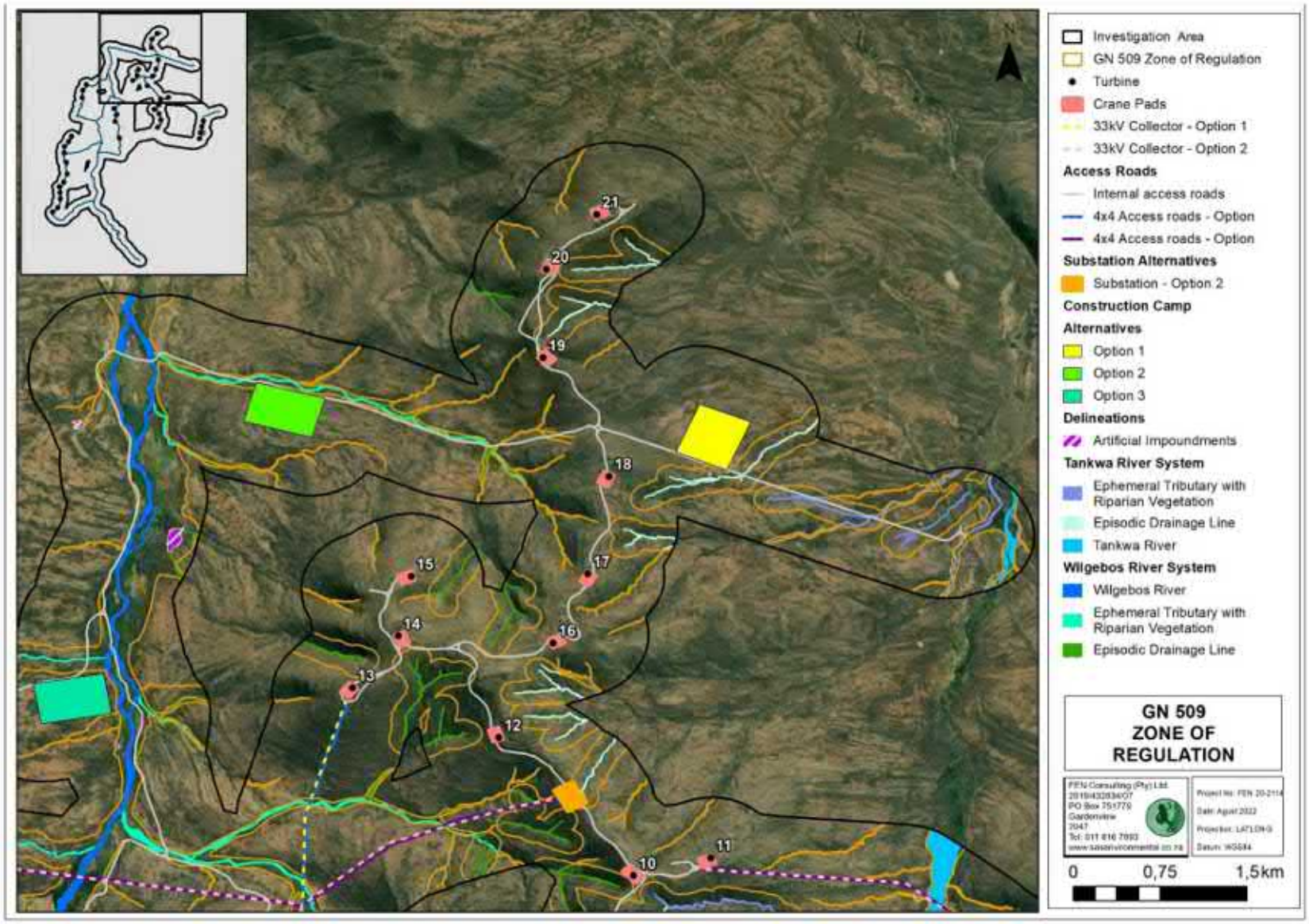


Figure 24: The conceptual presentation of the zone of regulation in terms of GN509 of 2016 as it relates to the NWA (determined as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, where applicable) for the watercourses associated with the northern most portion of the investigation area.

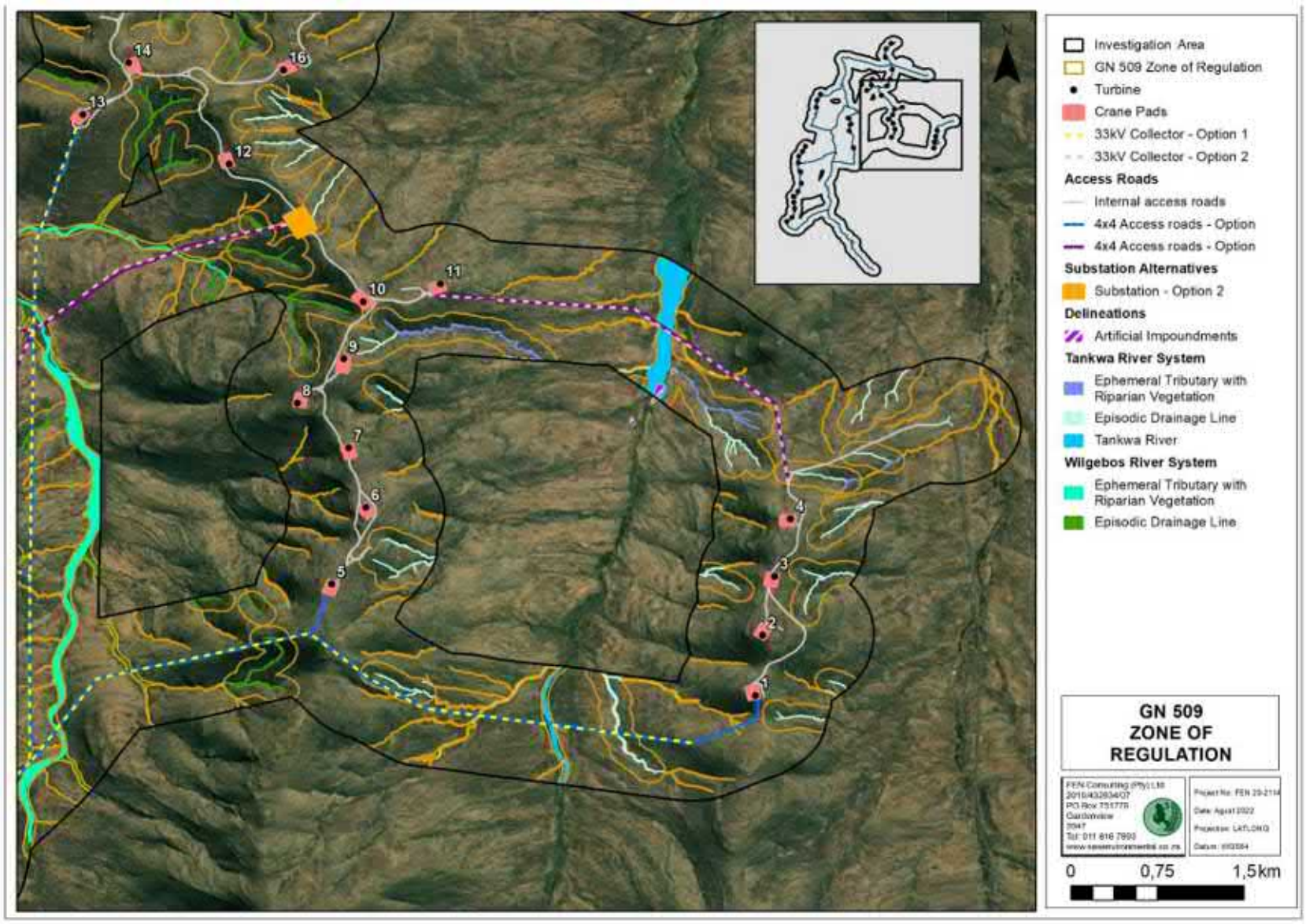


Figure 25: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA (determined as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, where applicable) for the watercourses associated with the eastern portion of the investigation area.

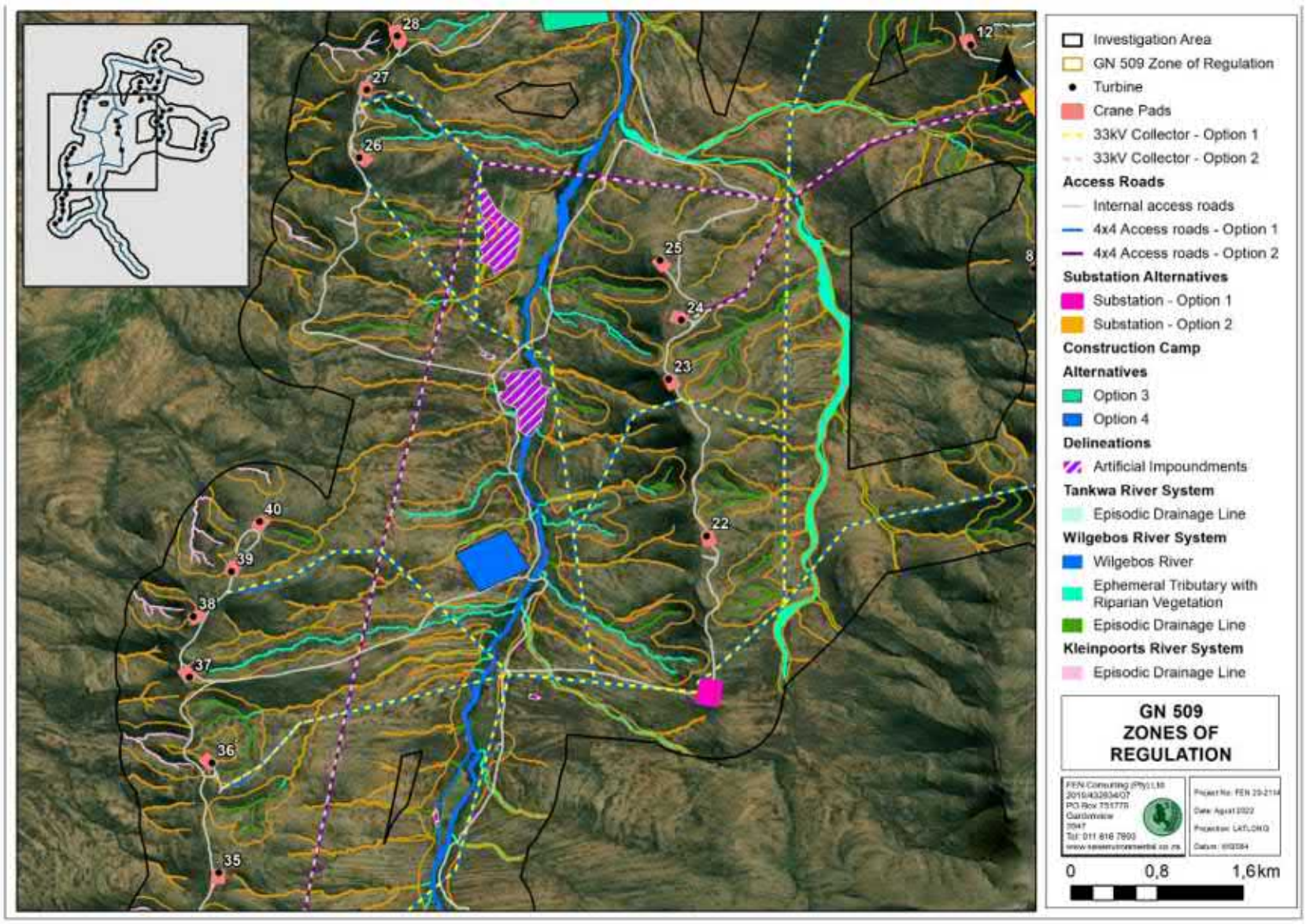


Figure 26: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA (determined as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, where applicable) for the watercourses associated with the north western portion of the investigation area.

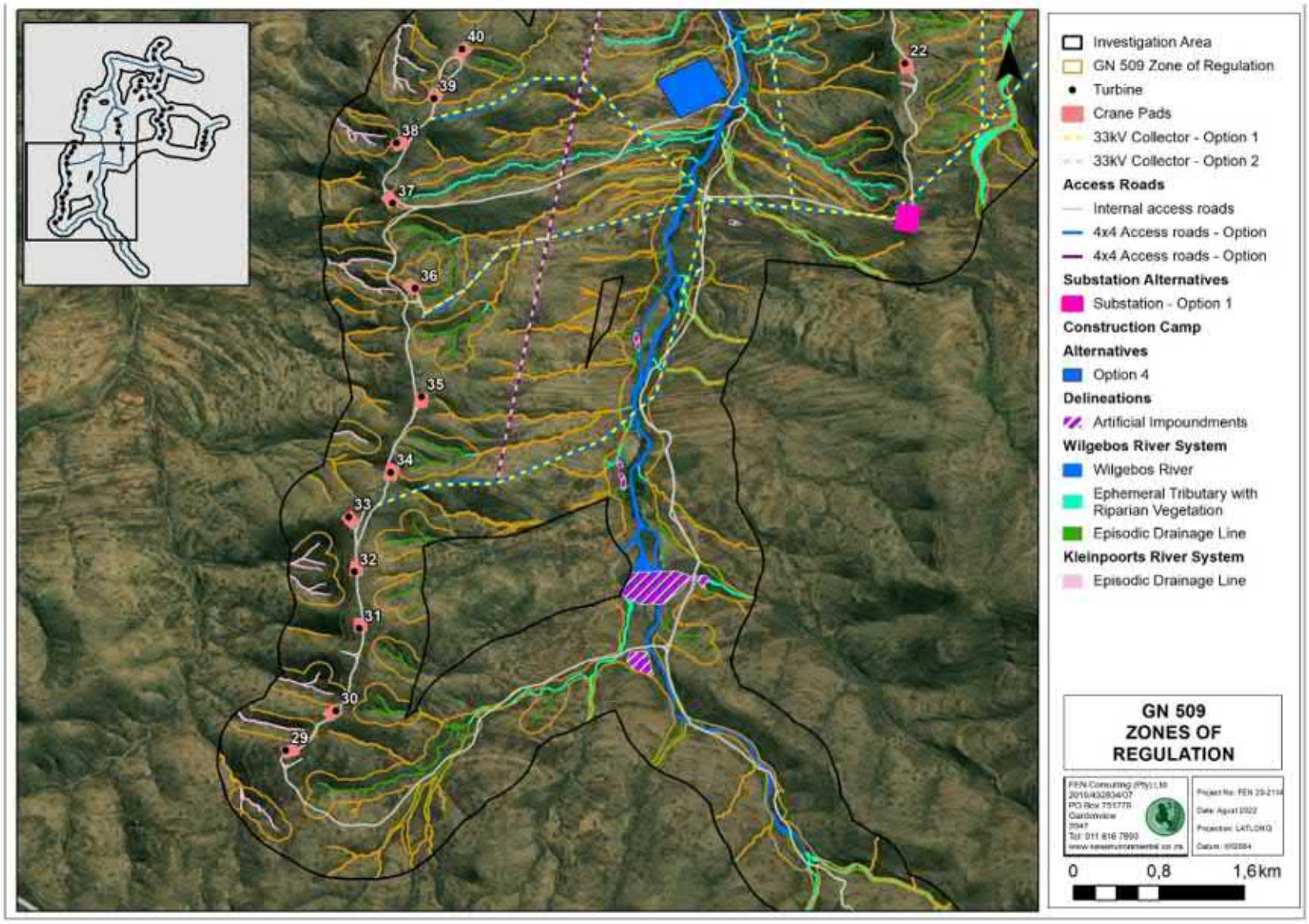


Figure 27: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA (determined as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, where applicable) for the watercourses associated with the south western portion of the investigation area.

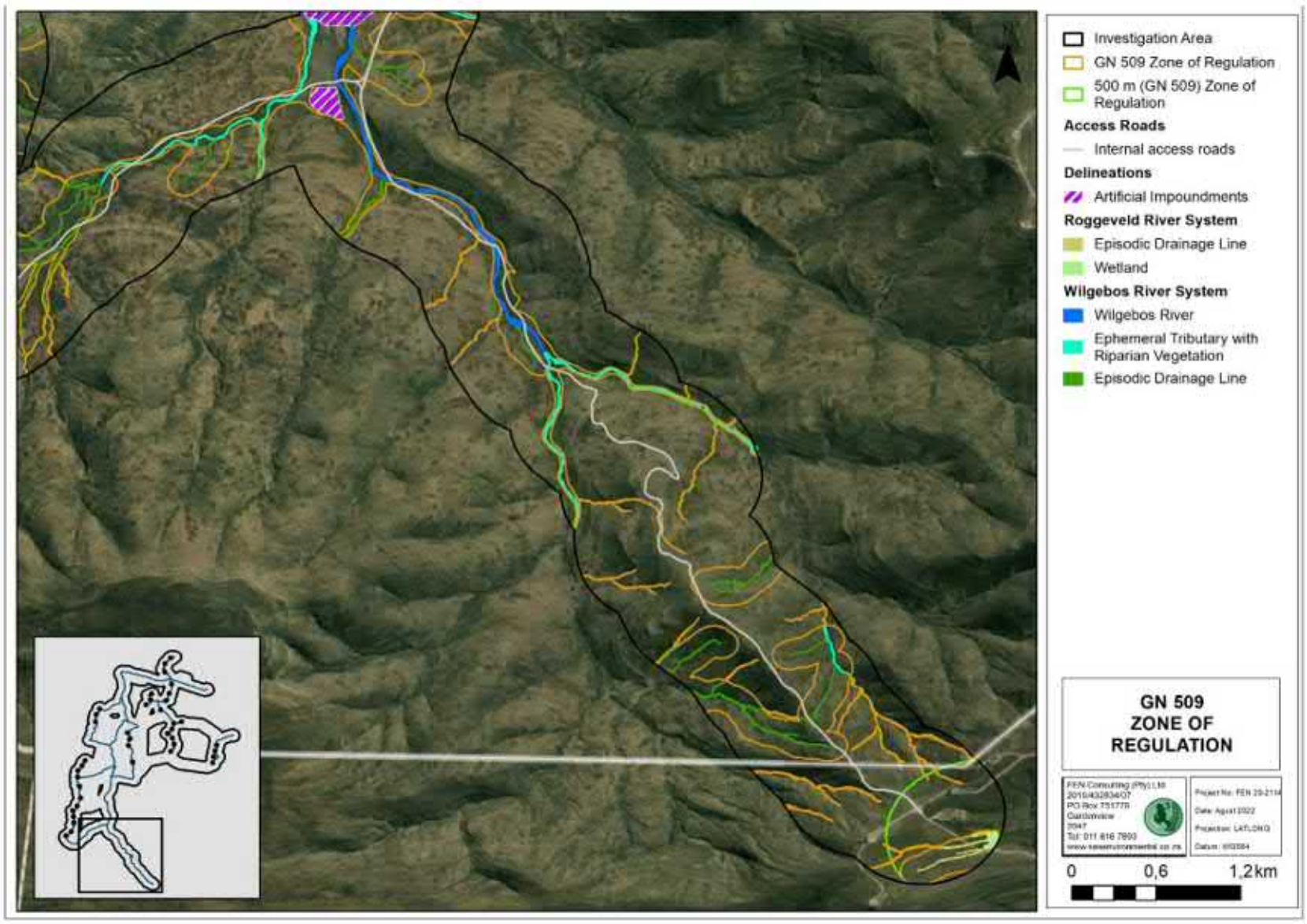


Figure 28: The conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA (determined as the combined extent of the delineated edge of a watercourse and the modelled 1:100 year floodline, where applicable) for the watercourses associated with the southern portion of the investigation area

7 RISK ASSESSMENT AND MICRO-SITING CONSIDERATIONS

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.

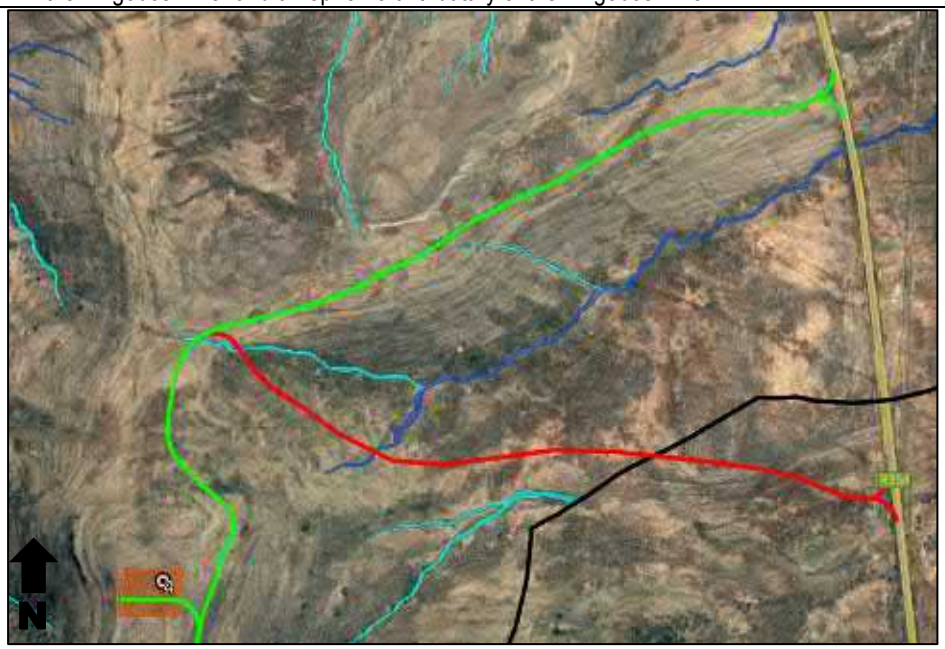
7.1 *Risk Assessment considerations and outcome*

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;
- The proposed 33kV overhead collector system and proposed access roads will directly traverse watercourses (Table 9). However, it noted that the powerline support structures will be constructed outside of the delineated extent of the watercourses and at least 32 m from its delineated extent (where feasible). Additionally, several other portions of the internal roads are located within the GN509 Zone of Regulation (as described in Section 6). Table 9 below provides a summary of all the turbines and crane pads within the GN509 ZoR that were considered as part of the risk assessment. The risk significance of roads, Substation Option 1, turbines and crane pads located outside of the GN509 ZoR was not considered as these components are considered to not pose a quantum of risk to the identified watercourses due to their distance from the watercourses (located more than 100 m from 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
Construction Camp Option 1	Located outside the delineated extent of the watercourses, approximately 64 m from the nearest watercourse.
Construction Camp Options 2 and 4	Located outside the delineated extent of the watercourses, but slightly encroaches into the boundary of the 32 m of the nearest watercourse (less than 5% of the total construction camp area).
Construction Camp Option 3	Located outside the delineated extent of the watercourses, but directly outside the boundary of the nearest watercourse and thus encroaches relatively more significantly into the 32 m of the nearest watercourse (approximatrly 5% of the total construction camp area).
Substation Option 2	Located outside the delineated extent of the watercourses, approximately 20 m from the nearest watercourse (EDL).
Turbines and Crane pads	No turbines or crane pads directly intercept any watercourses. All proposed turbines are located at least 100 m (Turbine 38) and more than 100 m from the delineated extent of a watercourse. The following crane pads slightly encroach into the boundary of the GN509 ZoR: • Crane pad associated with Turbine 9, located approximately 97 m from a riparian watercourse

Proposed surface infrastructure component	Approximate distance from the closest watercourse
	• Crane pad associated with Turbine 26, located approximately 66 m from a riparian watercourse • Crane pad associated with Turbine 28, located approximately 41 m from a riparian watercourse • Crane pad associated with Turbine 36, located approximately 88 m from a riparian watercourse • Crane pad associated with Turbine 37, located approximately 70 m from a riparian watercourse • Turbine 38 located approximately 100 m from a riparian watercourse and crane pad associated with Turbine 38, located approximately 72 m from a riparian watercourse • Crane pad associated with Turbine 40, located approximately 86 m from a riparian watercourse
33kV Collector system – Option 1 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 technically 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 existing access roads which are located adjacent to the Wilgebos River and an ephemeral tributary of the Wilgebos River
The two access route options from the R354 (eastern ridge access route) will traverse watercourses associated with the Tankwa River System	 **Figure A: The proposed eastern ridge access road option 1 (green line) and eastern ridge access road option 2 (red line) from the R354 will require new watercourse crossings within the ephemeral tributary and episodic drainage line associated with the Tankwa River System. Only one of these eastern turbine ridge access road options will be constructed.** The access route must make use of appropriately sized through flow structures, installed during the dry period when there is low to no flow with the watercourses, to limit direct negative impacts to these minor tributaries of the Tankwa River System.

- 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 but with proposed mitigation measures can be managed, and thus an offset would not be required;

- The default score for legal issues (for all watercourses proposed to be traversed) is '5' since some activities, as listed in Table 10, will be located within the GN509 ZoR (as described in section 6) 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 infrastructure as listed in Table 9* located within the GN509 ZoR (as described in Section 6) but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the GN509 ZoR but outside the delineated extent of watercourses. *Infrastructure as per Table 9 considered includes: • 33kV Collector overhead powerlines • Crane pads • Construction Camp (Options 1 to 4); and • Substation Option 2	Vehicular movement (transportation of construction materials).	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soil, 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 defined 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, particularly if a chemical dust suppressant is selected; • 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 defined GN509 ZoR; • All vehicle re-fuelling is to take place outside of the GN509 ZoR (at least 100 m from the nearest watercourse); and • No vegetation may be removed from the 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 soil.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; • Exposure of soil, 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;	Removal of vegetation and associated disturbances to soil.	• Earthworks and exposure of soil 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	4,5	6,5	14	91	M	• It is imperative that all construction works be undertaken during the dry periods when there is little to 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
	• installation of underground cables traversing through watercourses, and • upgrading of roads within close proximity (within 32 m) to watercourses, with specific mention of the access road adjacent to the Wilgebos River.		• Proliferation of alien and/or invasive vegetation as a result of disturbances.						• 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	Creation of 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 within 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.	4,5	6,5	15	97,5	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 (bisecting the investigation are in a north to south direction) must take cognisance of the delineated extent of the Wilgebos River and a tributary of the Wilgebos River, 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 river, to ensure that the remaining natural buffer (where still intact) between the access road and the river 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 disturbed 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; • The alien vegetation management plan as compiled by the terrestrial/botanical ecologist is highly recommended and supported by the freshwater ecologist and must be 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

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									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. The designs should follow the recommendations of the NatureStamp 2022 hydrology assessment and Stormwater Management Plan for the proposed development, to ensure a free draining landscape, and maintenance of the hydraulic functioning of the systems. 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. It must be ensured that the final design accounts for appropriate wetting frequencies and patterns are maintained in the pre-development condition (with input from the freshwater ecologist, where necessary); • 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 Wilgebos and Tankwa Rivers) 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 where possible and practical. 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

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									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 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 within the GN509 ZoR (as described in Section 6), as per Table 9 considered includes: • 33kV Collector overhead powerlines • Crane pads • Construction Camp Options 1 to 4; and • Substation Option 2	• 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	• Disturbances of soil 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 soil 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 33kV overhead collector powerlines) are 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).** • **Due to the pollution risk associated with any potential transformer leakage such as substations, Substation Option 2 is not preferred as it is located in close proximity to the delineated extent of the watercourses (at least 20 m of a watercourse). Therefore, if Substation Option 2 were to be constructed, it must be relocated as far away from the watercourse as possible in order to lower this potential pollution risk.** With regards to ground-breaking activities outside the delineated extent of a watercourse, but within the 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;

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
		construction personnel.							• All exposed soil 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 ensured along the crane pads and construction camp as per the detailed site specific Stormwater Management Plan by NatureStamp (2022), 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 the ECO. Stormwater management is still applicable to the Construction Camp Option 1 if approved/constructed; • 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 • 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 where possible; • 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									

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
6	Operation and maintenance of the surface infrastructure outside the watercourses but within the GN509 ZoR, which includes: • 33kV Collector overhead powerlines • Turbines • Crane pads • Construction Camp Options 1 to 4; and • Substation Option 2	• 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 soil 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; • 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.

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
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 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

	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
									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 within and adjacent to the watercourses, with specific mention of the Wilgebos River and an associated tributary, the direct impacts during the construction phase pose a Moderate to Low risk significance to the watercourses. It is the opinion of the freshwater 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. The same is applicable to the proposed two eastern ridge access route alternatives that currently traverse watercourses and will require new watercourse crossings. Both access route alternatives are considered acceptable with the implementation of mitigation measures as outlined in this report, with specific mention of installing appropriately sized throughflow structures and construction preferably undertaken during the dry period when there is little to no flow within the 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 the infrastructure components and all their alternatives (such as the proposed substation, 33kV collector overhead powerline support structures, Construction Camp (Option 1), turbines and crane pads) located outside of the watercourses and at least 32 m from the delineated extent of a watercourse, but within the GN509 ZoR, are considered to pose a Low risk significance to the identified watercourses. However, preference is given to Substation Option 1 and thus the proposed 33kV collector Option 1 and associated 4 x 4 access roads Option 1, since the proposed substation is located outside the GN509 ZoR, and no direct or indirect impacts from Substation Option 1 are expected, as opposed to Substation Option 2 that is located in very close proximity to a watercourse. In addition, although transformers such as substations have a spill tray/bund factored into the design to catch any potential accidental spills (of hazardous material), the risk of pollution due to an accidental leakage is higher for Substation Option 2 considering its distance from the delineated watercourses (located at least 20 m of a watercourse), and is therefore, not preferred. Furthermore, Construction Camp Options 1, 2 and 4 are considered acceptable from a freshwater management perspective considering their distance from the nearest watercourse (approximately at least 28 m from a watercourse), compared to the proposed Construction Camp Option 3 which is located directly outside the delineated boundary of a watercourse, increasing the likelihood of negative indirect and cumulative impacts to the receiving watercourse.

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.

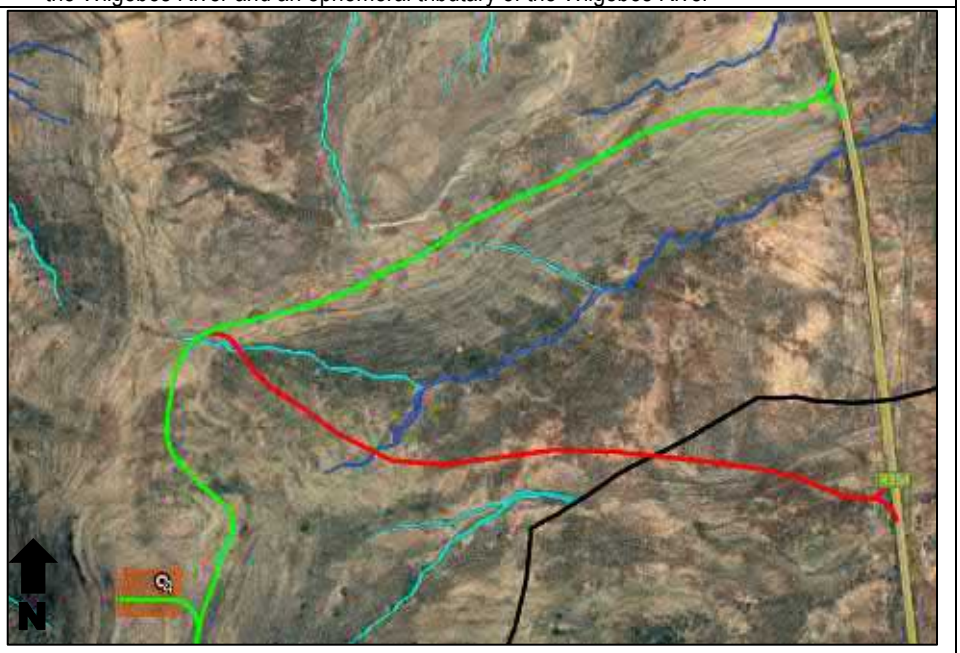
7.2 *Site Walk Down Verification and Micro-siting Considerations*

The site walkdown undertaken in May 2021 specifically focused on the watercourse areas proposed to be directly traversed by the infrastructure associated with the proposed development and that located within the 32 m NEMA ZoR (as presented in Figures 19 to 23). Additionally, the delineated extent of the watercourses and its ecological integrity was verified. Floodline assessments were also done in July 2022, from which assessmentand impacts could be determined. It can be confirmed that the ecological description of the watercourses as per Section 5 of this report is accurate and representative of the verified watercourses.

No turbines or crane pads directly intercept any watercourses. All proposed turbines and crane pads are located at least 41 m (Crane pad associated with Turbine 28). The proposed Substation Option 1

(located more than 100 m from the nearest watercourse) and Construction Camp Option 1 (located approximately 64 m from the nearest watercourse), are located outside the 32 m NEMA ZoR and were thus not considered for micro-siting. The proposed alignment of the access roads (new and existing) and internal 4x4 roads have been assessed within a 200 m corridor. This has been done to facilitate necessary vertical and horizontal alignment required to facilitate safe vehicle movement on the internal roads and placement of the substations.The following table provides the details of the infrastructure directly traversing watercourses and located within the 32 m NEMA ZoR:

Table 11: 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
Construction Camp Options 2 and 4	Located outside the delineated extent of the watercourses, but slightly encroaches into the boundary of the 32 m of the nearest watercourse (less than 5% of the total construction camp area).
Construction Camp Option 3	Located outside the delineated extent of the watercourses, but directly outside the boundary of the nearest watercourse and thus encroaches relatively more significantly into the 32 m of the nearest watercourse (approximatrly 5% of the total construction camp area).
Substation Option 2	Located outside the delineated extent of the watercourses, approximately 20 m from the nearest watercourse (EDL).
33kV Collector system – Option 1 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 technically 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 existing access roads which are located adjacent to the Wilgebos River and an ephemeral tributary of the Wilgebos River
The two access route options from the R354 (eastern ridge access route) will traverse watercourses associated with the Tankwa River System	 **Figure A: The proposed eastern ridge access road option 1 (green line) and eastern ridge access road option 2 (red line) from the R354 will require new watercourse crossings within the ephemeral tributary and episodic drainage line associated with the Tankwa River System. Only one of these eastern turbine ridge access road options will be constructed.** The access route must make use of appropriately sized through flow structures, installed during the dry period when there is low to no flow with the watercourses, to limit direct negative impacts to these minor tributaries of the Tankwa River System.

The following aspects must be considered for the required approvals and/or permits by the relevant authorities:

- The watercourses are considered to be 'no-go' areas for building infrastructure components. Linear infrastructure (such as roads and underground cables) as provided, should only be planned within these areas if it is absolutely unavoidable to circumnavigate these watercourses;
- The proposed two eastern ridge access route alternatives are considered acceptable with the implementation of mitigation measures as outlined in this report, with specific mention of installing appropriately sized throughflow structures and construction preferably undertaken during the dry period when there is little to no flow within the watercourses and thus no flow diversion required;
- Development of access roads (new and existing) and the proposed 4x4 internal roads within the 200 m corridors will not have any additional impact to the watercourses and ecological functionality over and above what was previously assessed (as part of the Final EIA Report (2015)) or mitigation measures identified;
- Preference is given to Substation Option 1 and thus the associated 33kV collector overhead powerlines and cables (Option 1) and internal 4x4 access roads associated with it, since the proposed Substation Option 1 is located outside the 32 m NEMA ZoR (and GN509 ZoR), and no direct or indirect impacts from Substation Option 1 are expected, as opposed to Substation Option 2 that is located in very close proximity to a watercourse. In addition, Construction Camp Options 1, 2 and 4 are considered acceptable (with implementation of mitigation measures) from a freshwater management perspective considering their distance from the nearest watercourse (approximately at least 28 m from a watercourse), compared to the proposed Construction Camp Option 3 which is located directly outside the delineated boundary of a watercourse; and
- As part of the Part 2 EA amendment, Final layout and EMPr approval process to DFFE, all watercourse crossings and infrastructure within 32 m of a watercourse must be authorised. Based on the outcome of the risk assessment as presented in Section 7.1 above, the proposed amendments and final layout of the Karreebosch WEF are not considered to be a fatal flaw and pose a Moderate to Low risk significance, with the application of the recommended mitigation measures (largely because of direct watercourse crossings from the proposed access roads and the underground cables ontop of the ridges along the access roads that cannot practically avoid watercourses). As such, it is the opinion of the freshwater ecologist that the amendments proposed for the authorised Karreebosch WEF and its final layout be authorised.

Therefore, provided that the recommended mitigation measures are applied, the proposed final layout for the authorised Karreebosch WEF is considered acceptable from a freshwater ecological perspective and should be approved. The recommended mitigation measures in this report should be considered as comprehensive as they also take into consideration those listed in the previously submitted EMPr as part of the Final EIA Report (2015).

7.3 *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 grid 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 the Wilgebos river and an ephemeral tributary of the Wilgebos River 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 stated development infrastructure for any erosion during the operational phase, the direct and indirect negative impacts can be reduced to an acceptable level and managed.

8 CONCLUSION

FEN Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment and 'site walkdown' and micro-siting as part of the NWA WUA application process and NEMA Part 2 EA Amendment, Final Layout and EMPr approval process for the authorised Karreebosch 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 with riparian vegetation were identified. These watercourses form part of the Roggeveld, Kleinpoorts, Tankwa and Wilgebos River systems.

Although the 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, 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 12: Summary of results of the ecological assessment as discussed in Section 5.

Watercourse	PES	Ecoservices	EIS	REC /BAS/RMO
Wilgebos River	C (Moderately modified)	Intermediate (1,5)	High	REC: Category C (Moderately modified) BAS: Category B RMO: B/C (Improve)
Ephemeral tributaries with riparian vegetation	B (Largely natural with few modifications)	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) / C (Moderately modified)	Intermediate (1,4)	High	REC: B (Largely natural with few modifications) BAS: Category B RMO: B (Improve)

With the exception of watercourse road crossings, all other infrastructures (turbines and crane pads, substation, construction camp) are located outside the delineated extent of the watercourses. Due to the ecological sensitivity and importance of the watercourses, the upgrading of access roads directly adjacent to watercourses and the upgrading and development 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 33kV 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 32 m 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 remainder of the infrastructure associated with the

Karreebosch WEF including the 33kV Collector overhead powerlines and cables, turbines, crane pads, Construction Camp Options 1 to 4; and Substation Options 1 and 2 pose a Low risk significance. However, preference is given to Substation Option 1 and and thus the associated 33kV collector overhead powerlines and cables (Option 1) and internal 4x4 access roads associated with it, and the proposed Construction Camp Options 1, 2 and 4, as these were determined to pose the least negative impacts where direct and indirect negative impacts can be reduced to an acceptable level and managed.

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. Therefore, provided that the recommended mitigation measures are applied and included in the final EMPr, the proposed final layout for the authorised Karreebosch WEF is considered acceptable from a freshwater ecological perspective and should be approved.

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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 I & (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 21I 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 21I 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 21I 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.

1.7 *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.

1.8 *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 to be associated with the proposed development were 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 is 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 & Wilgebos 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 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	Ephemeral tributaries
Ecological Importance and Sensitivity				
Biodiversity support				
			0,67	1,00
Presence of Red Data species			0	0
Populations of unique species			0	1
Migration/breeding/feeding sites			2	2
Landscape scale				
			2,00	2,20
Protection status of the wetland			2	2
Protection status of the vegetation type			2	2
Regional context of the ecological integrity			2	2
Size and rarity of the wetland type/s present			2	3
Diversity of habitat types			2	2
Sensitivity of the wetland				
			1,67	2,00
Sensitivity to changes in floods			2	3
Sensitivity to changes in low flows/dry season			1	1
Sensitivity to changes in water quality			2	2
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			**B**	**B**
Hydro-Functional Importance				
Regulating & supporting benefits	**Flood attenuation**		1,7	1,8
	Streamflow regulation		1,6	2,2
	Water Quality Enhancement	***Sediment trapping***	1,6	1,8
		Phosphate assimilation	1,9	1,9
		Nitrate assimilation	1,7	1,7
		Toxicant assimilation	1,8	1,8
		Erosion control	2,1	1,8
	Carbon storage		0,8	0,8
HYDRO-FUNCTIONAL IMPORTANCE (average score)			2	2
Direct Human Benefits				
Subsistence benefits	***Water for human use***		0,7	0,7
	Harvestable resources		0,6	0,8
	Cultivated foods		0,4	0,4
Cultural benefits	***Cultural heritage***		0,5	0,5
	Tourism and recreation		2	2,5
	Education and research		0,8	1,8
DIRECT HUMAN BENEFITS (average score)			0,83	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 during the dry periods when there is no flow within the watercourses;
- 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 infrastructure as listed in Table 9* located within the GN509 ZoR (as described in Section 6) but at least 32 m from the delineated extent of the watercourses, and general movement of construction personnel within the GN509 ZoR but outside the delineated extent of watercourses. *Infrastructure as per Table 9 considered includes: • 33kV Collector overhead powerlines • Crane pads • Construction Camp (Options 1 to 4); and • Substation Option 2	Vehicular movement (transportation of construction materials).	• Loss of watercourse vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soil, 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 soil.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; • Exposure of soil, 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; • installation of underground cables traversing through watercourses, and • upgrading of roads within close proximity (within 32 m) to watercourses, with specific mention of the access road adjacent to the Wilgebos River.	Removal of vegetation and associated disturbances to soil.	• Earthworks and exposure of soil 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	4	4	5	4,5	1	1	6,5	5	3	5	1	14	91	M
4		Creation of 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 within 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	4	4	5	4,5	1	1	6,5	5	4	5	1	15	97,5	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 within the GN509 ZoR (as described in Section 6), as per Table 9 considered includes: • 33kV Collector overhead powerlines • Crane pads • Construction Camp Options 1 to 4; and • Substation Option 2	• 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 soil 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 soil 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

	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
6	OPERATIONAL PHASE	Operation and maintenance of the surface infrastructure outside the watercourses but within the GN509 ZoR, which includes: • 33kV Collector overhead powerlines • Turbines • Crane pads • Construction Camp Options 1 to 4; and • Substation Option 2	• 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 soil 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
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

Rabia Mathakutha	MSc Plant Science (University of Pretoria)
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)
Nelanie Cloete	MSc Environmental Management (University of Johannesburg)
Paul da Cruz	BA (Hons) Geography and Environmental Studies (University of the Witwatersrand)

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

Company of Specialist:	SAS Environmental Group of Companies		
Name / Contact person:	Rabia Mathakutha		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	083 739 2284
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	rabia@sasenvgroup.co.za		
Qualifications	MSc Plant Science (University of Pretoria)		
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

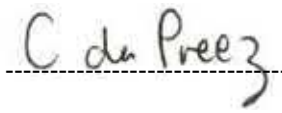
I, Rabia Mathakutha, declare that –

- 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

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



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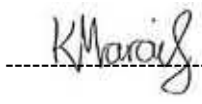
1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

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 -

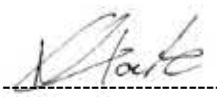
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity 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

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

I, Nelanie Cloete, 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 Reviewer

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

I, P da Cruz, 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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF RABIA MATHAKUTHA

PERSONAL DETAILS

Position in Company	Field Ecologist Wetland ecology
Joined SAS Environmental Group of Companies	2020

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate member of the South African Council for Natural Scientific Professions (SACNASP – Reg. No. 120040)
Member of the Western Cape Wetland Forum (WCWF)
South African Association of Botany (SAAB)

EDUCATION

Qualifications

MSc Plant Science (University of Pretoria)	2018
BSc (Hons) Environmental Science (Biogeography) (University of KwaZulu-Natal)	2015
BSc Environmental Science (Life Science stream) (University of KwaZulu-Natal)	2014

Short Courses

Tools for Wetland Assessment (Rhodes University)	2021
Official DWS Section 21 (c) and (i) Water Use Authorisation Course	2018
Basic and Applied Statistics in R	2016

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Western Cape, Northern Cape, Eastern Cape
Africa – Lesotho, Mozambique

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 Plan

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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF NELANIE CLOETE

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Water Resource and Botanical Discipline Lead
Joined SAS Environmental Group of Companies	2011

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 400503/14)
Member of the South African Association of Botanists (SAAB)
Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa group
Member of the Grassland Society of South Africa (GSSA)
Member of the Botanical Society of South Africa (BotSoc)
Member of the Gauteng Wetland Forum (GWF)
Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2013
MSc Botany (University of Johannesburg)	2007
BSc (Hons) Botany (University of Johannesburg)	2005
BSc (Botany and Zoology) (Rand Afrikaans University)	2004

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Environmental legal compliance, Monitoring and Auditing	2021

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Eastern Cape, Free State
Africa - Democratic Republic of the Congo (DRC)

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

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

Freshwater Assessments

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

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
- Environmental Control Officer monitoring

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF PAUL DA CRUZ

PERSONAL DETAILS

Position in Company	Senior Ecologist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Certificated Scientist at South African Council for Natural Scientific Professions (SACNASP)
Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA)
Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)	1998
BA (Geography) (University of the Witwatersrand)	1997

Short Courses

Taxonomy of Wetland Plants (Water Research Commission)	2017
Advanced Grass Identification (Frits van Outshoorn)	2010
Grass Identification (Frits van Outshoorn),	2009
Soil Form Classification and Wetland Delineation; (TerraSoil Science)	2008

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development
4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment
7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- EIA / BA Applications
- Environmental Authorisation Amendments
- EMPr Compilation
- Environmental Compliance Monitoring (Environmental Auditing)
- Environmental Screening Assessments and Listing Notice 3 Trigger Identification / Mapping
- Strategic Environmental Assessments and Environmental Management Frameworks
- EIA / Specialist Study Peer Review

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 Assessments in support of Environmental Screening Assessments, Precinct Planning & SEA
- Wetland Construction (Compliance) Monitoring

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping